LUND UNIVERSITY
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Global Inequality: Redistributing Income & CO2 Emissions

- A Quantitative Thought Experiment

By

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Abstract

This thesis is a thought experiment challenging the status quo by exploring how greater income equality between countries does not necessarily lead to higher CO2 emissions. Based on a theoretical framework linking income increases to CO2 emissions, it is expected that greater income equality will lead to higher consumption, but CO2 emissions will not increase proportionally. Using data on Gross National Income (GNI) per capita and carbon footprint for 123 countries from 2000-2022, a three-step methodology is applied: redistributing GNI per capita, estimating the relationship between income and CO2 emissions, and predicting the CO2 emissions resulting from the redistribution of GNI per capita. The analysis reveals that halving the deviation from the global mean GNI per capita could elevate all countries to at least upper-middle-income status while reducing global CO2 emissions by approximately 10.2%. These findings suggest that economic equity and environmental sustainability can coexist.

Keywords: Income Redistribution, Global Inequality, CO2 Emissions, Planetary Boundaries, Gross National Income (GNI), Carbon Footprint, Consumption Patterns, Climate Change.

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1. Introduction

The twin crises of climate change and inequality constitute the greatest challenge facing the Earth at the start of the 21st century (Piketty 2020:877; Rao & Min 2017; Schor 2015). CO_2 emissions, as identified by the IPCC (2021), are the primary driver of contemporary climate change. In 2019, the top 1% of global income earners, approximately 77 million individuals, were responsible for 16% of these emissions, primarily due to their consumption patterns. This level of emissions is comparable to that of the poorest 66% of the world's population, which encompasses about 5.11 billion people (Oxfam 2023). Additionally, the average citizen in high income countries generates more than 30 times the CO_2 emissions of those in low income countries (Ritchie 2023). This stark disparity is further highlighted by the International Energy Agency, which notes that wealth, energy consumption, and the use of goods and services are unevenly distributed worldwide, leading to significant variations in CO_2 emissions across different countries, generations, and income levels (IEA 2023).

While the wealthiest emit the most CO_2, the poorest bear the brunt of climate change (World Bank 2023). The IPCC's Sixth Assessment Report reveals that climate risks are escalating more rapidly and severely than anticipated, complicating adaptation as global temperatures rise. Currently, 3.6 billion people live in areas highly vulnerable to climate change, with low income countries and small island developing states suffering the most despite their minimal contribution to global emissions (Birkmann et al. 2022). Research from the WHO highlights that, in vulnerable regions, mortality rates from extreme weather events over the past decade were 15 times higher than in less vulnerable areas. Furthermore, the WHO projects that climate change will cause approximately 250,000 additional deaths annually from undernutrition, malaria, and heat stress between 2030 and 2050 (WHO 2023). Thus, global warming will exacerbate existing global inequalities.

Given these developments, a critical question arises: can we tackle climate change and reduce inequality simultaneously? In terms of reducing inequality, the World Bank (2006) projects that low- and middle-income countries will grow annually by 3.3% until 2050, based on growth rates from the 1960s and 70s. In contrast, rich countries are expected to grow by 2% annually, based on estimates from 1985 to 2005. This growth could increase global income to over $135 trillion by 2050, up from $35 trillion in 2006. At this rate, developing countries could account for 40% of global income, effectively doubling their current share (World Bank 2006). However, these projections must be considered in the context of global population growth, which is expected to reach 9 billion by 2050, up from 6 billion in 2006, with the majority of this increase occurring in developing countries (World Bank 2006).

Additionally, prominent economists have found that during the first half of the twentieth century, inequality between countries has decreased (Atkinson 2015:4; Lakner & Milanovic 2016). However, it has also been established that within-country inequalities have increased since the 1980s in many high income countries (Piketty 2014:141-166). While challenges persist, these predictions overall indicate promising economic prospects for developing countries.

On the environmental front, the OECD (2012) warns of severe climate consequences if the World Bank's population and economic growth predictions hold true without additional climate action. The OECD's 2050 outlook projects a 50% increase in global greenhouse gas emissions, primarily due to a 70% rise in energy-related CO_2 emissions driven by economic growth. By 2050, greenhouse gas concentrations could reach 685 parts per million in CO_2 equivalents, potentially raising the global average temperature by 3°C to 6°C above pre-industrial levels, far exceeding the Paris Agreement's limit of 2°C (OECD 2012).

While these projections warrant caution, they suggest that tackling climate change and reducing inequality simultaneously is unlikely if we maintain the status quo. This thesis seeks to challenge the status quo through a thought experiment.

Recent economic studies challenge the status quo by disputing the notion of perpetual economic growth, arguing that indefinite growth contradicts the natural principle that nothing can grow endlessly. These studies propose an interdisciplinary alternative to mainstream economic theories by integrating insights from both natural and social sciences. They emphasize the inherent limits to economic growth and stress the need to view the economy as a subsystem within the larger global ecosystem (Røpke 2020:10; Dalby et al. 2013:219-231; Raworth 2017:245). To address inequality, these studies advocate for sustainable practices, often including economic redistribution (Vogel & Hickel 2023). Economist József Böröcz's 2005 article explores a theoretical scenario where income is redistributed between countries to bring every nation 50% closer to the global mean. Böröcz concludes that such redistribution is feasible in theory, suggesting it could be an effective approach to mitigate between-country inequality (Böröcz 2005).

Building on these recent economic theories and Böröcz's redistributive experiment, it is intriguing to explore the potential impact of income redistribution on global CO2 emissions. Specifically, could redistributing income between countries effectively reduce inequality without exacerbating CO2 emissions? This question underpins the exploration of whether economic redistribution can be a viable strategy for achieving both economic equity and environmental sustainability. By examining this scenario, this thesis aims to provide a perspective on the dual challenge of climate change and global inequality.

1.1 Aim and Scope

To challenge the status quo, I propose a thought experiment exploring how a more equitable distribution of income between countries could impact CO2 emissions. The primary aim is to investigate whether it is possible to address the twin crises of climate change and inequality simultaneously. By examining a hypothetical scenario where income redistribution occurs, I seek to determine if reducing inequality between countries can be achieved without increasing CO2 emissions. This inherently speculative assessment contributes to the academic debate on inequality and climate change by linking global income redistribution to its potential impact on CO2 emissions which has not been explored previously.

The purpose of this thesis is not to reiterate well-established arguments for a fairer and less polluting world, nor to assess the political feasibility of such a redistribution system. Instead, this approach embraces a utopian perspective, arguing that such thinking is essential for envisioning alternatives beyond the limitations of the status quo. To envision such an alternative, I aim to investigate:

How does reducing between-country inequality through income redistribution affect global CO2 emissions?

In addressing this question, I acknowledge the global scope of this inquiry, which inevitably entails a lack of nuanced consideration for specific regional and contextual differences. The broad nature of this thought experiment means it cannot capture the intricate variations and complexities present in different parts of the world. However, the intent behind this global approach is to challenge prevailing perspectives on inequality and climate change and to stimulate more nuanced, context-specific research that can build on these broad outlines. It is important to clarify that I do not aim to establish a causal relationship between income and CO2 emissions. Rather, the objective is to explore the potential relationship between income redistribution and CO2 emissions in a hypothetical scenario, encompassing 123 countries worldwide over the years 2000-2022.

To empirically investigate this relationship, I will analyze data on Gross National Income (GNI) per capita, measured in Purchasing Power Parity (PPP) using constant 2017 international dollars, and the carbon footprint, measured in metric tonnes of CO2 emissions per capita through Consumption-Based Accounting (CBA). The choice of these indicators, specifically the carbon footprint as an environmental metric linked to changes in income, is rooted in the theoretical framework. The relevance of these variables to the study will be further discussed in the upcoming chapters on “Theory and Previous Research” and “Data and Methods”.

2. Theory and Previous Research

This chapter explores the theoretical relationship between income and consumption and examines the subsequent impact of consumption on CO_2 emissions, to answer how a redistribution of income affects CO_2 emissions. This analysis elucidates how redistributing income among countries might influence CO_2 emissions. Initially, I will establish the theoretical framework underpinning this inquiry. Following this, I will integrate insights from the theory and empirical research to outline the anticipated effects of income redistribution on CO_2 emissions.

2.1 Inequality and Ecological Boundaries

This thesis utilizes the economic theories of Thomas Piketty, Kate Raworth, and Jason Hickel to analyze the links between inequality and climate change. Each theorist offers a unique perspective on how these issues intersect and can be addressed today. Despite their differing approaches, they collectively stress the need for economic changes that respect ecological boundaries and address global inequality. Piketty, Raworth, and Hickel critically challenge traditional economic theories, advocating for rethinking economic principles within ecological limits. Their approach aligns with this thought experiment, questioning the feasibility of economic growth without environmental costs, and highlighting the shortcomings of conventional strategies in tackling environmental degradation and economic inequality.

This section presents the key ideas from each theorist central to my analysis. While a comprehensive review of their entire work is beyond this study's scope, their perspectives are essential for understanding and interpreting the empirical results.

2.1.1 Thomas Piketty - the need to address inequality when addressing climate change

In his influential work "Capital and Ideology" (2020), Piketty explores how different ideologies have justified and sustained inequality throughout history. He proposes a framework for a more equitable economic system that addresses the most pressing challenges of our time—climate change and rising inequality (Piketty 2020:877). Piketty highlights how these issues are intertwined, suggesting that solutions must address both simultaneously. He notes that a significant portion of CO_2 emissions is sharply concentrated among a small group of wealthy individuals, primarily from high income countries (Piketty 2020:878).

Piketty argues that substantial lifestyle changes and the implementation of strict juridical standards are crucial for gaining social and political support for climate initiatives. He suggests that without perceived equity in the distribution of responsibilities across different income groups, particularly if the wealthy remain unaccountable, the lower and middle-income groups are unlikely to engage in demanding climate actions (Piketty 2020:866). Furthermore, Piketty connects high inequality with social fragmentation and the emergence of populism, which hinders collective efforts. He asserts that a more equitable society would naturally be more cooperative and effective in organizing cohesive responses to global challenges like climate change (Piketty 2020:876-786).

To address inequality and environmental degradation, Piketty advocates for a progressive taxation framework, including annual property taxes, progressive inheritance taxes, and income taxes. This framework aims to channel approximately 5% of a country's national income toward capital allocation, while an additional progressive income tax—including contributions to social security and a specific CO_2 tax—would account for about 45% of national income. These resources would finance public expenditures essential for sustaining a welfare state, including healthcare, education, and pension systems, thereby promoting a fairer and more resilient society (Piketty 2020:837-838).

2.1.2 Kate Raworth - living within the ecological ceiling and social foundation

In "Doughnut Economics" (2017), British economist Kate Raworth introduces a visionary model for societal organization with seven prinicples, conceptualized as a doughnut. This model includes an outer boundary of nine planetary limits and an inner boundary of twelve UN Sustainable Development Goals, together defining a safe and just space for humanity (Raworth 2017:40-47).

Raworth's fifth principle, "design to redistribute," is particularly relevant to this thesis. It challenges the belief that economic growth alone will resolve global inequalities, advocating instead for economies that broadly distribute value. This not only involves income redistribution but also wealth derived from resources such as land, enterprises, technology, and knowledge (Raworth 2017:29). Raworth’s seventh principle questions the necessity of endless economic growth, noting that perpetual growth contradicts natural limits. She argues that economies should focus on enhancing well-being, regardless of GDP growth, recognizing that GDP growth must eventually encounter limits (Raworth 2017:254). Raworth acknowledges that in low- and middle-income countries, GDP growth is essential and closely linked to significant improvements in well-being, such as increased life expectancy, reduced child mortality, and higher school attendance. However, she suggests that with adequate international support, these countries can leapfrog outdated, environmentally harmful technologies and build economies that are distributive and regenerative by design. As she states, “No country has ever ended human deprivation without a growing economy. And no country has ever ended ecological degradation with one” (Raworth 2017:245). This approach would allow these countries to elevate their citizens above the social baseline of the doughnut model without exceeding ecological limits (Raworth 2017:254).

Raworth emphasizes the role of contemporary economists in achieving a safe and just space for humanity, encouraging them to challenge established norms and explore innovative ideas. She concludes with a motivational call to action: “Draw the change you want to see in the world (...) it’s easy to get started. Just pick up a pencil and draw” (Raworth 2017:293).

2.1.3 Jason Hickel - The rich need to degrowth for the poor to grow

Jason Hickel, similar to Raworth's seventh principle, underscores the unsustainable relationship between economic growth and environmental sustainability, proposing a degrowth strategy that reduces production and consumption to align with the Earth's ecological limits (Hickel 2021). He highlights global inequalities in carbon emissions, noting that high income countries have been the predominant contributors since the Industrial Revolution. Hickel suggests compensatory frameworks for high-emission countries to support those most affected by climate change but least responsible for it (Fanning & Hickel 2023).

Hickel also critiques the "catch-up" development model, which assumes developing countries can achieve the levels of developed countries through similar growth paths. He argues that global trade and economic policies, shaped by historical colonialism, perpetuate disparities (Hickel 2022). To allow developing countries the ecological space to grow, developed countries should acknowledge their historical responsibilities and significantly reduce their consumption levels. Hickel recommends strategies such as reducing working hours, enhancing public services, and shifting away from carbon-intensive industries to achieve this (Hickel et al. 2022).

While the theoretical framework of this thesis is built on the works of Piketty, Raworth, and Hickel, it is essential to examine previous research that explores the link between income changes and CO2 emissions through the lens of consumption to answer the research question. The following sections will elucidate these connections.

2.2 Income - Consumption

The relationship between income and consumption is central to economic theories of consumption, as featured in Keynes's seminal work, "The General Theory of Employment, Interest, and Money" (1936). Here, Keynes introduces the consumption function, expressed as $C = a + bY$, where C represents real consumption, Y is real income, a denotes autonomous consumption (independent of income), and b, the marginal propensity to consume (MPC), quantifies how much consumption increases with income (Keynes 1936:80). Keynes suggests that as income rises, consumption increases at a diminishing rate, meaning that the MPC is not constant but decreases as income grows:

> "The fundamental psychological law, upon which we are entitled to depend with great confidence both a priori from our knowledge of human nature and from the detailed facts of experience, is that men are disposed, as a rule and on the average, to increase their consumption as their income increases, but not by as much as the increase in their income" (Keynes 1936:85).

This law reflects the tendency to enhance living standards with rising income while saving part of the incremental income. This balance is influenced by objective factors, such as absolute income levels, and subjective factors, like attitudes towards saving and economic uncertainty (Keynes 1936:79-99). Keynes's exploration shows that higher incomes lead to increased consumption, but the relationship is complex and influenced by broader factors. I will examine consumption patterns across income groups by reviewing recent empirical literature (A full overview can be found in appendix 1).

However, Keynes's consumption function has faced critiques. Milton Friedman argued it overlooks long-term income expectations, suggesting consumers plan their consumption on a longer horizon (Friedman 1957:20-37). David Ricardo suggested that individuals tend to save more to mitigate future uncertainties, indicating that immediate income might not significantly impact consumption as much as Keynes suggests (Ricardo 2004:167).

2.2.1 Low Income Countries

Research in low income countries often highlights restricted consumption due to limited economic resources. Cata-Preta et al. (2020) discuss how wealth-related inequalities impact access to essential services, such as health and vaccinations, reflecting broader consumption limitations. Similarly, Mayén et al. (2014) link lower socioeconomic status to poorer and less diverse dietary choices. Farhani and Ben Rejeb (2012) correlate economic growth with increased energy consumption, suggesting that increases in GNI per capita enhance the ability to meet basic needs, thereby increasing the consumption of essential goods and services.

2.2.2 Lower-Middle Income Countries

In lower-middle income countries, the relationship between income and consumption begins to show diversification patterns. Lahoti et al. (2015) provide a comprehensive overview of how rising incomes enhance consumption diversity. Dey (2019) further explores the interplay between income, consumption, and GDP, highlighting evolving consumption behaviors as economies grow. These changes indicate a shift from subsistence-level consumption to more varied consumer choices, including increased demand for manufactured goods and services.

