33609001

BSc Economics with Econometrics

IMS53018A: From National Statistics to Big Data

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Introduction

Environmental degradation is the deterioration of the environment through the depletion of natural resources such as fossil fuels, whose consumption releases toxic greenhouse gasses (GHG) into the atmosphere (Maurya et al., 2020). This project is set to analyse a possible correlation between economic growth, represented by GDP per capita and Environmental degradation, represented by CO2 emissions per capita, the main driver of GHG. Although CO2 has increased in atmospheric concentration by 30% circa from the start of the industrial revolution to 1992, researchers obtain contrasting results on the relationship between the two variables, especially in projects focused on individual countries, which neglect the diversity of income levels and ecological characteristics as determinants of diverse results (Heil and Selden, 2001). This project focuses on measuring the influence of GDP per capita on CO2 per capita by income level not by individual country, arguably attempting to solve these divergences. The research is divided into 3 sections focused on the inequalities of CO2 emissions per capita by income group, its evolution by economic development area (Global North and Global South) between 1995 and 2014, and quantitative regression analysis aimed at studying a possible correlation between economic development and environmental degradation.

Dataset Properties

The dataset for this project is based on 2014 data and was created from the air and GHG emissions indicator published by the Organisation of Economic Co-operation and Development (OECD) (2022), and from the Gross National Income (GNI) and Gross Domestic Product (GDP) per capita indicators published by the World Bank Group (WGB) (2020). The available sample for the project consists of 129 countries. The project reports the average CO2 emissions per capita in relation to GDP per capita of countries and examines contrasts between their income group and the others. The dataset is comprised of geographical characteristics such as their location in the world (Region), development such as location in the North-South divide (N-S_D) and GDP per capita, demographical characteristics such as population (POP), and of environmental indicators such as CO2 emissions per capita (CO2).

Section 1: Inequalities in CO2 emissions per capita by income group

To interpret this section, a one-variable analysis was applied to compare the frequency distributions of three income level groups and to examine the differences in CO2 emissions per capita between and within these income groups. As 2014 represents the year for analysis, the allocation of 129 countries in the income groups was determined by relying on the GNI per capita of 2013. Low income countries have a GNI of $1045 or less, middle income countries of more than $1045 but less than $12746, whereas the high income group corresponds to a GNI higher than $12746 (World Bank, 2014).

Table 1. Country GDP per capita and CO2 emissions per capita by income level (2014)

	No_Countries	GDPP_bar	CO2P_bar	GDPP_bar_rel	CO2P_bar_rel
High income	47	40533.20	9600.00	228.58%	193.48%
Low income	8	737.71	176.25	4.16%	3.55%
Middle income	74	5088.80	2533.11	28.70%	51.05%
Grand Total	**129**	**17732.81**	**4961.71**	**100.00%**	**100.00%**

References:

No_Countries: Number of countries in the sample for each income level

GDPP_bar: Average GDP per capita by income level (in USD)

CO2P_bar: Average CO2 emissions per capita by income level (in Kg)

GDPP_bar_rel: Income group average expressed as a proportion of total average (in %)

CO2P_bar_rel: Income group average expressed as a proportion of total average (in %)

Source: Own computation based on WBG (2020) and OECD (2022)

A pivot table (table 1) based on two variables was constructed, from which it can be inferred that the income groups define a development pattern, indeed a higher GDP per capita can be associated to a higher CO2 per capita, as indicated by the average GDP and CO2 emission per capita of the three income groups. Indeed, as shown in table 2, the high income group is overperforming in both GDP and CO2 emissions per capita by 128.58% and 93.48% respectively. On the other hand, middle income countries and low income countries are considerably underperforming in GDP per capita by -71.30% and -95.84% and in CO2 per capita by -48.95% and -96.45% respectively. Noticeably, Low income countries present higher differences with respect to the total average in CO2 emissions per capita then in GDP per capita because the income group has not yet entered an intensive process of development that requires high fossil fuel combustion (main driver of environmental degradation) and change in land use, moving away from subsistence farming towards industrial development and agricultural mechanisation which leads to a drastic increase in CO2 emissions per capita which exceeds the capacity of the earth's natural sinks to absorb them, as shown by the lower differences with respect to the total average in CO2 emissions per capita than in GDP per capita in middle income countries (Todaro and Smith, 2015). Inequalities of energy consumption by income group increased as human populations economically specialised and were able to exceed the CO2 emissions per capita threshold of survival which, beyond a certain threshold of income, continues to increase at a slower rate because the wealthiest are able to also purchase goods and services that have a relatively small energy content (Chancel, 2020). Indeed, as it can be inferred from table 2, high income countries

experience higher differences with respect to the total average in GDP per capita than in CO2 per capita, indicating a possible diminishing marginal propensity to emit (Heil and Selden, 2001).