2.2.3 Upper-Middle Income Countries

In upper-middle income countries, consumption patterns show greater diversification with increased spending on non-essential goods (Golley & Meng 2012). Dey (2019) examines income and consumption trends in Asian nations from 1980 to 2014, finding that income significantly influences consumption patterns, particularly in lower and upper-middle income groups, who predominantly spend rather than save or invest their earnings. Baker and Yannelis (2017) observe that many middle income households live from one income to the next, often spending beyond their means, which limits their capacity to handle financial emergencies. Additionally, Campbell and Mankiw (1991) identified a consistent correlation between predictable increases in income and corresponding rises in consumption among middle income families.

2.2.4 High Income Countries

These countries exhibit complex consumption patterns characterized by significant discretionary spending. Clements et al. (2006) observed that as incomes rise, consumption patterns diversify, indicating a higher elasticity in demand for various products. Their research shows that simple demand models can explain much of the variation in global consumption trends. Notably, the poorest countries allocate over half their budget to food, compared to only about 15% in the wealthiest nations. Further studies by Schor (1998) and Scruggs (1998) explore the psychological and environmental impacts of consumption habits in high income countries, focusing on cultural and political aspects. Additionally, research by Jorgenson et al. (2016) and Liobikienė and Rimkuviene (2020) links higher incomes with increased environmental consciousness and potentially more responsible consumption behaviors.

2.2.5 Geographical differences

Studies by Jackson (2004) and Crewe & Lowe (1995) emphasize the resilience of local consumption cultures amidst globalization, illustrating how unique consumer practices persist in regions such as China, India, and Russia. Grigg (1999) and Gerbens-Leenes et al. (2010) explore historical and economic perspectives on food consumption, highlighting a global nutritional transition that parallels economic development. These studies reveal that disparities in food consumption reflect broader socio-economic divides between developed and developing regions.

2.3 Consumption - CO2 emissions

The previous section highlighted that individuals in high income groups typically exhibit more varied consumption behaviors. Further analysis reveals that these behaviors are also associated with the highest levels of CO2 emissions. The following section will detail how studies have found that economic growth, income inequality, and wealth concentration in high income and upper-middle income countries significantly drive these consumption patterns, thereby intensifying CO_2 emissions.

Baležentis et al. (2020) illustrate that higher income inequality correlates with increased consumption-based emissions, especially in high income countries. Berthe & Elie (2015) support this, theorizing that economic inequality in these countries leads to environmental deterioration by limiting access to clean technologies for lower income groups and enhancing the consumption of environmentally harmful goods for high income groups. Knight et al. (2017) further expand on this by noting that wealth inequality within high income countries results in more carbon-intensive consumption patterns.

Focusing on specific regions, Golley & Meng (2012) and Grunewald et al. (2012) find that higher disposable incomes in upper-middle income and high income countries lead to greater energy expenditure and consequently higher CO_2 emissions. Liu et al. (2019a, 2019b) complement these findings by demonstrating that income inequality in these regions influences consumption choices, particularly in terms of carbon emissions and environmentally impactful behaviors.

Diffenbaugh & Burke (2019) add a global dimension to this discussion, showing how global warming, exacerbated by emissions from wealthy consumption, disproportionately impacts low income countries, deepening global economic disparities. This effect illustrates the cyclical nature of consumption-driven emissions, which not only directly affect the environment but also reinforce global inequalities. Hubacek et al. (2017) and Knight et al. (2017) underscore how wealth inequality impacts environmental outcomes through consumption. Xu et al. (2021) trace how consumption in developed countries leads to emissions in less developed ones, illustrating a significant detachment between where goods are consumed and where their environmental impacts occur. This global supply chain dynamic highlights the need for international cooperation in addressing climate change.

2.4 Expectations and Contribution

Based on this theory and research, redistributing income could significantly influence CO2 emissions through various mechanisms related to changes in consumption patterns across different income groups. Following Keynes' concept of the Marginal Propensity to Consume (MPC), lower and middle-income groups are likely to spend a larger portion of any additional income they receive. This spending typically focuses on necessities, which are less carbon-intensive compared to the luxury consumption patterns of higher income individuals. Therefore, increasing the disposable income of lower-income groups might not proportionately increase CO2 emissions, especially if it is spent on improving basic living standards such as housing, healthcare, and education. Conversely, decreasing the disposable income of higher-income individuals could reduce their consumption of carbon-intensive luxury goods and services, such as frequent flying and large private vehicles. This aligns with Jason Hickel's degrowth strategy, advocating for reduced resource and energy consumption in wealthier regions, thus allowing poorer regions the ecological space to grow their economies.

Moreover, more equitable income distribution could foster greater public support for stringent environmental regulations and climate policies. This might include broader acceptance of CO2 taxes and other measures critical to reducing emissions, as proposed by Piketty. Income redistribution could reduce disparities in consumption patterns, leading to a more uniform and potentially less environmentally damaging mode of consumption globally. Enhanced global cooperation might also result in climate finance and technology transfer, helping lower-income countries adopt cleaner technologies without following the high-emission developmental paths of wealthier nations, as suggested by Raworth.

Building on this theoretical framework and informed by prior research, *I expect progressive income redistribution among countries to increase consumption but result in lower CO2 emissions.*

While inequality and climate change are frequently discussed together in academic literature (Kakeu & Agbo 2022; Ravallion et al. 2000; Rojas-Vallejos & Lastuka 2020; Rao & Min 2018; Grunewald et al. 2017), studies specifically examining the effects of income redistribution on

CO_2 emissions are scarce. Most related research focuses on eradicating poverty rather than redistributing income per se (Wollburg et al. 2023). This chapter have aimed to bridge this gap by exploring how income redistribution influences CO_2 emissions through changes in consumption patterns. This theoretical exploration provides a foundation for the data and methodologies utilized in this thesis, designed to empirically assess this relationship. Thus, this study contributes to the academic debate by linking income redistribution through consumption with its potential impact on CO_2 emissions.

2.5 Limitations

A key limitation of this thesis is the focus on between-country inequality, which overlooks the significant impact of the wealthiest 1% who are responsible for 16% of global carbon emissions, a figure comparable to the emissions of the poorest 66% of humanity (Oxfam 2023). Although this is not directly analyzed, it is encompassed within the broader discussion of income inequality and the theoretical framework. Additionally, within-country inequality is not explored, as it would exceed the scope of this thesis and require a more context-specific analysis for each of the countries examined. Nonetheless, I acknowledge that substantial disparities in income and carbon footprints within countries significantly influence the global patterns of emissions and inequality.

I refrain from exploring theoretical perspectives on green growth, which contrasts with the theories presented. Incorporating these perspectives could provide market-oriented solutions to climate change, based on the assumption that efficient markets can maintain a sustainable economy and that economic growth is compatible with sustainability. Green growth theories embrace the concept of sustainable growth, unconstrained by a maximum economic size or planetary boundaries (Van Den Bergh 2001:15). They aim for an optimal level of pollution through cost-benefit analyses, prioritizing efficiency as the primary criterion for development, while considerations of distribution and equity are secondary (ibid).

3. Data and Methodology

To explore the CO2 emissions of a theoretical global initiative aimed at reducing income inequality between countries, I investigate the variables of GNI per capita and carbon footprint using a three-step methodological approach. It is important to note that while establishing a correlation between income redistribution and CO2 emissions, I keep the relationship between GNI per capita and carbon footprint constant, without considering the potential dynamic changes after redistribution.

The following section details the variables of GNI per capita and carbon footprint and presents the dataset used in this thesis. The subsequent section outlines the three-step methodological approach: first, redistributing income between countries based on the method proposed by economist József Böröcz (2005), resulting in a modified GNI per capita for each country; second, estimating the relationship between income and CO2 emissions; and third, using this estimated relationship and the modified GNI to predict CO2 emissions in this hypothetical more equal world.

3.2 Data

To empirically investigate the impact of income redistribution on CO2 emissions through changes in consumption patterns, I utilize two variables: Gross National Income (GNI) per capita and consumption-based accounting (CBA) of CO2 emissions per capita, also known as carbon footprint. The data for these variables are sourced from two different databases. After cleaning and merging the datasets, the final dataset comprises information on 123 countries spanning the period from 2000 to 2022.

3.2.1 Gross National Income per capita

As introduced earlier in this chapter, the initial step in the methodological approach of this thesis draws from József Böröcz's 2005 article. Although this thesis adopts Böröcz's framework, it incorporates updated and adjusted data. Consistent with Böröcz's methodology, Gross National Income (GNI) per capita is utilized as the primary measure of economic performance, sourced from the World Bank database. GNI was selected over GDP because it offers a more precise reflection of economic activity. Unlike GDP, GNI excludes the economic output of foreign-owned corporations within the country and includes income earned abroad by domestically-based multinationals, thereby ensuring the measurement accurately reflects economic activities benefiting the resident population (OECD 2004).

In Böröcz's article, he utilized GNI per capita figures calculated using the Atlas Method for the year 2000. Although the same World Bank database was employed, discrepancies are evident when comparing these figures to the most recent data. For instance, the World Bank reports Luxembourg's GNI per capita in 2000 as $45,690, whereas Böröcz cites it as $42,060 (Böröcz 2005; World Bank 2024). These discrepancies likely arise from periodic updates and revisions in the World Bank's data, which were unavailable at the time of Böröcz's publication. Additionally, Böröcz's calculations may include specific adjustments or filters that differ from the standard methodologies used by the World Bank.

A common challenge when comparing economic data across countries is converting various currencies into a single unit for accurate comparison. For example, to compare incomes between Luxembourg and Burundi, incomes from both countries must be expressed in a common currency. The Balassa-Samuelson effect (Balassa 1964; Samuelson 1964) encapsulates the complexity of this process. This effect posits that productivity differences in the production of traded goods make non-traded goods more expensive in wealthier countries and cheaper in poorer ones. Since prevailing exchange rates do not fully account for the prices of non-traded goods, this leads to an exaggerated perception of global income inequality, making rich countries appear richer and poor countries poorer.

To address this, I have opted to use purchasing power parities (PPP) for calculating GNI per capita instead of the Atlas Method used by Böröcz. The PPP method adjusts for the cost of a standard set of goods and services across different countries, providing a more stable and accurate basis for comparing economic welfare and living standards. It better reflects the economic situation of citizens within their own countries, independent of international currency market fluctuations (Ward 2002). I use GNI per capita in PPP terms, measured in constant 2017 international dollars. The year 2017 serves as the baseline for this thesis, as it is the most recent year with updated GNI data in constant 2017 international dollars. This approach ensures a more accurate comparison across countries by adjusting for inflation, thereby enhancing the reliability of the analysis regarding the relationship between GNI per capita and CO_2 emissions.

As discussed in the chapter on theory and previous research, income and consumption patterns vary significantly across income groups. To effectively illustrate the transition of countries from their original GNI per capita in 2017 to the modified GNI per capita, I have categorized them according to the World Bank's income groups. These groups are defined as follows (Hamadeh et. al. 2023):

- Low income countries: GNI per capita of $1,135 or less
- Lower-middle income countries: GNI per capita between $1,136 and $4,465
- Upper-middle income countries: GNI per capita between $4,466 and $13,845
- High income countries: GNI per capita exceeding $13,845

3.2.2 Carbon Footprint per capita

In the review of previous research, the relationship between consumption and CO_2 emissions has been clarified. To capture this link in my analysis, I have employed the Consumption-Based Accounting (CBA) measure. This metric assigns the CO_2 emissions associated with the production of goods and services to the end consumers, thereby connecting a nation's citizens' consumption behaviors directly to its environmental impacts. By accounting for both domestic activities and international supply chains, CBA provides a comprehensive view of a nation's carbon footprint. Both GNI and carbon footprint are measured on a per capita basis, allowing for precise comparisons across countries of varying sizes (Worldmrio 2024).

For the data on carbon footprints, I utilize the Eora Global Supply Chain Database. This comprehensive database provides an extensive Multi-Regional Input-Output (MRIO) table, which covers inter-sectoral transfers among 15.909 sectors across 190 countries from 1990 to 2022. The MRIO model within the Eora database is crucial for tracing and attributing emissions from global supply chains back to consumers. It recalculates emissions from significant sources such as fossil fuel combustion and cement production. While it currently excludes emissions from aviation and marine bunker fuels due to methodological constraints, it also integrates the

PRIMAP-hist dataset, which provides historical greenhouse gas emission trajectories for countries from 1750 to 2019. This publicly accessible data from the Eora database, aligned with major IPCC categories and widely used in peer-reviewed articles and by organizations like the UN, includes Carbon footprint (CBA in per capita CO2 emissions measured in metric tonnes) for 190 countries from 1990 to 2022. It is enhanced with GDP figures from the World Bank and population estimates from the UN Population Division, illustrating the relationship between global consumption patterns and CO2 emissions, consistent with my theoretical framework (Worldmrio 2024).

The carbon footprint measure was selected over other environmental indicators because it aligns with the theoretical framework of this thesis, which emphasizes the link between consumption and CO2 emissions. This relationship is effectively captured through the Consumption-Based Accounting (CBA) measure (Worldmrio 2024), as it accounts for consumption patterns related to CO2 emissions and is measured in per capita, similar to GNI.

3.2.3 Presentation of dataset

To investigate the relationship between gross national income (GNI per capita, PPP, in constant 2017 international dollars) and carbon footprint (CBA, in metric tonnes of CO2 emissions per capita), it was necessary to combine data from the World Bank and the Eora Global Supply Chain Database, as no single database currently integrates these specific measures. This merged dataset includes the continuous variables of GNI per capita, adjusted for purchasing power parity in constant 2017 international dollars, and carbon footprint per capita measured in metric tonnes of CO2 emissions. The dataset comprises panel data with 2,708 observations from 123 countries, spanning from 2000 to 2022, based on the availability of data for both GNI per capita and CBA per capita[1].

In instances where a country lacked only a few data points, imputation techniques such as Last Observation Carried Forward (LOCF) or Next Observation Carried Backward (NOCB) were employed to maintain data continuity (Sampoornam 2022). Moreover, countries exhibiting extreme outliers in carbon footprints - identified through autocorrelation checks in the residuals

[1] See appendix 2

and further validated by boxplot analysis - were excluded to prevent distortion of the overall analysis[2].

Below, the dataset's representation is categorized by income group and region, where the "global representation" column reflects the raw extracted data on GNI per capita from the World Bank, providing the baseline for comparison (World Bank 2024).

Table 1: Data representation in the thesis

Income Group	Representation in Thesis	Global Representation	Difference
High Income	36.59%	31.61%	+4.98%
Upper-Middle Income	23.58%	27.98%	-3.36%
Lower-Middle Income	29.27%	26.94%	+1.29%
Low Income	10.57%	13.47%	-2.9%

Region	Representation in Thesis	Global Representation	Difference
Europe & Central Asia	30.08 %	26.8%	+3.28%
Sub-Saharan Africa	26.02%	24.74%	+1.28%
Latin America & Caribbean	16.26%	17.01%	-0.75%
Middle East & North Africa	10.57%	10.31%	+0.26%
East Asia & Pacific	10.57%	15.98%	-5.41%
South Asia	4.88%	4.12%	+0.76%
North America	1.63%	1.03%	+0.6%

Note: The calculation in % is based on the number of countries (not population) in each dataset by region and by income groups.

[2] Belarus, Kazakhstan, and Romania have significant industrial bases that rely heavily on fossil fuels, and in Ethiopia and Zimbabwe a significant proportion of the economy is related to agriculture. However, the reason why these country are outliers could also be due to reporting and measurement differences

Although the data is relatively evenly distributed, there are notable discrepancies, including an overrepresentation of high income countries by nearly 5% and an underrepresentation of upper-middle income countries by 3.36%. Furthermore, Europe and Central Asia are overrepresented by 3.28%, while East Asia and the Pacific are underrepresented by 5.41%. These disparities suggest potential biases toward regions with better data availability and more advanced economies, which could influence interpretations of global economic and environmental trends. These biases will be carefully considered when interpreting the results.

Below are the descriptive statistics for the GNI per capita (measured in international dollars) and carbon footprint (measured in metric tonnes of CO2 emissions) variables from the final dataset used in this thesis.

Table 2: Summary statistics for the variable GNI and CBA

GNI	**All Years (2000-2022)**	**Year 2017**
Mean	20,413	21,721
Median	12,437	13,471
Standard Deviation	18,791	19,675
Minimum value	529	692
Maximum value	102,231	82,238
CBA	**All Years (2000-2022)**	**Year 2017**
Mean	7,730,421	6,910,149
Median	5,507,406	5,550,552
Standard Deviation	9,184,204	5,895,381
Minimum value	1,822	23,472
Maximum value	69,321,671	27,380,991

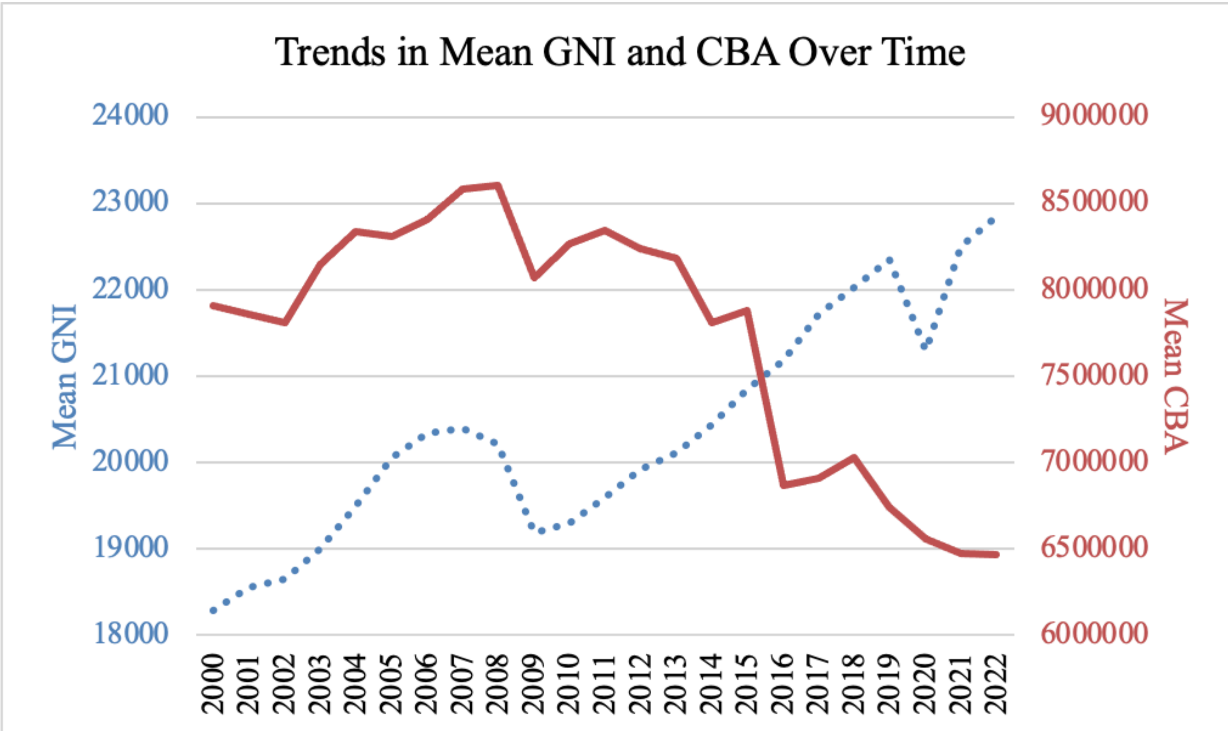
Note: GNI is measured in PPP, constant 2017 international dollars. The carbon footprint is measured as CBA, in metric tonnes of CO2 emissions per capita.

Table 2 presents the summary statistics for GNI per capita in PPP (constant 2017 international dollars) and the carbon footprint in metric tonnes of CO2 per capita. From 2000 to 2022, the mean GNI was $20,413, which increased to $21,721 in 2017. The median GNI rose from $12,437 to $13,471, indicating overall income growth. However, the high standard deviation (18,791 for all years and 19,675 for 2017) reveals significant income variability. The range of GNI was broad, from $529 to $102,231 over all years, narrowing slightly to $692 to $82,238 in 2017.

The mean CBA for 2000-2022 was 7,730,421 metric tonnes, which decreased to 6,910,149 in 2017. The median values remained stable at 5,507,406 for all years and 5,550,552 in 2017. However, the high standard deviation (9,184,204 for all years and 5,895,381 for 2017) indicates substantial disparities. Minimum values increased from 1,822 to 23,472, while maximum values decreased from 69,321,671 to 27,380,991. In 2017, the total carbon footprint for the 123 countries in this dataset was 849,948 million metric tonnes of CO2.

The graph below illustrates the trends in mean GNI per capita and Carbon Footprint (CBA) for 123 countries from 2000 to 2022, highlighting the relationship between these two variables over time.

Figure 1: Trends in Mean GNI and CBA from 2000-2022



Note: GNI is measured in PPP, constant 2017 international dollars, and is the blue dotted line on the left. The carbon footprint is measured as CBA, in metric tonnes of CO2 emissions per capita, and is the red filled line on the right.

The GNI per capita demonstrates a generally increasing trend from 2000 to approximately 2019, with some fluctuations. Notable dips occur around 2008 and 2019, likely due to the financial crisis and the COVID-19 pandemic. After 2019, GNI rises significantly, peaking around 2022.

In contrast, the CBA (carbon footprint) trend differs. From 2000 to 2014, the carbon footprint showed an upward trajectory, peaking around 2014. Subsequently, there is a marked decline, which becomes more pronounced from 2015 to 2021. The graph illustrates that GNI per capita and carbon footprint do not follow a linear relationship over time. While GNI per capita consistently trends upwards with occasional fluctuations, carbon footprint exhibits a more volatile pattern with distinct peaks and declines. This indicates that various factors influence these metrics, and each country has a unique relationship between income and CO2 emissions. The non-linear nature of this relationship will be addressed in the following chapter on the methodologies employed.

3.3 Methodology

To address the research question, I employ a three-step methodological approach. First, I redistribute GNI per capita across 123 countries worldwide. Second, I link GNI per capita to CO_2 emissions to investigate this relationship. Finally, based on the relationship identified in the second step, I examine the implications of redistributing GNI per capita for CO_2 emissions. Each of these steps is described in greater detail below.

3.3.1 The first step: Redistribute Income

The methodological approach to redistribute income across the 123 countries in my dataset is based on my theoretical framework. As previously discussed, the theories of Piketty, Raworth, and Hickel advocate for income redistribution to provide low income and lower-middle income countries with the ecological space to grow. An alternative approach could have involved applying World Bank growth estimates to a future scenario for 2050 and discussing the implications for CO_2 emissions. However, this would contradict the aim of this thought experiment, which is to envision a world fundamentally different from the status quo. Moreover, the choice to redistribute income in the initial phase of this experiment does not, in principle, alter production structures. However, the economic effects that occur following income redistribution fall outside the scope of this thesis.

The methodology for redistributing income is inspired by the academic work of József Böröcz (2005), who posed the question, "Where would each of the world's states be, were a twice more equitable system of redistribution – one that would create 50 percent less inequality than the one we have in place today – implemented?". My thesis extends Böröcz's initial thought experiment by examining the implications of such a redistribution on CO_2 emissions.

Following Böröcz's method for redistributing income, I assign each country an initial GNI per capita for the year 2017, calculated using PPP in constant 2017 international dollars. To derive the redistributed GNI, adjustments are made to each country's GNI per capita to reduce its deviation from the global mean by 50%. This adjustment is applied proportionally rather than uniformly, meaning that countries significantly above the global mean will see more substantial reductions in their GNI per capita, while those well below the mean will experience corresponding increases. Accordingly, it is a zero-sum game where the total GNI remains the same in both scenarios: the status quo and the redistributed. This method of proportional redistribution aims to halve the standard deviation of GNI per capita across all countries without altering the global mean, thereby demonstrating a thought experiment for reducing global income inequality between countries. The calculations are performed as follows:

$$\mu = \frac{\text{Sum of GNI values}}{\text{Number of countries}} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$\text{Modified GNI} = \mu + 0.5 \times (x_i - \mu)$$

Where μ is the mean GNI across all countries and x_i is the original GNI of the *i*th country. Modified GNI adjusts the GNI of the *i*th country towards the mean, reducing the deviation from the mean by 50%. The adjustment brings the country's GNI closer to the mean, reducing differences in GNI across countries, and thus making the distribution more uniform.

3.3.2 The second step: Estimate the relationship between income and CO2 emissions

Since I have not found any studies estimating the impact of income redistribution between countries on CO2 emissions, I drew inspiration from a study examining the relationship between GDP and energy consumption through a regression analysis (Wollburg et al. 2023). However, given the significant gap in the literature, as discussed in the chapter on theory and previous research, I developed a novel yet related approach for this thesis. Using my dataset of 123 countries from 2000 to 2022 and focusing on only two variables, I explore how GNI per capita and carbon footprint have changed over time.

In this bivariate analysis, I investigate the relationship between Gross National Income (GNI) per capita as the independent variable and carbon footprint as the dependent variable. The aim is to determine whether variations in GNI per capita coincide with changes in carbon footprint, providing evidence of a potential correlation. It is important to remember that analyzing the relationship between GNI per capita and carbon footprint reveals correlations, not causation. In some cases, an apparent causal effect in one direction may actually operate in the opposite direction (Bryman 2016:339-341).

Given that my dependent variable, carbon footprint, is continuous, I applied a linear regression model. To account for unobserved heterogeneity across countries, I used a fixed effects regression model. This method controls for country-specific effects that might influence the carbon footprint, isolating the impact of GNI per capita (Seber & Lee 2012; Montgomery et al. 2015). To ensure robust and reliable results, I addressed the assumptions of linear regression, including normally distributed residuals, constant variance (homoscedasticity), no autocorrelation, and no significant outliers (Aldrich & Nelson 1984; Weisberg 2005). To meet these conditions, I applied logarithmic transformations to both GNI per capita and carbon footprint, which stabilized variance, reduced skewness, linearized relationships, and mitigated heteroscedasticity. Robust standard errors were also used to address any homoscedasticity violations (see Appendix 3).

However, my methodological approach differs from a traditional linear regression model as I apply a second-order polynomial. As shown in Figure 1, which depicts a non-linear relationship between the mean GNI per capita and mean carbon footprint, applying a second-order polynomial effectively captures the non-linear effects of income changes on a country's carbon footprint. This method recognizes that income variations impact the carbon footprint differently as income levels rise or fall in each country. While some countries may exhibit a linear relationship between these two variables, others may not, which is captured by the second-order polynomial (Stock & Watson 2020:286-287).

Instead of conducting multiple regression analyses for each country, income group, or region with limited data, I utilized all 2,708 observations across 123 countries from 2000 to 2022 available in my dataset. This approach leverages a broad spectrum of panel data, capturing regional and income group dynamics. It accounts for countries transitioning between income levels, such as moving from low to lower-middle income or from upper-middle to high income, and utilizes historical data on the development between GNI per capita and carbon footprint.

The model is specified as follows: the logarithm of the carbon footprint for country i at time t ($log(CBA_{it})$) is a function of the logarithm of GNI per capita for country i at time t ($log(GNI_{it})$)

the square of the logarithm of GNI per capita ($log(GNI_{it})^2$) country-specific fixed effects (u_i), and an error term (ϵ_{it}). The equation is given by:

$$log(CBA_{it}) = \beta_0 + \beta_1 log(GNI_{it}) + \beta_2 log(GNI_{it})^2 + u_i + \epsilon_{it}$$

From this equation applied to the 2,708 observations, I derive the intercept and coefficients for the relationship between GNI per capita and carbon footprint. These estimates are then used to explore CO2 emissions in a more equal world, as outlined in the third step of the methodology and demonstrated in the formula in the following section.

3.3.3 The third step: Predicted CO2 emissions

The methodological approach for the third step of this thesis builds upon the reasoning established in the previous two steps. The exploration of how income redistribution between countries could impact global CO2 emissions is grounded in the theories of Piketty, Raworth, and Hickel, who argue that the world needs to become both less unequal and less polluting. This thought experiment allows for the consideration of new and transformative ideas that challenge the status quo. In this step, I keep the relationship constant between GNI per capita and carbon footprint to investigate the theoretical assumption that changes in GNI per capita affect consumption patterns, which in turn influence environmental outcomes, particularly CO2 emissions. By focusing on the relationship between these two variables, the analysis aims to provide insights into the potential environmental impact of a more equal distribution of income between countries.

To generate a new variable that predicts[3] CO2 emissions in a more equal world, I use the intercept and coefficients derived from the relationship identified in the second step of my methodology. These are applied to the modified GNI per capita variable created in the first step, which represents a more equal distribution of income. Together, these three steps predict the CO2 emissions associated with a more equal distribution of GNI per capita between countries, while

[3] I use the term "predict" to describe the methodological approach for examining how income redistribution affects CO2 emissions. However, it is important to clarify that "predict" in this context does not imply a causal relationship. Instead, it is based on the correlation I aim to identify in step 2 of my methodology.

maintaining the constant relationship between carbon footprint and GNI per capita. This process is depicted in the following equation:

$$Predicted\ CBA = e^{\beta_0 + (\beta_1 \times log(Modified\ GNI)) + (\beta_2 \times log(Modified\ GNI)^2}$$

Where β_0 is the intercept and β_1 and β_2 are the coefficients from the regression model in the second step of my methodology. The formula uses the exponential function *e*, to transform the results from the logarithmic domain back to the original scale. This allows the carbon footprint to be interpreted meaningfully as metric tonnes of CO2 emissions per capita. The rationale for using logarithmic transformations and the second-order polynomial has been explained in the second step of my methodology.

3.3.4 Limitations and Robustness Check

This methodology aims to model the correlation between GNI per capita and carbon footprint, serving as a thought experiment to explore the relationship between these two variables rather than to establish causality. Establishing a causal link would require the inclusion of additional variables such as production and employment structures, transforming the study from a conceptual exploration to a more predictive and general analysis. Additionally, this thought experiment assumes unchanged production structures when predicting CO2 emissions per capita. The GNI per capita is recalculated through a theoretical redistribution among the sample of 123 countries, envisioning a scenario where GNI per capita is more evenly distributed globally. This approach provides a conceptual view of a more economically equitable world without exploring the subsequent impacts of such redistribution on factors like production structures and employment.

Incorporating regional consumption patterns and differences across income groups could enrich the analysis but would limit the dataset, potentially excluding regions lacking comprehensive data. These reflections will be evaluated in a robustness check to assess the potential effects on the results of the predicted CO2 emissions. This thesis acknowledges the potential socioeconomic impacts of changes in GNI per capita, influenced by shifts in production and employment structures. However, to maintain the integrity of this thought experiment and avoid broad generalizations, it focuses solely on the correlation between GNI per capita and CBA. While the results provide valuable insights, they also invite further research into the specific characteristics and contexts of the explored relationships.

An inherent limitation of quantitative research, such as this thesis, is its potential inability to fully capture nuances. Additionally, determining causality in a quantitative study can be challenging, whereas qualitative analysis can provide deeper insights into underlying causal reasoning. Future research could address these limitations by employing a mixed-method approach. This approach could combine narrative analysis with quantitative insights, select in-depth case studies based on large-N correlations, analyze outliers, or conduct an exploratory theoretical study supported by quantitative data (Panke 2018:140-155).

4. Results

This chapter presents the empirical findings of this thought experiment, examining the impact of reducing income inequality between countries on CO_2 emissions. The results build on previous research that shows connections between income and consumption, as well as between consumption and CO_2 emissions. The analysis follows a three-step methodological approach, which also structures the presentation of results. First, the outcomes of income redistribution are discussed. Next, the predicted CO_2 emissions resulting from this redistribution are analyzed. This includes an examination of the relationship between GNI per capita and carbon footprint, followed by the estimation of predicted CO_2 emissions based on this relationship.

4.1 Redistributing income between countries

Table 3 summarizes the key shifts between income groups resulting from the redistribution of Gross National Income (GNI) per capita, measured in Purchasing Power Parity (PPP) using 2017 international dollars. This analysis includes data from 123 countries for the year 2017.

Table 3: Result of modified GNI per capita across income groups

Income Group	Number of Countries (2017 GNI)	Number of Countries (Modified GNI)
Low-income	3	0
Lower-middle-income	22	0
Upper-middle-income	39	35
High-income	59	87

Note: GNI is measured in per capita, PPP, constant international dollars.