Table 2. Country GDP per capita and CO2 emissions per capita by income level (2014)

	No_Countries	GDPP_bar_rel	CO2P_bar_rel	GDPP_bar_rel_dif	CO2P_bar_rel_dif
High income	47	228.58%	193.48%	128.58%	93.48%
Low income	8	4.16%	3.55%	-95.84%	-96.45%
Middle income	74	28.70%	51.05%	-71.30%	-48.95%
Grand Total	**129**	**100.00%**	**100.00%**	**0.00%**	**0.00%**

References:

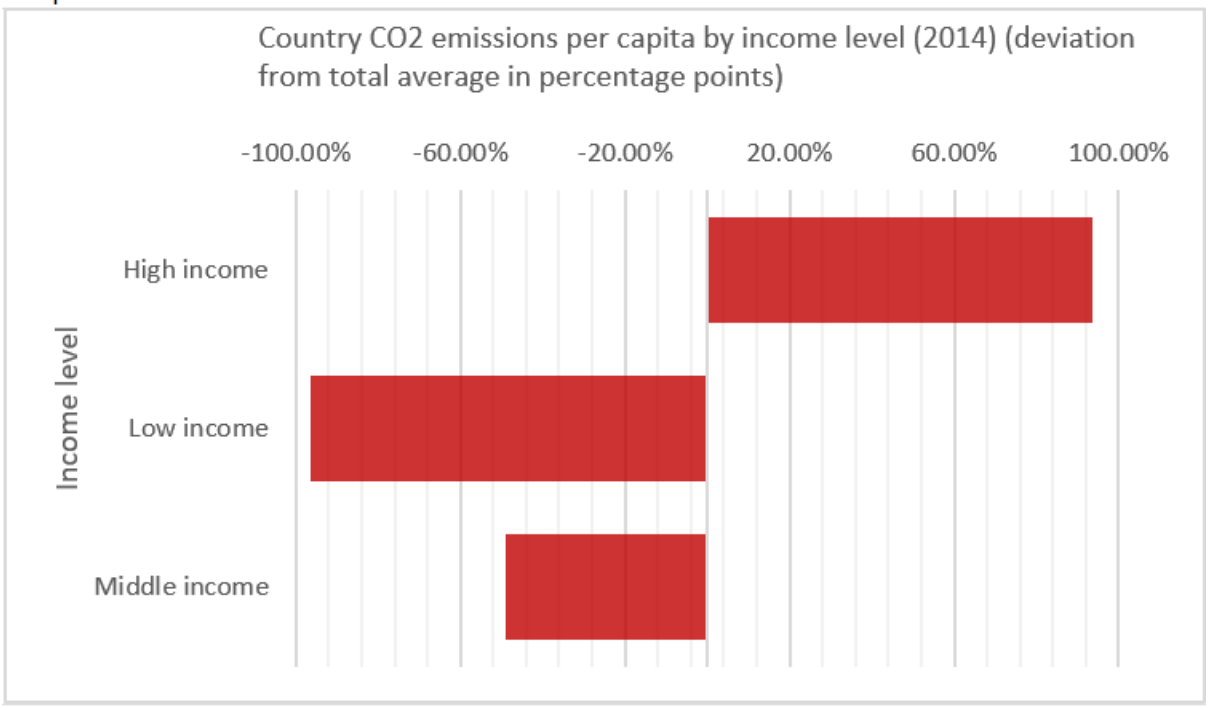
GDPP_bar_rel_dif: Differences by income level with respect to total average (in percentage points)

CO2P_bar_rel_dif: Differences by income level with respect to total average (in percentage points)

Source: Own computation based on WBG (2020) and OECD (2022)

Subsequently, the CO2 emissions per capita differences by income level with respect to the total average were represented graphically, through a bar chart (Graph 1), from which it can be clearly inferred, as mentioned before that high income countries are overperforming emitting more CO2 per capita than middle and low income countries, which are underperforming, as their average values are lower than the total average of 17732.81 kg. Indeed, according to table 1, the high income group emits 6.96 times as much CO2 per capita as the middle and low income groups combined.