The table demonstrates significant changes among income groups when each country's GNI per capita for 2017 is adjusted to be 50% closer to the global mean. Under this adjustment, no country remains in the low income or lower-middle income categories. All countries achieve a GNI per capita of at least $4,466, reaching the threshold for upper-middle income status. This thought experiment illustrates the potential of the global economy to elevate the material conditions of all citizens to at least the level of today's upper-middle income countries, which highlights the vast inequalities currently present between countries. Additionally, the number of high income countries increases substantially, with 28 countries moving into this category. These results suggest that some high income countries must have significantly higher GNIs per capita to enable such a widespread elevation to higher income statuses.

Table 4 provides deeper insights into the shifts among countries categorized by their GNI per capita for the year 2017. It outlines the changes among the bottom 5, median 5, and top 5 countries. Employing the same methodological framework as Table 3, the wealth hierarchy among countries remains consistent: wealthier countries retain their positions at the top, while poorer countries remain at the bottom. The total amount of GNI per capita being transferred due to the adjustment is approximately 510,430.78 international dollars. This sum applies equally to both the reduction in GNI per capita for some countries and the increase for others, representing the cumulative redistribution of GNI per capita among the 123 countries in the dataset. Countries with higher GNI per capita contribute to this redistribution, while those with lower GNI per capita benefit from it.

Table 4: Main movements as the result of a modified GNI per capita[4]

Rank Order	Country	2017 GNI	Modified GNI	Change in GNI
	Burundi	751	11,236	+10,484
	Central African Republic	882	11,301	+10,417
	DR Congo	995	11,357	+10,363
	Niger	1,199	11,459	+10,260
Bottom 5	Madagascar	1,499	11,610	+10,110
	Sri Lanka	13,212	17,466	+4,254
	Botswana	13,413	17,566	+4,153
	Bosnia and Herzegovina	13,470	17,595	+4,125
	Gabon	13,563	17,641	+4,078
Median 5	South Africa	13,564	17,642	+4,078
	Brunei	63,747	42,734	-21,014
	Norway	66,942	44,331	-22,611
	Switzerland	67,251	44,485	-22,765
	United Arab Emirates	71,689	46,704	-24,985
Top 5	Luxembourg	82,297	52,008	-30,289

Luxembourg, which has the highest GNI per capita, experiences the most substantial decrease, followed by a somewhat smaller decrease for the United Arab Emirates, ranked second. As the rankings descend, the reductions in GNI per capita gradually lessen, reaching a minimal reduction in Bulgaria. Below Bulgaria, the redistributive effects become apparent, as seen with Montenegro's GNI per capita slightly increasing from $20,087 to $20,465. Further down the list, the increases in GNI per capita grow more pronounced (see Appendix 4 for the complete list of countries).

The disparity between the GNI per capita of the wealthiest and poorest countries is stark. For instance, Luxembourg's GNI per capita is roughly 4 times greater than the global average, while Burundi’s is about 29 times lower. Under the redistribution model, Burundi’s GNI per capita

[4] In József Böröcz’s article from 2005 similar shifts are observed.

increases nearly 15-fold, while Luxembourg's GNI per capita decreases by 30,289 international dollars, bringing it close to Sweden's 2017 level. Conversely, Burundi's modified GNI per capita aligns more closely with Egypt's 2017 level. Additionally, table 4 highlights that the median five countries experience an increase in their modified GNI per capita, which further emphasizes the significant gap between the highest incomes and the global average. Bulgaria ranked 76 out of 123, shows virtually no change in its GNI per capita, moving from 20,987 to 20,915 international dollars. For large countries, China's modified GNI per capita is comparable to Lebanon’s in 2017, India’s aligns with Bosnia and Herzegovina’s, and the United States sits between South Korea's and New Zealand's GNI per capita for the same year.

Overall, this experiment with modified GNI per capita envisions a more equitable world. According to the theoretical framework of this thesis, such redistribution could enhance the potential for mobilizing climate action and support a global community living within the social bounds necessary for a just existence for humanity. My theoretical expectations suggest that progressive income redistribution among countries will lead to increased consumption but result in lower CO2 emissions. These implications will be further explored in the subsequent results section.

4.2 The CO2 Emissions in a More Equal World

4.2.1 The relationship between income and CO2 emissions

In a regression analysis involving 2,708 observations from 123 countries, a clear relationship emerges between GNI per capita (measured in PPP, constant 2017 international dollars) and carbon footprint (expressed in metric tonnes of CO2 per capita). Following the methodology's second and third steps, this fixed effects regression was conducted to determine the intercept and coefficients for the relationship between GNI per capita and carbon footprint. These values are then used to predict CO2 emissions based on the modified GNI per capita for these 123 countries. The results of this fixed effects regression, outlined in step two of the methodology, are presented in Table 5:

Table 5: Regression analysis of log CBA and log GNI

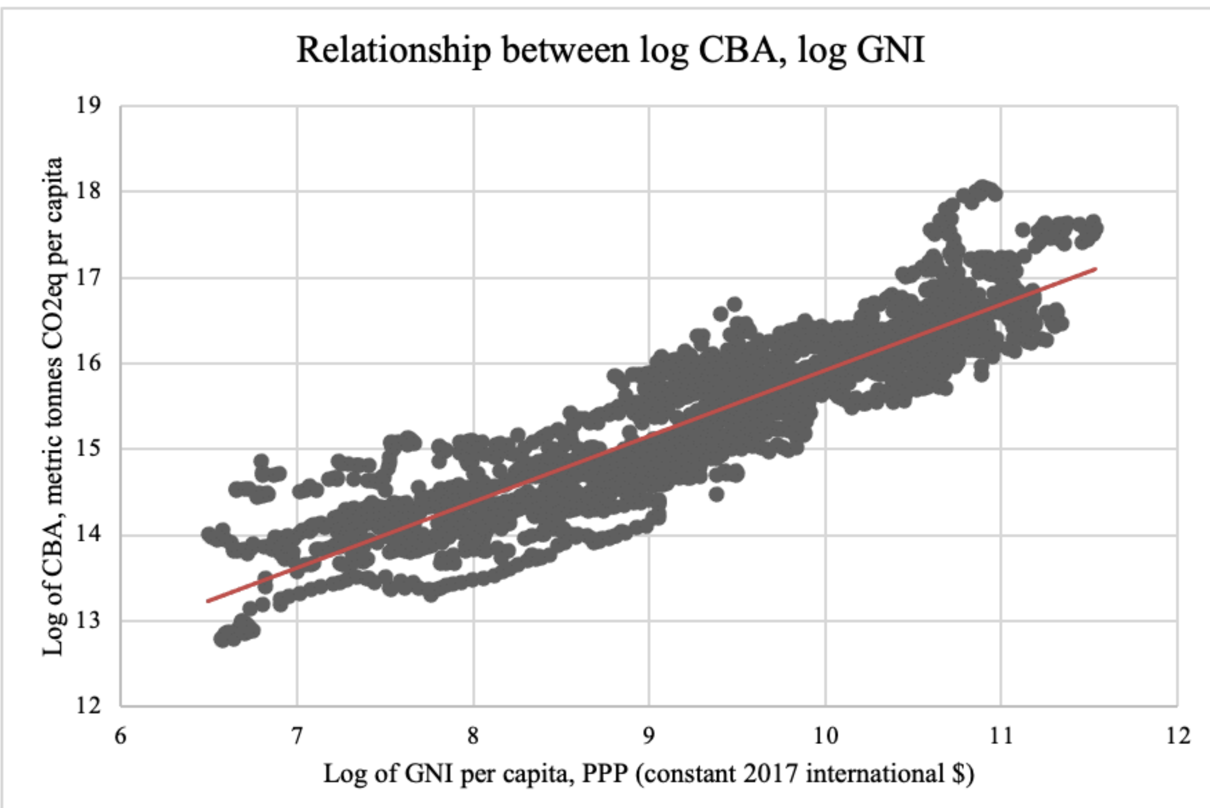
Log CBA	*Coefficient*	*Robust Standard Error*	*P-value*
Log GNI	1.8429	0.5195	0.001
Log GNIsq	-0.0849	0.0291	0.004
Constant	5.7325	2.3005	0.014
Overall R^2	0.6992		
N	2708		
Number of countries	123		
Prob > F	0.0000		

Table 5 presents a regression analysis modeling the logarithmic relationship between Gross National Income per capita (log GNI) and carbon footprint per capita (log CBA). The results reveal a positive relationship, where a 1% increase in GNI per capita leads to an approximately 1.8429% increase in CBA, assuming other variables are constant. However, the model also indicates diminishing returns, with the coefficient for log GNI squared at -0.0849. This suggests that as GNI per capita increases, the rate of increase in CBA decreases, reflecting a concave relationship. This aligns with prior research indicating that higher GNI per capita leads to more sophisticated consumption patterns, with a smaller proportion of income spent on consumption and more allocated to savings. However, this does not necessarily mean that high income countries emit less CO_2 overall, as their consumption often are related to higher CO_2 emissions due to activities such as frequent flying and large energy consumption.

Statistical tests confirm the significance of these relationships, with both coefficients showing p-values well below the 0.05 threshold, providing robust evidence of their impact on CBA. The model's R^2 value of 0.6992 indicates that it explains about 70% of the variation in log CBA, and a high F-statistic confirms the regression's overall statistical significance compared to a simple intercept-only model. The robustness of these findings is further supported by a large dataset, comprising 2,708 observations across 123 countries, enhancing both the reliability and generalizability of the analysis within this thought experiment. From this table, the intercept (5.7325) and the coefficients for log GNI (1.8429) and log GNI squared (-0.0849) can be derived. These values will be applied in the equation from step three of the methodological approach.

Thus, the regression indicates a strong, statistically significant link between GNI per capita and carbon footprint in their logarithmic forms. Initially, increases in GNI per capita are associated with proportional increases in carbon footprint, but this impact diminishes with higher income levels, suggesting that wealthier economies might see smaller incremental environmental effects from additional income gains. The relationship between log CBA and log GNI is visually depicted in the scatterplot below:

Figure 2: Scatterplot of the relationship between log CBA and log GNI

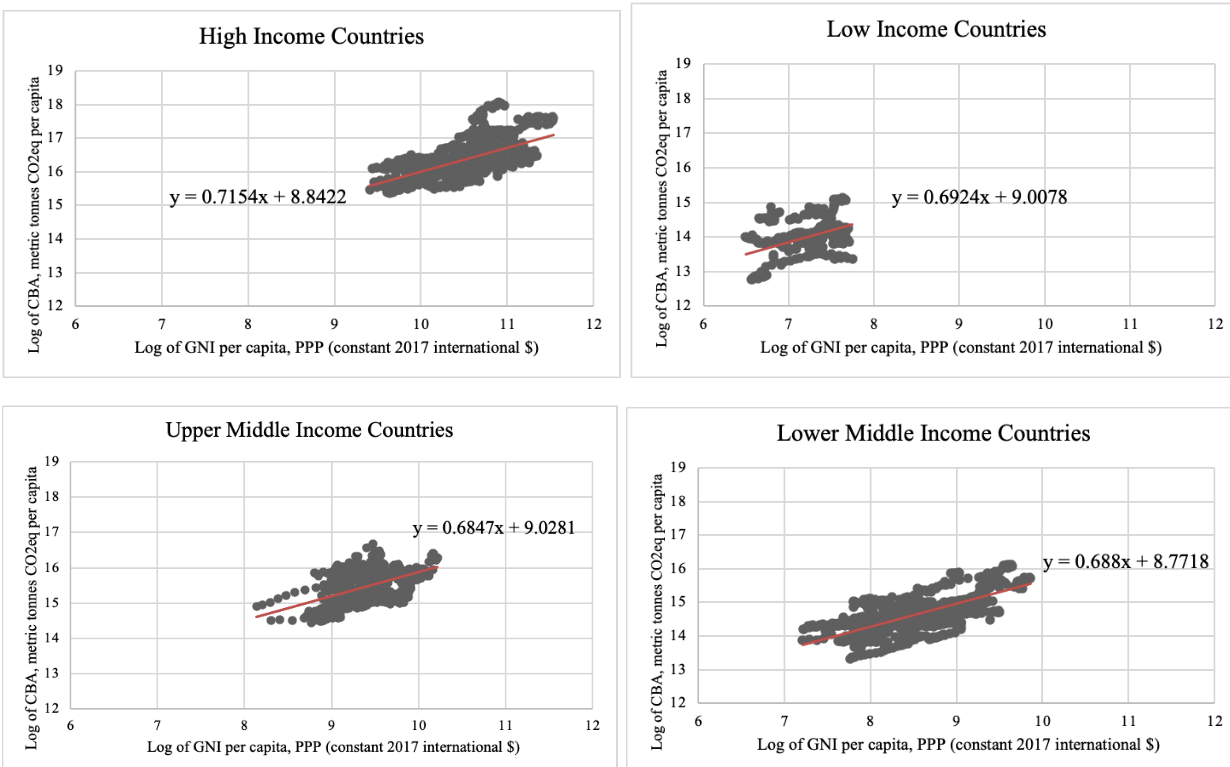


The scatterplot illustrates the relationship between the logarithm of Gross National Income per capita (log GNI per capita, PPP, using constant 2017 international dollars) on the x-axis and the logarithm of CBA (log CBA metric tonnes CO2e per capita) on the y-axis. It shows a strong, positive, and linear correlation: as GNI per capita increases, CBA per capita generally rises, indicating that higher incomes are associated with larger carbon footprints.

The linear relationship suggested by the red fitted line deviates at higher GNI values, where data points show greater variability in CBA. This points to additional factors that might influence CBA levels, such as consumption habits, emission management, or environmental policies. There are also notable clusters and potential outliers, particularly at the higher GNI end, suggesting that high income countries exhibit diverse levels of CBA. The bulk of the data clusters in the middle-income range, reflecting the typical distribution of global economic data with fewer countries at the extremes. This pattern underscores the economic and environmental dynamics as countries' economic status correlates with their environmental impact.

Figure 3 categorizes the relationship between Gross National Income per capita (log GNI) and carbon footprint per capita (log CBA metric tonnes CO2e per capita) across various income groups, providing a more nuanced perspective on how these variables correlate.

Figure 3: Scatterplot of the relationship between log CBA and log GNI by income group



High-income countries exhibit significant variability in emissions intensity, as indicated by the wide spread in log CBA at higher log GNI levels. The regression equation y = 0.7154x + 8.8422 shows that as income increases, carbon emissions per capita increase at a relatively high rate. This finding aligns with research by Clements et al. (2006) and Schor (1998), which highlights that high income countries have complex and varied consumption patterns, leading to higher emissions.

In comparison, upper-middle income countries have a less pronounced slope y = 0.6847x + 9.0281, indicating a slightly lower rate of emissions increase with income. The spread of data suggests a more homogeneous response. This supports research suggesting that income significantly influences consumption patterns, with citizens in upper-middle income countries predominantly spending rather than saving or investing their earnings (Campbell & Mankiw 1991; Dey 2019).

Lower middle-income countries, with a slope of y = 0.688x + 8.7718, display a consistent and proportional relationship between income and emissions, though at a lower rate than high income countries, similar to upper middle-income countries. Low-income countries, with a slope of y = 0.6924x + 9.0078, exhibit a slightly steeper increase in emissions with income than middle-income groups. This somewhat contradicts previous research suggesting that higher income levels are associated with a higher carbon footprint compared to lower income levels, as the carbon emissions associated with consumption for low income countries are supposedly lower (Golley & Meng 2012; Grunewald et al. 2012). The scattered data points suggest substantial variability in emissions intensity, possibly due to restricted consumption caused by limited economic resources (Cata-Preta et al. 2020).

In summary, the regression lines indicate a positive relationship between income and carbon footprint for all countries, as suggested by the Keynesian consumption function. However, the slope and concentration of the data points reveal a more nuanced relationship, emphasizing the need to examine the differences between GNI per capita and carbon footprint across income groups. While these scatterplots suggest varying patterns, they do not imply causality or definitive reasons for these differences.

For a more detailed analysis, Figure 4 explores the correlation between Gross National Income per capita (log GNI) and carbon footprint (log CBA metric tonnes CO_2e per capita) across various regions:

Figure 4: Scatterplot of the relationship between log CBA and log GNI by region

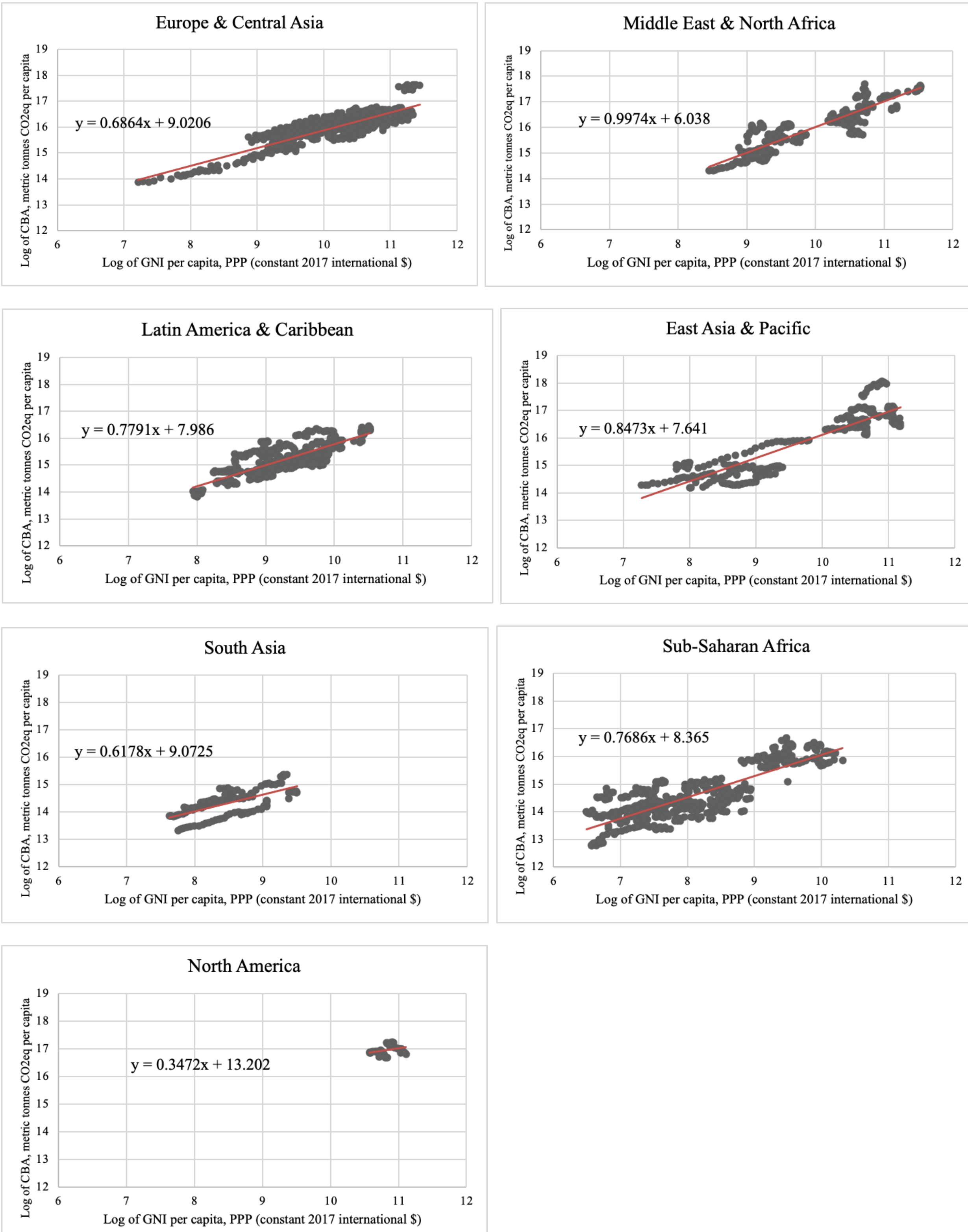


Figure 4 highlights regional variations in the relationship between log GNI per capita and log CBA, while also considering the influence of the number of observations per region, particularly in North America as detailed in the thesis's data and methods chapter. The figure illustrates increased variability in this relationship across regions at higher levels of log GNI, a trend previously noted in Figure 3.

In Europe & Central Asia and Latin America & the Caribbean, data points cluster more tightly around the trendline, indicating that increases in log GNI correlate closely with proportional increases in log CBA. Conversely, in the Middle East & North Africa, East Asia & Pacific, and Sub-Saharan Africa, the data shows a broader scatter, suggesting a less consistent relationship. While all regions display a positive correlation, the slopes of the regression lines differ. Excluding North America due to limited data, the slope across regions ranges from 0.61 in South Asia to 0.99 in the Middle East and North Africa. Considering the logarithmic nature of these values, the differences between regions are substantial. This supports the studies by Jackson (2004) and Crewe & Lowe (1995), which emphasize varying consumption patterns across countries. These differing slopes also bolster the arguments by Grigg (1999) and Gerbens-Leenes et al. (2010), which indicate that a global nutritional transition mirrors economic development.

These regional plots demonstrate how the interactions between GNI per capita and carbon footprint vary considerably across different regions, likely due to differences in regional economic structures, environmental policies, and technological levels. Drawing further conclusions about these variations would require more in-depth, region-specific studies.

4.2.2 Predicted CO2 emissions

To address the research question, "How does reducing between-country inequality through income redistribution affect global CO2 emissions?", the intercepts and coefficients from the relationship found in Table 5 are applied to the following equation:

$$Predicted\ CBA = e^{5.7325+(1.8429 \times log(Modified\ GNI))+(-0.0849 \times log(Modified\ GNI)^2}$$

In 2017, the total carbon footprint (CBA) for the 123 countries in this dataset was 849,948,363.5 metric tons of CO2 emissions, as mentioned in the data chapter. Predictions for the same countries, assuming a scenario where each country's GNI per capita is adjusted to be 50% closer to the global mean, indicate a total carbon footprint of 763,303,716.5 metric tons of CO2. This represents a net reduction of 86,644,647 metric tons of CO2 emissions or approximately a 10.2% decrease from the original total. This substantial reduction highlights the potential environmental impact of redistributing GNI per capita between countries.

This thought experiment suggests that a more equitable world, with income more evenly distributed among 123 countries, could result in a significant decrease in global CO2 emissions compared to the levels recorded in 2017. However, it is important to recognize that this is a theoretical model involving a large number of countries and using only two variables to predict CO2 emissions. Consequently, the findings are constrained by the limitations of this setup and do not directly apply to real-world situations. Furthermore, the fundamental relationship between GNI per capita and carbon footprint remains unchanged even as GNI is modified. Therefore, any conclusions drawn about changes in carbon footprint relative to GNI per capita adjustments are based on consistent underlying dynamics.

Table 6 provides a visual overview of the results from this equation, with the complete overview available in Appendix 5.

Table 6: Predicted CBA per capita of Modified GNI per capita

Rank	Country	Original GNI	Modified GNI	Change in GNI	Original CBA	Predicted CBA	Change in CBA
Bottom 5	Burundi	751	11,236	+10,484	369,021	5,579,442	+5,210,420
	Central African Republic	882	11,301	+10,417	1,980,551	5,587,845	+3,607,294
	DR Congo	995	11,357	+10,363	1,0159,82	5,594,985	+4,579,003
	Niger	1,199	11,459	+10,260	1,298,564	5,607,843	+4,309,279
	Madagascar	1,499	11,610	+10,110	1,268,783	5,626,464	+4,357,681
Median 5	Sri Lanka	13,212	17,466	+4,254	24,389,450	6,152,465	+3,713,519
	Botswana	13,413	17,566	+4,153	8,408,872	6,158,946	-2,249,927
	Bosnia and Herzegovina	13,470	17,595	+4,125	7,839,546	6,160,761	-1,678,785
	Gabon	13,563	17,641	+4,078	7,509,919	6,163,735	-1,346,185
	South Africa	13,564	17,642	+4,078	7,780,468	6,163,764	-1,616,704
Top 5	Brunei	63,747	42,734	-21,014	19,458,100	6,777,678	-12,680,422
	Norway	66,942	44,331	-22,611	16,343,790	6,784,914	-9,558,876
	Switzerland	67,251	44,485	-22,765	13,586,580	6,785,516	-6,801,064
	United Arab Emirates	71,689	46,704	-24,985	19,274,620	6,792,541	-12,482,079
	Luxembourg	82,297	52,008	-30,289	16,113,750	6,798,374	-9,315,377

Note: The original GNI and original CBA values refer to the figures for the year 2017. In the "Change in GNI" column, green numbers indicate countries that gain financial resources from redistribution, while red numbers denote those that lose GNI per capita. Similarly, in the "Change in CBA" column, green numbers signify countries with a projected decrease in CO2 emissions, and red numbers highlight those expected to emit more.

When examining the movements presented in Table 6, categorized into three groups based on their original GNI rankings—bottom 5, median 5, and top 5—several nuances emerge.

For the bottom 5 countries, there is a significant increase in predicted CBA with the modified GNI per capita. According to the theoretical framework and previous research, this rise in CO2 emissions can be attributed to increased economic capacity, which typically leads to greater consumption, and emissions. The median 5 countries exhibit varied changes in their carbon emissions, with most experiencing a decrease. This reduction suggests improvements in consumption efficiency or a shift towards less CO2-intensive activities as economic conditions improve, consistent with the concave relationship identified in the regression analysis and Figure 1. In the top 5 countries, significant reductions in predicted CBA are observed, indicating that a decrease in income correlates with a lower carbon footprint. This aligns with the hypothesis that wealthier nations typically have higher per capita carbon footprints and that reducing income can substantially affect their emissions levels.

The findings from this thought experiment suggest that increases in GNI per capita at the lower end of the income spectrum result in a smaller rise in carbon footprint compared to the upper end. This indicates that redistributing GNI per capita does not lead to a proportional redistribution of carbon emissions, highlighting a disparity in how income gains translate into environmental impacts across different income levels. These results align with Keynes' consumption function, suggesting that lower and middle-income groups tend to spend a larger portion of any additional income they receive. Previous research indicates that this spending is more likely to focus on necessities, which are generally less carbon-intensive compared to the luxury consumption patterns of higher-income individuals. Therefore, increasing the disposable income of lower-income groups does not proportionately increase CO_2 emissions, as their spending is likely directed towards improving basic living standards such as housing, healthcare, and education.

Conversely, reducing the disposable income of higher-income individuals leads to a decrease in their consumption of luxury goods and services, which are often carbon-intensive, such as frequent flying and large private vehicles. Consequently, the total carbon footprint decreases, supporting Piketty's observation that a small group of extremely wealthy individuals has a disproportionately large carbon footprint. In this experiment, high income groups, which experience the most significant reductions in GNI per capita, also see substantial decreases in their carbon footprints. Piketty's theory suggests that a more equitable world, as proposed in this experiment, could potentially enhance support for reducing national carbon footprints.

Tables 7 and 8 display the percentage changes in GNI per capita and carbon footprint (CBA) for different income groups and regions based on levels recorded in 2017. These tables illustrate general trends and should be interpreted with caution, as they do not account for country-specific effects. The percentage changes are shown instead of total numbers to facilitate meaningful interpretation. These tables highlight the broader impact of adjusting GNI per capita to be 50% closer to the global mean but do not reflect the variations within individual countries.

Table 7: Movements in % across income groups

Income group	% Change in GNI	% Change in CBA
Low Income	646.95	287.66
Lower-Middle Income	113.06	116.74
Upper-Middle Income	25.16	9.49
High Income	-25.47	-47.49

Note: % Change in GNI is calculated as the aggregate change in GNI for each income group, divided by the original total GNI for that group, multiplied by 100. It reflects the overall impact of the adjustment on the GNI of countries within each income group. % Change in CBA is calculated as the aggregate change in Carbon Footprint (CBA) for each income group, divided by the original total CBA for that group, multiplied by 100. It shows the overall impact of the GNI adjustment on the carbon footprint of countries within each income group.

Table 7 further underscores the stark inequalities between low income and high income countries, as previously highlighted in Table 3. A reduction in GNI per capita by 25.47% across high income countries is sufficient to significantly increase GNI per capita for low income and lower-middle income countries, with even smaller percentage increases for upper-middle income countries. The percentage change in CO_2 emissions (CBA), measured based on the relationship observed between 123 countries from 2000 to 2022, supports Hickel's theoretical reflections. Hickel emphasizes the necessity for rich countries to pursue degrowth, allowing poorer countries to increase their CO_2 emissions as part of their development process without exacerbating the total carbon footprint.

Furthermore, the findings align with studies that associate higher income with more polluting consumption patterns. A 47.49% reduction in the carbon footprint by high income countries creates sufficient ecological space for all other income groups to grow. The overall reduction in the global carbon footprint suggests that redistributive policies aimed at balancing global inequalities in GNI per capita could address both economic disparities and environmental challenges, such as CO_2 emissions. This supports the notion that addressing economic inequality is integral to global sustainability efforts, as posited by Kate Raworth's doughnut model.

The table below reveals regional differences, yet the overall pattern remains consistent: countries experiencing an increase in GNI per capita due to redistribution also see an increase in CO_2 emissions, while those with a decrease in GNI per capita experience a reduction in CO_2 emissions.

Table 8: Movements in % across regions

Region	% Change in GNI	% Change in CBA
Sub-Saharan Africa	144.55	112.36
South Asia	100.58	169.68
Latin America & Caribbean	28.38	34.79
East Asia & Pacific	-10.01	-39.27
Middle East & North Africa	-10.90	-40.69
Europe & Central Asia	-20.23	-28.99
North America	-30.05	-69.48

Note: % Change in GNI is calculated as the aggregate change in GNI for each region, divided by the original total GNI for that group, multiplied by 100. It reflects the overall impact of the adjustment on the GNI of countries within each region. % Change in CBA is calculated as the aggregate change in Carbon Footprint (CBA) for each region, divided by the original total CBA for that group, multiplied by 100. It shows the overall impact of the GNI adjustment on the carbon footprint of countries within each region.

Notable regional differences from Table 8 include the decrease in GNI per capita experienced by Europe & Central Asia, where the reduction in CO_2 emissions (CBA) is smaller compared to East Asia & Pacific and the Middle East & North Africa. This is despite Europe & Central Asia having a larger decrease in GNI per capita than these other regions. This discrepancy is likely due to differences in consumption patterns at higher income levels. While it is challenging to draw decisive conclusions without context-specific knowledge, it appears that Europe & Central

Asia has a lower carbon footprint and therefore does not need to make as dramatic changes as East Asia & Pacific, Middle East & North Africa, and North America.

Another interesting regional difference is that while Sub-Saharan Africa experiences the greatest increase in GNI per capita, followed by South Asia, it is South Asia that sees the largest increase in CO2 emissions, with Sub-Saharan Africa following. This could be because Sub-Saharan Africa's growth is driven by less carbon-intensive sectors such as agriculture and services, whereas South Asia's growth relies more on heavy industrialization and manufacturing, which are more carbon-intensive (Abid 2016). Additionally, South Asia's higher dependence on fossil fuels and greater population density result in higher total emissions, despite similar levels of economic growth (Adzawla et. al. 2019).

Overall, this thought experiment suggests that redistributing GNI per capita globally could lead to substantial economic and environmental benefits, aligning with theoretical expectations that progressive income redistribution enhances climate action potential while reducing global CO2 emissions. The next chapter will discuss these results in detail and outline the robustness tests conducted to validate the findings.

5. Discussion - The danger of a single story

This thesis has told the story of how a hypothetical more equal world is a less polluting world than the world of today. In the previous research arguments presented in the thesis, I have told a story about how a more equal world, redistributing the GNI per capita between 123 countries, would presumably result in a more consuming world. Followingly, I told a story about how analyzing the relationship between GNI per capita and carbon footprint per capita over 22 years for 123 countries reveals that redistributing GNI does not proportionally redistribute carbon emissions. There are multiple ways to tell this story, and it is important not to rely on one solely. In fact, my choice to explore the impact of income redistribution on CO2 emissions was driven by the urge to paint a new picture of a world that can allow developing countries to develop, without polluting more.

Humans are easily influenced by a single story, making it essential to view this thesis within the broader scope of studies on inequality and climate change. To grasp the complexities of GNI per capita and carbon footprint and their interrelation, an in-depth examination across all 123 countries or at least their regional variations would be essential. In an effort to explore some of these complexities, I conducted various regression analyses, testing models with and without interaction terms and performing region-specific evaluations.

These robustness checks aimed to assess the stability and reliability of my findings under different model specifications and assumptions and to identify the conditions under which they are valid. When introducing interaction terms between log GNI per capita, its square, and different income groups, the results revealed varying impacts of GNI per capita on carbon footprints, particularly noting a more pronounced effect in upper-middle income countries. This variation suggests that the model's outcomes are sensitive to how income variables are specified, and the influence of GNI per capita on carbon footprint depends on the economic levels of the countries studied. Including regional interaction terms made the model statistically insignificant, implying that the overarching relationship might be consistent across regions, or that regional influences are overshadowed by other, unmodeled factors.

Region-specific analyses further highlighted disparities: East Asia & Pacific and Europe & Central Asia experienced increases in carbon footprint with rising GNI per capita, suggesting a pattern where economic growth impacts the environment under certain conditions. In contrast, regions like Latin America & the Caribbean, and Middle East & North Africa showed no significant correlation, indicating specific conditions under which broader findings are applicable. North America displayed a strong, positive correlation with marked increases in carbon footprint as GNI per capita rose, despite diminishing returns. Conversely, South Asia and Sub-Saharan Africa did not exhibit a clear relationship, with the latter showing a significant baseline carbon footprint irrespective of GNI per capita changes. These regional discrepancies suggest that local economic and environmental policies significantly shape these outcomes.

Overall, these robustness checks indicate that a more context-specific approach, incorporating additional variables and potentially augmented by qualitative data, is necessary to establish any causal relationship between the two variables. This is an avenue I intend to explore further in my second-year thesis.

This paper may rightly be subject to criticism for its broad and somewhat utopian portrayal, which may not seem immediately practical. Nonetheless, it is important to clarify that the primary objective of this thesis is not to suggest that the findings can be straightforwardly applied to real-world scenarios, given the numerous evident limitations. Rather, the purpose is to provoke a reevaluation of our prevailing assumptions about the potential effects of a more equitable world on both social welfare and the environmental conditions of the global population.

6. Conclusion

In conclusion, this thought experiment demonstrates that bringing 123 countries 50% closer to the global average GNI per capita for the year 2017 results in a significant net reduction of approximately 86.644 million metric tons of CO2 emissions. This reduction represents a substantial share of the global CO2 emissions for that year. The outcome is based on data spanning from 2000 to 2022, which includes GNI per capita adjusted by Purchasing Power Parity (constant 2017 international dollars) and the Consumption-Based Accounting (CBA) of CO2 emissions per capita. Furthermore, such redistribution practically eliminates the low income and lower-middle income categories, elevating all countries to a GNI per capita of at least $4,466.

These results reveal a critical insight: redistributing income to foster a more equitable global economy does not necessarily lead to increased CO2 emissions. Rather, the data suggest that while higher incomes typically correlate with greater emissions, the intensity of these emissions may decrease as income is redistributed. This observation aligns with the theoretical frameworks proposed by Thomas Piketty, Kate Raworth, and Jason Hickel, which advocate for equitable economic policies, sustainable economic practices within ecological limits, and a degrowth strategy in developed countries to allow room for growth in developing countries.

However, the limitations of this study are notable. The focus on the theoretical redistribution of GNI per capita and its hypothetical impact on CO2 emissions does not capture the full spectrum of global economic interactions. It does not thoroughly explore within-country inequality or potential shifts in production and employment structures that redistributive policies could trigger. Additionally, the assumption of static production structures does not accurately reflect the dynamics of a global economy. Future research should strive to fill these gaps by incorporating context-specific data on changes in production, consumption patterns, and employment. A multidisciplinary approach that includes insights from environmental science, political theory, and economic sociology would enrich the understanding of how economic policies intersect with environmental outcomes.

This thesis contributes to academic discussions by proposing a theoretical model in which economic equity and environmental sustainability can potentially coexist. The analysis suggests that it is theoretically possible to simultaneously promote greater economic equality among countries and reduce CO2 emissions. However, the practical implementation of such a model, requiring the establishment of global social institutions for effective political action, may seem utopian. This highlights the inherent constraints of this thought experiment. Nevertheless, given the pronounced inequalities currently present worldwide, there is a crucial decision to be made: either to develop a system for global economic redistribution or to maintain the existing economic order. Choosing the latter may be less challenging in the short term but continues to support a global structure marked by significant geographic and economic inequalities, which have profound long-term consequences for both the ecological and social sustainability of global societies. Looking ahead, it is important to acknowledge that tackling global issues such as climate change requires innovative economic ideas and a commitment to fair development. This combined effort is crucial for fostering a more economically equal future within the limits of the planet.

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Appendix 1: Literature review overview

Author	Period of study	Type of climate measurement	Type of inequality measurement	Findings
Anand & Segal (2008)	Historical overview	Not applicable	Global income inequality	This analysis synthesizes existing research on global income inequality, discussing methodological challenges and summarizing findings that show widening income gaps, which significantly influence global consumption trends.
Andriuškevičius et al. (2017)	Not specified	Not directly measured; focuses on economic impacts	Income inequality effects on savings and investment	Argues that income inequality can hinder sustainable economic growth by affecting savings rates and investment efficiency.
Baležentis et al. (2020)	Not specified	Consumption-based greenhouse gas emissions	Global income inequality	Analyzes data from multiple countries to show that higher income inequality is linked to higher consumption-based emissions, particularly in high-income countries.
Baumgartner et al. (2017)	Not specified	Willingness to pay for environmental sustainability	Income inequality	Examines how income inequality within countries affects public willingness to pay for environmental goods, finding that greater inequality decreases collective willingness to invest in these goods, impacting sustainable consumption practices.
Benchekroun & Chaudhuri (2014)	Conceptual and theoretical analysis	Transboundary pollution	Not directly related to economic inequality, but focuses on disparities in technology access and usage	This study explores the dynamics of transboundary pollution and the role of clean technologies in mitigating these effects. The authors develop a game-theoretical model to analyze how countries can cooperate to reduce pollution through the adoption of cleaner technologies. The findings highlight the potential for significant reductions in pollution if countries can align their economic and environmental policies to encourage the use of such technologies. The study also discusses the challenges of achieving this alignment, particularly under conditions of competitive economic behavior and uneven technological advancement.
Berthe & Elie (2015)	Theoretical analysis	Environmental deterioration	Economic inequality	This study offers theoretical insights into how economic inequality contributes to environmental deterioration. It discusses mechanisms such as reduced access to clean technologies and increased consumption of goods that lead to greater environmental impact among wealthier populations.
Borghesi (2006)	Review and analysis of existing data	Various environmental metrics	Income inequality	Borghesi examines the environmental Kuznets curve (EKC), which hypothesizes that environmental quality worsens and then improves as per capita income grows. The study focuses on how income inequality affects this curve, suggesting that higher inequality may delay the turning point at which environmental improvement begins.
Boyce (1994)	Conceptual framework	environmental degradation	Socioeconomic inequality	Boyce discusses the link between socioeconomic inequality and environmental degradation, arguing that inequality leads to a misallocation of resources that exacerbates environmental harm, particularly in less affluent areas.
Caron & Fally (2018)	?	CO2 emissions	the “environmental Kuznets curve” which relates per capita income to emissions intensity.	Economic growth affects CO2 emissions intensity differently across countries, with potential reductions in middle- and high-income countries and increases at low incomes. Consumption patterns influenced by income changes partially explain the inverted-U relationship between GDP per capita and emissions intensity.
Cata-Preta et al. (2020)	Not specified	Not applicable	Wealth-related inequalities	Explores how wealth inequalities correlate with vaccine hesitancy across 86 low- and middle-income countries, suggesting that disparities in wealth significantly influence health behaviors and access, which could be analogously significant in consumption and environmental impact studies.
Clements et al. (2006)	Not specified	Consumption patterns	International economic disparities	Compares consumption patterns across various countries, highlighting how economic, cultural, and policy differences shape consumer behavior and environmental impacts, with a focus on sustainability and resource usage.
Crewe & Lowe (1995)	Not specified	Not applicable	Geographic and cultural disparities	Discusses the geographical and cultural differences that shape consumption patterns, illustrating how identity and place influence consumer behavior, which has broader implications for environmental impact.
Dey (2019)	Recent decades analysis	Not applicable	Economic performance metrics	Finds strong correlations between income levels and consumption patterns in Asian countries, suggesting that economic growth significantly drives consumption changes.
Diffenbaugh & Burke (2019)	Historical data analysis	Global warming effects	Economic inequality	Analyzes historical data to demonstrate that global warming has exacerbated economic inequality between countries by disproportionately impacting poorer countries’ economies, which are less able to cope with climate extremes.
Drupp et al. (2018)	Conceptual and empirical analysis	Value of natural resources	Economic inequality	This paper explores how economic inequality affects the societal value placed on natural resources. It suggests that greater inequality reduces the public's willingness to invest in environmental conservation, undermining efforts to protect natural ecosystems.
Farhani & Rejeb (2012)	Not specified	Energy consumption	Economic growth disparities	Analyzes the relationship between economic growth and energy consumption across more than 90 countries, showing that higher economic growth typically leads to increased energy consumption, with implications for environmental policy and sustainable development strategies.
Gerbens-Leenes et al. (2010)	Not specified	Food consumption	Economic wealth	Examines the link between economic growth and food consumption, demonstrating that higher affluence leads to increased resource use, particularly in terms of dietary choices that affect the environment.
Golley & Meng (2012)	Not specified	CO2 emissions	Income inequality among urban households in China	This study investigates the link between income inequality and CO2 emissions in urban China, finding that higher income inequality leads to increased emissions due to the consumption patterns of wealthier households.
Grigg (1999)	1950-1999	Food consumption	Geographical income differences	Analyzes shifts in global food consumption over five decades, showing how economic development and cultural exchange have reshaped diets worldwide, with significant environmental consequences.
Grigoryev et al. (2020)	Conceptual analysis	Broader environmental impacts	Socioeconomic inequality	Discusses integrated solutions to address both climate change and socioeconomic inequality, emphasizing policy synergy and cooperative international strategies.
Grunewald et. al. (2012)	Not specified	Carbon footprint	Household income	Analyzes the carbon footprints across different income levels of Indian households, showing that wealthier households have significantly higher carbon footprints, reflecting greater consumption intensity.
Grunewald et. al. (2017)	Comparative analysis	CO2 emissions	Income inequality	The relationship between income inequality and emissions depends on income levels. At lower levels of income higher income inequality reduces emissions while at higher levels of income, the effect is reversed.
Hao (2022)	Recent data analysis (2000s-2020s)	Greenhouse gas emissions	Economic indicators including GDP	Finds that improvements in human development and renewable energy consumption can mitigate the adverse effects of economic growth on climate change.
Heerink et al. (2001)	Analysis of empirical data	Environmental degradation	Income inequality	This paper critiques the Environmental Kuznets Curve (EKC) by highlighting aggregation bias issues. It argues that when income inequality is considered, the apparent relationship between income growth and environmental improvement often observed at national levels may not hold, indicating that the EKC might not universally apply.

Appendix 1: Literature review overview

Author	Period of study	Type of climate measurement	Type of inequality measurement	Findings
Hellebrandt & Mauro (2015)	Forecasting up to 2035	Not applicable	Predicted changes in global income distribution	The study projects changes in global income distribution and their potential impacts on consumption, emphasizing that rising middle-class incomes in developing nations are likely to drive future consumption growth.
Hubacek et. al. (2017)	Not specified	CO_2 emissions	Poverty levels	Discusses the challenges of eradicating poverty while managing CO_2 emissions, suggesting that achieving sustainable development goals requires innovative policies that integrate economic and environmental objectives.
Jackson (2004)	Not specified	Consumption cultures	Global vs. local disparities	Investigates how globalization affects local consumption cultures, finding that while global influences are strong, local traditions still significantly determine consumption habits, affecting sustainability practices differently across regions.
Jorgenson et al. (2016)	Comparative historical analysis	Carbon emissions	Domestic income inequality	This study provides evidence that domestic income inequality is a significant driver of carbon emissions in high-income countries, contrasting with lower emissions in more egalitarian societies.
Kakeu & Agbo (2022)	Not specified	Transboundary pollution	Global economic inequality	This study assesses the potential of international financial transfers to reduce global inequality and mitigate transboundary pollution. It posits that well-designed transfers not only alleviate poverty but also reduce environmental impacts by enabling greener technologies in developing countries.
Knight et. al. (2017)	Not specified	Carbon emissions	Wealth inequality	Explores how wealth inequality within high-income countries exacerbates carbon emissions, as wealth concentration leads to consumption patterns that are significantly more carbon-intensive.
Lahoti et al. (2014)	Not specified	Not applicable	Income disparities globally	This study introduces the GCIP database, illustrating global disparities in consumption and income, and emphasizes the significant variations in income across different global regions, which correlate with differences in consumption patterns.
Lahoti et. al. (2016)	Ongoing since 2014	Not applicable	Income disparities globally	his paper provides an overview of the GCIP database, highlighting its utility in tracking income and consumption changes globally, revealing crucial insights into how income inequality affects consumption behavior across various regions.
Liobikienė & Butkus (2018)	Not specified	Policy impact on environmental outcomes	Economic development stages	This paper reviews how different stages of economic development influence the effectiveness of climate change policies, with wealthier nations able to implement more comprehensive and effective policies.
Liobikienė & Juknys (2016)	Not specified	Environmental behavior	Socio-economic factors	Investigates how socio-economic factors, including income levels, influence environmental behaviors in Lithuania, showing that higher awareness and perceived responsibility lead to more sustainable practices.
Liobikienė & Rimkuviene (2020)	Contemporary analysis	Consumption-based greenhouse gas emissions	Income inequality at various stages of economic development	Demonstrates that income inequality can exacerbate greenhouse gas emissions in developing countries, where increased wealth often leads to higher carbon-intensive consumption.
Liu et. al. (2019)	Not specified	Carbon emissions	Income inequality	This study examines the relationship between income inequality and carbon emission reduction efforts in the US, finding that higher income inequality may actually facilitate emission reductions due to decreased overall consumption by lower-income groups.
Liu et. al. (2019)	Not specified	CO_2 emissions	Income inequality	This study explores the impact of income inequality on CO_2 emissions from both non-spatial and spatial analytical perspectives, revealing complex interactions where higher inequality can lead to higher emissions due to increased consumption by the wealthy.
Magnani (2000)	Theoretical and empirical review	Environmental protection and policy impact	Income distribution	Magnani discusses the Environmental Kuznets Curve in the context of environmental protection policies and income distribution. The study suggests that unequal income distribution can exacerbate environmental degradation at lower income levels and that effective environmental policies must be coupled with efforts to address income inequality to be truly effective.
Mayén et al. (2014)	Review of existing literature	Not applicable	Socioeconomic factors affecting dietary patterns	Reviews evidence that socioeconomic status significantly influences dietary habits in low- and middle-income countries, affecting health outcomes and economic stability.
Mayén et al. (2016)	Recent data collection	Not applicable	Socioeconomic disparities	Highlights how socioeconomic differences within the Seychelles impact dietary choices, with wealthier segments adopting more Westernized diets.
Rao & Min (2018)	2013 + 2050	CO_2 emissions	a rate of reduction in the Gini coefficient of about 8 points per decade	Even if in the next 30 years within-country inequality reduced at unprecedented rates in all countries across the globe, global emis- sions would at worst increase by just a few percent.
Ravallion et al. (2000)	1975-1992	carbon emissions	Gini	Income inequality within countries exacerbates carbon emissions, equitable growth can lead to a reduction in emissions over time, with the relationship between emissions and income showing a potential reversal at higher income levels.
Rojas-Vallejos & Lastuka (2020)	1961-2010	carbon emissions per-capita	net income Gini coefficients	A 1% decrease in inequality leads to approximately a 0.3% increase in carbon emissions. Implies an intra-temporal tradeoff between inequality and emissions.
Schor (1998)	Not specified	Not applicable	Consumer culture	Discusses the cultural and economic drivers behind high consumption patterns in America, highlighting how these patterns contribute to environmental degradation and are influenced by broader socio-economic inequalities.
Scruggs (1998)	Not specified	Environmental policies	Political and economic inequality	Examines how political and economic inequalities influence environmental outcomes, arguing that greater inequality often leads to poorer environmental policies and outcomes.
Selvanathan & Selvanathan (1993)	Not specified	Consumption patterns	Cross-country economic disparities	Provides a statistical analysis of how consumption patterns vary across countries, linking economic factors to differences in how goods and services are consumed, which can inform targeted environmental policies.
Xu et. al (2021)	2015	Carbon transfers	Emission contributions.	This study explores the complex pathways through which global consumption drives carbon transfers across international borders. By identifying key sectors and paths, it highlights how developed countries' consumption patterns significantly contribute to carbon emissions in developing countries through supply chains. The study uses network analysis to map out the critical sectors and their roles in carbon transfer, suggesting targeted interventions in these sectors could help mitigate global carbon footprints.

Appendix 2: List of excluded countries

The 66 countries that were omitted: Afghanistan, Andorra, Antigua and Barbuda, Azerbaijan, Barbados, Comoros, Cuba, Djibouti, Dominica, Equatorial Guinea, Eritrea, Eswatini, Fiji, Grenada, Guinea-Bissau, Guyana, Iceland, Jordan, Kiribati, Korea (Dem. People's Rep.), Kuwait, Kyrgyz Republic, Lao PDR, Liberia, Libya, Liechtenstein, Malawi, Malaysia, Maldives, Marshall Islands, Micronesia, Fed. Sts., Monaco, Mongolia, Mozambique, Myanmar, Nauru, Nigeria, North America, North Macedonia, Palau, Panama, Papua New Guinea, Qatar, San Marino, São Tomé and Principe, Singapore, Solomon Islands, Somalia, South Sudan, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Suriname, Syrian Arab Republic, Thailand, Timor-Leste, Tonga, Trinidad and Tobago, Türkiye, Turkmenistan, Tuvalu, Uzbekistan, Venezuela, RB, Yemen, Rep., and Zambia.

Appendix 3: Do.file

```
*Importing merged dataset in long format on GNI and CBA with categories
import excel "/Users/mathie/Desktop/Updated Final excel file for thesis.xlsx", sheet("Sheet1") firstrow

//CLEANING DATA//

* Keep only the observations from the years 2000 to 2022
keep if year >= 2000 & year <= 2022

*I drop 56 countries that have missing data for CBA and GNI, and the countries with very limited data. These are: Bermuda, Caym

* Define a list of country codes to be dropped
local codes_to_drop "BMU CYM PYF PSE GRL NCL MKD SSD SDN AND VGB CUB ERI LIE MCO PRK SYR VEN YEM AFG AT

* Drop observations where the CountryCode is in the list
foreach code in `codes_to_drop' {
drop if CountryCode == "`code'"
}
*Conduct imputation through forward linkages
bysort CountryCode (year): replace GNI = GNI[_n-1] if missing(GNI)

*View the countries still missing data on GNI, for the early years
sort Country year
list Country year GNI if year >= 2000 & year <= 2010 & missing(GNI)

* Applying backward fill for countries missing a few of the early year
sort CountryCode year
foreach country in "ARE" "VUT" "SLE" "NPL" "AGO" {
replace GNI = GNI[_n+1] if CountryCode == "`country'" & missing(GNI) & !missing(GNI[_n+1])
}
sort CountryCode year
foreach country in "AGO" "VUT" {
replace GNI = GNI[_n+1] if CountryCode == "`country'" & missing(GNI) & !missing(GNI[_n+1])
}
* After applying imputation techniques 18 countries (Cape Verde, Central African Republic, Cote d'Ivoire, Ethiopia, Gambia, Georg
save "imputation.dta", replace

//EXPLORATORY DATA ANALYSIS (EDA)//
*Exploring the data visually and statistically.
summarize GNI CBA

* Generate the means of GNI and CBA by year
egen mean_GNI = mean(GNI), by(year)
egen mean_CBA = mean(CBA), by(year)

* Graph the means on two y-axes
twoway (line mean_GNI year, yaxis(1)) (line mean_CBA year, yaxis(2)), ///
ytitle("GNI", axis(1)) ///
ytitle("CBA", axis(2)) ///
xlabel(2000(2)2022) ///  Set x-axis labels to increment by 2 years from 2000 to 2022
ylabel(, axis(1)) ylabel(, axis(2)) /// Adjust these to fit your specific y-axis scale for both GNI and CBA
legend(label(1 "GNI") label(2 "CBA")) ///
title("Trends in GNI and CBA Over Time (2000-2022)")
//this tell me that the relationship is non-linear, which is why I will use a second order polynomial in my regression analysis.

use "imputation.dta", replace

*Scatterplot
scatter CBA GNI, mlabel(CountryCode) title("Scatter Plot of GNI vs. CBA") xtitle("Gross National Income (GNI)") ytitle("CBA CO2
```

```
pwcorr GNI CBA //The correlation coefficient of approximately 0.77 indicates a strong positive correlation between these variables

//DATA TRANSFORMATION//
*Depending on the initial analysis, we might need to transform the data (e.g., log transformation) to meet the assumptions of regre

*Generate a Numeric Country Identifier
egen Country2 = group(Country)
codebook Country2
xtset Country2 year //Declares Country2 and year as the panel identifiers (country and time, respectively), setting up the data for p

*Generating logvariables
gen log_GNI = log(GNI)
gen log_CBA = log(CBA)

scatter log_CBA log_GNI, mlabel(CountryCode) title("Scatter Plot of GNI vs. CBA") xtitle("Gross National Income (GNI)") ytitle("CI

correlate log_GNI log_CBA //a correlation of 0.8099, indicating a strong positive relationship.

* Ordering dataset
order Country2 CountryCode year GNI log_GNI CBA log_CBA Country Region IncomeGroup

//MODEL CHECKING//
*Assess the fit and assumptions of the regression models, such as checking for heteroscedasticity, autocorrelation, and multicollin

*Fitting the regression model
xtset Country2 year
xtreg log_CBA log_GNI, re // The panel regression model reveals that Gross National Income is a strong predictor of CO2 emissio

*Heteroscedasticity test
reg log_CBA log_GNI
estat hettest //there is significant evidence of heteroscedasticity in the regression model,ie. the residuals (errors) is not constant ac
regress log_CBA log_GNI, robust //applying robust standard errors to ensure that the standard errors are reliable even when there

*Checking for autocorrelation in the residuals
xtset CountryCode year
xtreg log_CBA log_GNI, fe
predict residuals, residuals
predict fittedvalues, xb
scatter residuals fittedvalues, mlabel(CountryCode) title("Plot of Residuals vs. Fitted Values") xtitle("Fitted Values") ytitle("Residua

graph box log_GNI
graph box log_CBA //My outliers were related to CBA

drop if inlist(CountryCode, "ETH", "MDA", "BLR", "ROU", "KAZ", "ZWE") //I drop the outliers based on the scatterplot of fitted_valu

drop residuals fittedvalues

save "transformed.dta", replace

//REGRESSION ANALYSIS//
use "/Users/mathie/Desktop/transformed.dta", clear
*I want to analyze how changes in Gross National Income (independent variable) are associated with Consumption-Based Accour

* Regression model with robust standard errors
gen log_GNI_sq = log_GNI^2  // Generates the squared term
xtreg log_CBA log_GNI log_GNI_sq, fe vce(robust) //A 1% increase in GNI is associated with an approximate 1.843% increase in
//Constant: 5.732511
//log_GNI: 1.842858
//log_GNI_sq: -0.0849058
```

```
scatter log_CBA log_GNI, || lfit log_CBA log_GNI, legend(label(1 "Data Points") label(2 "Fitted Line")) title(`"{stSerif:Relationship b

scatter log_CBA log_GNI_sq
//FORECASTING//
* Generate the log of ModifiedGNI
gen log_ModifiedGNI = log(ModifiedGNI)

* Calculate predicted log CBA
gen predicted_log_CBA = 5.732511 + 1.842858*log_ModifiedGNI - 0.0849058*log_ModifiedGNI^2

* Convert log predictions to actual predictions
gen predicted_CBA = exp(predicted_log_CBA)

keep if year == 2017
keep CountryCode Country GNI CBA ModifiedGNI predicted_CBA

* List the results
list CountryCode Country GNI CBA ModifiedGNI predicted_CBA

export excel using "/Users/mathie/Desktop/predicted_cba_final.xlsx", replace firstrow(variables)

/////ROBUSTNESS CHECK/////
use "/Users/mathie/Desktop/transformed.dta", clear
gen log_GNI_sq = log_GNI^2

*creating dummy-variables for each region and incomegroup to use them as interactionterms in the regression.
gen EAP = (Region == "East Asia & Pacific")
gen ECA = (Region == "Europe & Central Asia")
gen LCN = (Region == "Latin America & Caribbean")
gen MEA = (Region == "Middle East & North Africa")
gen NAC = (Region == "North America")
gen SAS = (Region == "South Asia")
gen SSF = (Region == "Sub-Saharan Africa")
gen HIC = (IncomeGroup == "High income")
gen UMIC = (IncomeGroup == "Upper middle income")
gen LMIC = (IncomeGroup == "Lower middle income")
gen LIC = (IncomeGroup == "Low income")

* Regression model with interaction terms between log_GNI, log_GNI_sq and incomegroups
xtreg log_CBA log_GNI log_GNI_sq HIC#(c.log_GNI c.log_GNI_sq) UMIC#(c.log_GNI c.log_GNI_sq) LMIC#(c.log_GNI c.log_GN

* Regression model with interaction terms between log_GNI, log_GNI_sq and regions
xtreg log_CBA log_GNI log_GNI_sq NAC#(c.log_GNI c.log_GNI_sq) ECA#(c.log_GNI c.log_GNI_sq) LCN#(c.log_GNI c.log_GNI_

*To test the model, I will do one with and without regional differences, trough single regressions
xtreg log_CBA log_GNI log_GNI_sq if EAP == 1, fe vce(robust) //Both GNI and its squared term are statistically significant. Increa
xtreg log_CBA log_GNI log_GNI_sq if ECA == 1, fe vce(robust) //Both terms are statistically significant. Similar to EAP, an increas
xtreg log_CBA log_GNI log_GNI_sq if LCN == 1, fe vce(robust) //Neither GNI nor its squared term is statistically significant. There
xtreg log_CBA log_GNI log_GNI_sq if MEA == 1, fe vce(robust) //Neither term is significant. Similar to LCN, no significant relations
xtreg log_CBA log_GNI log_GNI_sq if NAC == 1, fe vce(robust) //Very high coefficients for GNI and its squared term, but due to o
xtreg log_CBA log_GNI log_GNI_sq if SAS == 1, fe vce(robust) //Neither coefficient is significant. No significant relationship is fou
xtreg log_CBA log_GNI log_GNI_sq if SSF == 1, fe vce(robust) //GNI and its squared term are not significant, although the consta
```

Appendix 4: Modified GNI

Country	GNI	ModifiedGNI	Change in GNI
Burundi	751,194	1,123,547,646	1,048,428,249
Central African R	8,823,774	1,130,106,816	1,041,869,078
DR Congo	9,946,366	1,135,719,778	1,036,256,117
Niger	1,198,882	1,145,932,028	1,026,043,867
Madagascar	1,499,247	1,160,950,292	1,011,025,603
Chad	1,559,085	1,163,942,173	1,008,033,722
Sierra Leone	1,568,076	1,164,391,752	1,007,584,143
Rwanda	1,874,027	1,179,689,294	9,922,866,008
Gambia	1,890,803	1,180,528,089	9,914,478,061
Burkina Faso	1,903,889	1,181,182,379	9,907,935,154
Togo	1,972,567	1,184,616,273	9,873,596,215
Uganda	2,078,315	1,189,903,694	9,820,722,007
Mali	2,083,634	1,190,169,643	9,818,062,518
Guinea	2,371,891	1,204,582,498	9,673,933,968
Tanzania	2,414,417	1,206,708,797	9,652,670,978
Benin	2,901,445	1,231,060,202	9,409,156,929
Lesotho	2,920,962	1,232,036,057	9,399,398,376
Vanuatu	3,039,204	1,237,948,172	9,340,277,227
Senegal	3,168,078	1,244,391,855	9,275,840,399
Haiti	3,212,447	1,246,610,285	9,253,656,102
Nepal	3,530,738	1,262,524,853	9,094,510,416
Cameroon	3,623,474	1,267,161,668	9,048,142,272
Tajikistan	3,709,165	1,271,446,199	9,005,296,958
Cambodia	3,768,481	1,274,411,986	8,975,639,087
Kenya	4230,84	1,297,529,931	8,744,459,643
Ghana	4,686,814	1,320,328,626	8,516,472,687
Cote dIvoire	4,694,304	132,070,313	8,512,727,645
Pakistan	4,819,412	1,326,958,565	8,450,173,297
Congo	4,917,808	1,331,878,367	8,400,975,278
Bangladesh	4,997,565	1,335,866,211	8,361,096,842
Honduras	5,114,506	1,341,713,236	8,302,626,585
Mauritania	5,184,306	1,345,203,241	8,267,726,536
Nicaragua	5,610,007	1,366,488,298	8,054,875,969
India	6045,97	1,388,286,469	7,836,894,259
Samoa	6,056,211	138,879,851	7,831,773,848
Angola	6,772,569	1,424,616,404	7,473,594,907
Cape Verde	6,912,811	1,431,628,491	7,403,474,039
Morocco	7,799,584	1,475,967,171	6,960,087,238
Bolivia	8,001,017	1,486,038,816	6,859,370,786
El Salvador	8,139,187	1,492,947,307	679,028,588
Guatemala	8,147,872	1,493,381,532	6,785,943,632

Belize	8,312,509	1,501,613,407	6,703,624,881
Viet Nam	8,503,906	1,511,183,246	6,607,926,489
Philippines	8,884,509	1,530,213,419	6,417,624,763
Jamaica	9,700,729	1,571,024,383	6,009,515,123
Iraq	9900,08	1,580,991,939	5,909,839,554
Namibia	10147,99	1,593,387,682	5,785,882,123
Indonesia	10595,22	1,615,748,768	5,562,271,273
Tunisia	10618,97	1,616,936,283	5,550,396,123
Bhutan	10664,81	1,619,228,545	5,527,473,501
Egypt	10792,76	1,625,625,869	5,463,500,256
Ecuador	11406,45	1,656,310,585	5,156,653,097
Algeria	11633,27	1,667,651,554	5,043,243,412
Peru	11870,28	1,679,501,975	4,924,739,201
Ukraine	12032,75	1,687,625,692	4,843,502,033
Albania	12802,15	1,726,095,469	4,458,804,256
Georgia	12924,22	1,732,198,858	4,397,770,372
Armenia	12949,75	1,733,475,425	43,850,047
Paraguay	13143,46	174,316,098	4,288,149,151
Sri Lanka	13212,33	17,466,046	425,371,295
Botswana	13413,1	1,756,642,913	415,332,982
Bosnia and Herz	13469,71	1,759,473,488	4,125,024,067
Gabon	13562,9	176,413,313	4,078,427,651
South Africa	13563,67	1,764,171,515	4,078,043,794
Colombia	14089,49	1,790,462,375	3,815,135,195
Brazil	14207,2	1,796,347,811	3,756,280,838
China	14224,87	1,797,231,385	3,747,445,094
Iran	15181,86	1,845,080,962	3,268,949,332
Serbia	15536,1	1,862,792,718	3,091,831,766
Dominican Repu	15740,88	1,873,031,947	2,989,439,475
Lebanon	17737,81	1,972,878,555	19,909,734
Costa Rica	19114,75	2,041,725,498	1,302,503,973
Mexico	20060,88	2,089,031,777	8,294,411,794
Montenegro	20086,51	2,090,313,641	8,166,225,385
Bulgaria	20986,66	213,532,111	366,547,848
Uruguay	22105,25	2,191,250,279	-1,927,438,442
Mauritius	22690,28	2,220,501,925	-4,852,603,007
Argentina	22994,83	223,572,927	-6,375,337,511
Chile	23592,67	226,562,161	-9,364,571,534
Russia	25233,84	2,347,680,135	-1,757,042,401
Croatia	27206,49	2,446,312,273	-274,336,378
Hungary	28302,78	2,501,126,848	-3,291,509,532
Greece	28461,46	2,509,060,738	-3,370,848,432

Latvia	28601,68	2,516,072,073	-3,440,961,785
Poland	28688,34	2,520,405,027	-348,429,132
Slovakia	29599,15	2,565,945,345	-3,939,694,498
Seychelles	30187,34	2,595,355,188	-4,233,792,929
Portugal	32269,04	2,699,440,025	-5,274,641,302
Lithuania	32541,24	2,713,049,867	-5,410,739,717
Bahamas	32551,22	271,354,882	-5,415,729,255
Oman	32981,26	2,735,051,113	-5,630,752,181
Estonia	32990,05	2,735,490,207	-5,635,143,125
Slovenia	35849,56	2,878,465,857	-7,064,899,625
Czech Republic	36626,67	2,917,321,637	-7,453,457,419
Cyprus	37246,57	2,948,316,268	-7,763,403,729
Israel	39139,08	3,042,942,064	-8,709,661,696
Malta	39144,14	3,043,194,721	-871,218,826
Spain	39565,06	306,424,078	-892,264,885
New Zealand	40618,38	3,116,906,869	-9,449,309,737
South Korea	41124,37	3,142,206,344	-9,702,304,487
Italy	41812,97	3,176,636,634	-1,004,660,739
Japan	42977,43	323,485,931	-1,062,883,415
United Kingdom	45552,73	3,363,624,578	-1,191,648,683
France	45584,57	3,365,216,491	-1,193,240,596
Bahrain	46185,09	3,395,242,483	-1,223,266,588
Australia	47092,19	3,440,597,521	-1,268,621,626
Finland	47593,89	3,465,682,298	-1,293,706,403
Canada	47702,71	3,471,123,673	-1,299,147,778
Saudi Arabia	48263,34	3,499,154,947	-1,327,179,052
Belgium	50904,69	3,631,222,402	-1,459,246,507
Sweden	52868,78	3,729,426,898	-1,557,451,003
Austria	53665,03	3,769,239,281	-1,597,263,386
Germany	54335,96	3,802,786,088	-1,630,810,193
Netherlands	54455,46	3,808,761,133	-1,636,785,238
Denmark	56568,42	3,914,408,742	-1,742,432,847
United States	61163,33	4,144,154,293	-1,972,178,398
Ireland	62004,39	4,186,207,311	-2,014,231,416
Hong Kong	62442,17	4,208,096,695	-20,361,208
Brunei	63747,36	4,273,356,015	-210,138,012
Norway	66942,35	4,433,105,277	-2,261,129,382
Switzerland	67250,54	4,448,514,982	-2,276,539,087
United Arab Emi	71688,9	4,670,432,985	-249,845,709
Luxembourg	82296,95	520,083,551	-3,028,859,615

Appendix 5: Predicted CBA

Country	GNI	ModifiedGNI	Change in GNI	CBA	predicted_CBA	Change in CBA
Burundi	751,194	1,123,547,646	1,048,428,249	369021,5	5,579,442	5210420,5
Central African R	8,823,774	1,130,106,816	1,041,869,078	1,980,551	5587844,5	3607293,5
DR Congo	9,946,366	1,135,719,778	1,036,256,117	1,015,982	5594984,5	4579002,5
Niger	1,198,882	1,145,932,028	1,026,043,867	1,298,564	5607842,5	4309278,5
Madagascar	1,499,247	1,160,950,292	1,011,025,603	1,268,783	5626463,5	4357680,5
Chad	1,559,085	1,163,942,173	1,008,033,722	2,688,527	5,630,135	2,941,608
Sierra Leone	1,568,076	1,164,391,752	1,007,584,143	916059,1	5630682,5	4714623,4
Rwanda	1,874,027	1,179,689,294	9,922,866,008	635870,9	5,649,228	5013357,1
Gambia	1,890,803	1,180,528,089	9,914,478,061	1,001,067	5,650,236	4,649,169
Burkina Faso	1,903,889	1,181,182,379	9,907,935,154	1,339,054	5,651,017	4,311,963
Togo	1,972,567	1,184,616,273	9,873,596,215	1,514,978	5,655,125	4,140,147
Uganda	2,078,315	1,189,903,694	9,820,722,007	1,187,224	5,661,417	4,474,193
Mali	2,083,634	1,190,169,643	9,818,062,518	3,663,474	5661735,5	1998261,5
Guinea	2,371,891	1,204,582,498	9,673,933,968	1,811,457	5678677,5	3867220,5
Tanzania	2,414,417	1,206,708,797	9,652,670,978	1,662,948	5,681,153	4,018,205
Benin	2,901,445	1,231,060,202	9,409,156,929	1,351,500	5709053,5	4357553,5
Lesotho	2,920,962	1,232,036,057	9,399,398,376	1,897,587	5710158,5	3812571,5
Vanuatu	3,039,204	1,237,948,172	9,340,277,227	1,452,696	5,716,801	4,264,105
Senegal	3,168,078	1,244,391,855	9,275,840,399	1,597,581	5723996,5	4126415,5
Haiti	3,212,447	1,246,610,285	9,253,656,102	1,248,189	5,726,459	4,478,270
Nepal	3,530,738	1,262,524,853	9,094,510,416	1,722,931	5,743,945	4,021,014
Cameroon	3,623,474	1,267,161,668	9,048,142,272	1,552,323	5,748,976	4,196,653
Tajikistan	3,709,165	1,271,446,199	9,005,296,958	1,626,324	5,753,605	4,127,281
Cambodia	3,768,481	1,274,411,986	8,975,639,087	2,338,817	5,756,794	3,417,977
Kenya	4230,84	1,297,529,931	8,744,459,643	1,506,605	5781282,5	4274677,5
Ghana	4,686,814	1,320,328,626	8,516,472,687	1,492,459	5804806,5	4312347,5
Cote dIvoire	4,694,304	132,070,313	8,512,727,645	1,298,801	5805188,5	4506387,5
Pakistan	4,819,412	1,326,958,565	8,450,173,297	2,421,736	5,811,531	3,389,795
Congo	4,917,808	1,331,878,367	8,400,975,278	3,886,582	5816493,5	1929911,5
Bangladesh	4,997,565	1,335,866,211	8,361,096,842	1,101,317	5820488,5	4719171,5
Honduras	5,114,506	1,341,713,236	8,302,626,585	1,697,142	5826325,5	4129183,5
Mauritania	5,184,306	1,345,203,241	8,267,726,536	1,955,251	5,829,788	3,874,537
Nicaragua	5,610,007	1,366,488,298	8,054,875,969	2,553,916	5,850,613	3,296,697
India	6045,97	1,388,286,469	7,836,894,259	2,019,896	5,871,434	3,851,538
Samoa	6,056,211	138,879,851	7,831,773,848	2,285,669	5871915,5	3586246,5
Angola	6,772,569	1,424,616,404	7,473,594,907	2,816,708	5905036,5	3088328,5
Cape Verde	6,912,811	1,431,628,491	7,403,474,039	1,251,557	5,911,370	4,659,813
Morocco	7,799,584	1,475,967,171	6,960,087,238	2,272,222	5950323,5	3678101,5
Bolivia	8,001,017	1,486,038,816	6,859,370,786	6,898,706	5958909,5	-939796,5
El Salvador	8,139,187	1,492,947,307	679,028,588	2,311,836	5964748,5	3652912,5
Guatemala	8,147,872	1,493,381,532	6,785,943,632	2,429,501	5965118,5	3535617,5

Belize	8,312,509	1,501,613,407	6,703,624,881	3,436,034	5972017,5	2535983,5
Viet Nam	8,503,906	1,511,183,246	6,607,926,489	2,169,802	5,979,962	3,810,160
Philippines	8,884,509	1,530,213,419	6,417,624,763	2,353,504	5995522,5	3642018,5
Jamaica	9,700,729	1,571,024,383	6,009,515,123	4,605,094	6027857,5	1422763,5
Iraq	9900,08	1,580,991,939	5,909,839,554	9,222,913	6035548,5	-3187364,5
Namibia	10147,99	1,593,387,682	5,785,882,123	6,512,558	6045001,5	-467556,5
Indonesia	10595,22	1,615,748,768	5,562,271,273	3,166,973	6061748,5	2894775,5
Tunisia	10618,97	1,616,936,283	5,550,396,123	3,151,101	6062627,5	2911526,5
Bhutan	10664,81	1,619,228,545	5,527,473,501	3,445,670	6,064,322	2,618,652
Egypt	10792,76	1,625,625,869	5,463,500,256	3,961,509	6069025,5	2107516,5
Ecuador	11406,45	1,656,310,585	5,156,653,097	3,910,175	6,091,164	2,180,989
Algeria	11633,27	1,667,651,554	5,043,243,412	5,738,174	6,099,174	361,000
Peru	11870,28	1,679,501,975	4,924,739,201	3,144,839	6,107,445	2,962,606
Ukraine	12032,75	1,687,625,692	4,843,502,033	5,048,467	6113062,5	1064595,5
Albania	12802,15	1,726,095,469	4,458,804,256	3,908,651	6139025,5	2230374,5
Georgia	12924,22	1,732,198,858	4,397,770,372	4,386,238	6143054,5	1756816,5
Armenia	12949,75	1,733,475,425	43,850,047	3,829,788	6143892,5	2314104,5
Paraguay	13143,46	174,316,098	4,288,149,151	4,727,865	6150229,5	1422364,5
Sri Lanka	13212,33	17,466,046	425,371,295	2,438,945	6152464,5	3713519,5
Botswana	13413,1	1,756,642,913	415,332,982	8,408,872	6158945,5	-2249926,5
Bosnia and Herz	13469,71	1,759,473,488	4,125,024,067	7,839,546	6,160,761	-1,678,785
Gabon	13562,9	176,413,313	4,078,427,651	7,509,919	6163734,5	-1346184,5
South Africa	13563,67	1,764,171,515	4,078,043,794	7,780,468	6,163,764	-1,616,704
Colombia	14089,49	1,790,462,375	3,815,135,195	3,611,518	6,180,304	2,568,786
Brazil	14207,2	1,796,347,811	3,756,280,838	5,282,279	6183947,5	901668,5
China	14224,87	1,797,231,385	3,747,445,094	8,007,102	6,184,496	-1,822,606
Iran	15181,86	1,845,080,962	3,268,949,332	9,563,036	6213333,5	-3349702,5
Serbia	15536,1	1,862,792,718	3,091,831,766	7,799,066	6,223,670	-1,575,396
Dominican Repu	15740,88	1,873,031,947	2,989,439,475	3,289,572	6,229,567	2,939,995
Lebanon	17737,81	1,972,878,555	19,909,734	6,131,239	6284110,5	152871,5
Costa Rica	19114,75	2,041,725,498	1,302,503,973	4,076,577	6318809,5	2242232,5
Mexico	20060,88	2,089,031,777	8,294,411,794	5,140,715	6341381,5	1200666,5
Montenegro	20086,51	2,090,313,641	8,166,225,385	5,647,236	6,341,980	694,744
Bulgaria	20986,66	213,532,111	366,547,848	8,474,225	6,362,523	-2,111,702
Uruguay	22105,25	2,191,250,279	-1,927,438,442	9,713,853	6,386,889	-3,326,964
Mauritius	22690,28	2,220,501,925	-4,852,603,007	6,544,200	6399137,5	-145062,5
Argentina	22994,83	223,572,927	-6,375,337,511	7,935,810	6405389,5	-1530420,5
Chile	23592,67	226,562,161	-9,364,571,534	6,570,135	6417398,5	-152736,5
Russia	25233,84	2,347,680,135	-1,757,042,401	10,647,800	6448742,5	-4199057,5
Croatia	27206,49	2,446,312,273	-274,336,378	5,550,552	6483447,5	932895,5
Hungary	28302,78	2,501,126,848	-3,291,509,532	5,935,093	6501440,5	566347,5
Greece	28461,46	2,509,060,738	-3,370,848,432	8,955,192	6503970,5	-2451221,5

Latvia	28601,68	2,516,072,073	-3,440,961,785	8,317,012	6506191,5	-1810820,5
Poland	28688,34	2,520,405,027	-348,429,132	8,797,600	6,507,557	-2,290,043
Slovakia	29599,15	2,565,945,345	-3,939,694,498	8,472,450	6521591,5	-1950858,5
Seychelles	30187,34	2,595,355,188	-4,233,792,929	7,756,280	6530360,5	-1225919,5
Portugal	32269,04	2,699,440,025	-5,274,641,302	7,038,196	6559578,5	-478617,5
Lithuania	32541,24	2,713,049,867	-5,410,739,717	9,207,163	6563201,5	-2643961,5
Bahamas	32551,22	271,354,882	-5,415,729,255	8,425,026	6,563,333	-1,861,693
Oman	32981,26	2,735,051,113	-5,630,752,181	16,296,140	6568968,5	-9727171,5
Estonia	32990,05	2,735,490,207	-5,635,143,125	12,146,390	6569081,5	-5577308,5
Slovenia	35849,56	2,878,465,857	-7,064,899,625	7,557,815	6,603,855	-953,960
Czech Republic	36626,67	2,917,321,637	-7,453,457,419	8,602,666	6612551,5	-1990114,5
Cyprus	37246,57	2,948,316,268	-7,763,403,729	12,114,590	6,619,271	-5,495,319
Israel	39139,08	3,042,942,064	-8,709,661,696	13,871,090	6,638,654	-7,232,436
Malta	39144,14	3,043,194,721	-871,218,826	6,892,636	6638698,5	-253937,5
Spain	39565,06	306,424,078	-892,264,885	8,438,080	6,642,783	-1,795,297
New Zealand	40618,38	3,116,906,869	-9,449,309,737	17,746,610	6,652,667	-11,093,943
South Korea	41124,37	3,142,206,344	-9,702,304,487	13,859,220	6,657,249	-7,201,971
Italy	41812,97	3,176,636,634	-1,004,660,739	8,029,463	6,663,309	-1,366,154
Japan	42977,43	323,485,931	-1,062,883,415	11,423,200	6,673,121	-4,750,079
United Kingdom	45552,73	3,363,624,578	-1,191,648,683	10,396,160	6,692,987	-3,703,173
France	45584,57	3,365,216,491	-1,193,240,596	9,452,440	6,693,217	-2,759,223
Bahrain	46185,09	3,395,242,483	-1,223,266,588	22,237,350	6697501,5	-15539848,5
Australia	47092,19	3,440,597,521	-1,268,621,626	22,713,270	6703738,5	-16009531,5
Finland	47593,89	3,465,682,298	-1,293,706,403	12,179,330	6,707,070	-5,472,260
Canada	47702,71	3,471,123,673	-1,299,147,778	20,218,730	6,707,780	-13,510,950
Saudi Arabia	48263,34	3,499,154,947	-1,327,179,052	20,926,330	6,711,389	-14,214,941
Belgium	50904,69	3,631,222,402	-1,459,246,507	12,731,920	6,727,069	-6,004,851
Sweden	52868,78	3,729,426,898	-1,557,451,003	11,323,080	6737412,5	-4585667,5
Austria	53665,03	3,769,239,281	-1,597,263,386	8,597,659	6741307,5	-1856351,5
Germany	54335,96	3,802,786,088	-1,630,810,193	10,777,110	6744464,5	-4032645,5
Netherlands	54455,46	3,808,761,133	-1,636,785,238	13,251,840	6745011,5	-6506828,5
Denmark	56568,42	3,914,408,742	-1,742,432,847	11,415,420	6,754,139	-4,661,281
United States	61163,33	4,144,154,293	-1,972,178,398	23,945,980	6770435,5	-17175544,5
Ireland	62004,39	4,186,207,311	-2,014,231,416	15,373,020	6,772,935	-8,600,085
Hong Kong	62442,17	4,208,096,695	-20,361,208	27,726,540	6774181,5	-20952358,5
Brunei	63747,36	4,273,356,015	-210,138,012	19,458,100	6777677,5	-12680422,5
Norway	66942,35	4,433,105,277	-2,261,129,382	16,343,790	6,784,914	-9,558,876
Switzerland	67250,54	4,448,514,982	-2,276,539,087	13,586,580	6,785,516	-6,801,064
United Arab Emi	71688,9	4,670,432,985	-249,845,709	19,274,620	6,792,541	-12,482,079
Luxembourg	82296,95	520,083,551	-3,028,859,615	16,113,750	6798373,5	-9315376,5