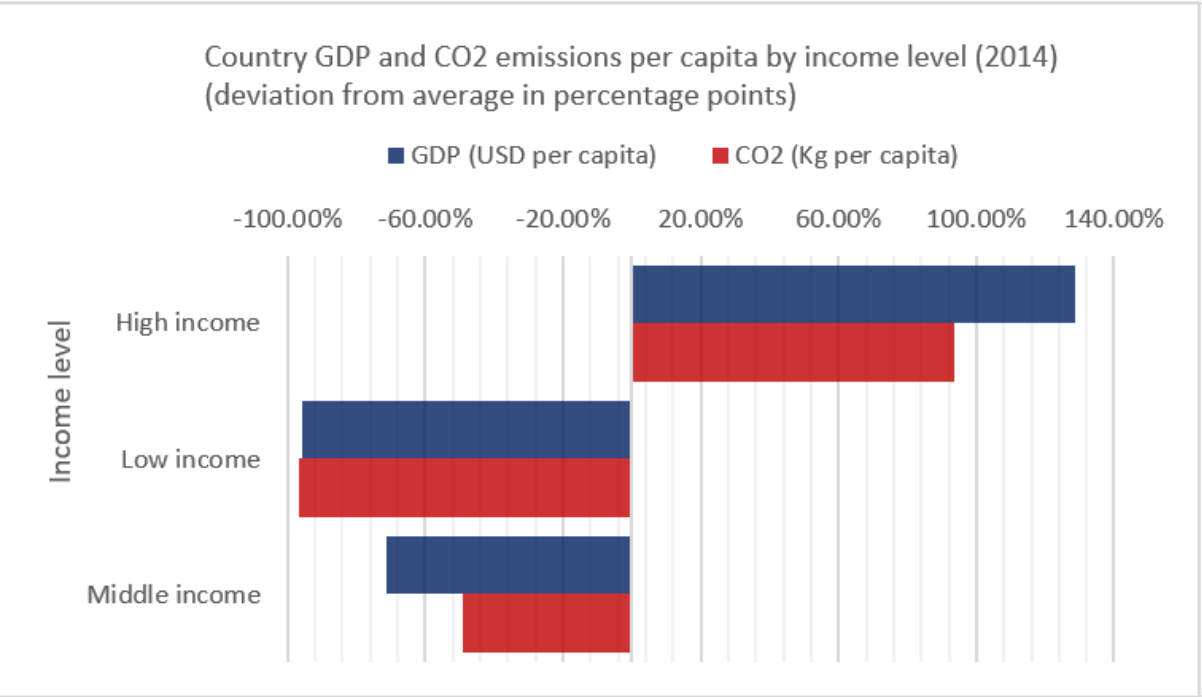
Graph 1.



Source: Own computation based on WBG (2020) and OECD (2022)

To analyse a possible correlation between CO2 emissions per capita and GDP per capita further graphically, another bar chart (Graph 2) was constructed, by adding GDP per capita differences by income level with respect to the total average to Graph 1, to compare the two variables.

Graph 2.



Source: Own computation based on WBG (2020) and OECD (2022)

Graph 2 shows that GDP and CO2 per capita are not homogeneous among the income groups and shows clearly a possible correlation between the two variables as an increase in GDP per capita is paired by an increase in CO2 emissions per capita as shown by the low and middle income groups until it reaches a possible income threshold that slows down CO2 emissions per capita as shown by the CO2 per capita deviations from the total average in the high income group. The implications of Graph 2 align with the observations of Table 1, indeed the average CO2 emissions per capita in low income countries is 0.24 times bigger than the average GDP per capita, in middle income countries the ratio increases to 0.49, whereas in high income countries it decreases again to 0.24. The ratio is also known as Carbon intensity, and it is used to measure the amount of CO2 (kg) consumed per unit of GDP (USD), reflecting both the income groups level of CO2 efficiency and their overall economic structure. Middle income countries are usually dominated by heavy industrial production which leads to a higher carbon intensity than high income countries that specialise in the lower-carbon service sectors and rely on middle income countries for industrial exports (Baumert et al., 2005).

Having compared the income groups to the overall average thus far, it was necessary to compare them with each other. The maximum and minimum value for each income group was computed and frequency distribution tables were constructed for CO2 per capita (Table 3) and GDP per capita (Table 4), allowing to find the respective relative frequencies, which were used for analysis and graphical interpretations. It can be inferred from Table 3 that in the low and middle income groups the data is

relatively less spread out and it is concentrated on a lower location than the high income group which is relatively more evenly spread out. In Table 4, the pattern is similar hinting at a possible correlation between the two variables. To clearly represent these patterns, two histograms were created for Table 3 (Graph 3) and Table 4 (Graph 4) to analyse their respective skewness.

Table 3. Frequency distribution for CO2 emissions per capita (Kg)

		High Income		Middle Income		Low Income	
more than	up to	Frequency	Rel. Freq.	Frequency	Rel. Freq.	Frequency	Rel. Freq.
0	5000	11	0.234	62	0.838	8	1.000
5000	10000	21	0.447	11	0.149	0	0.000
10000	15000	4	0.085	1	0.014	0	0.000
15000	20000	8	0.170	0	0.000	0	0.000
20000	25000	2	0.043	0	0.000	0	0.000
25000	30000	0	0.000	0	0.000	0	0.000
30000	35000	1	0.021	0	0.000	0	0.000
Total		47	1.000	74	1.000	8	1.000

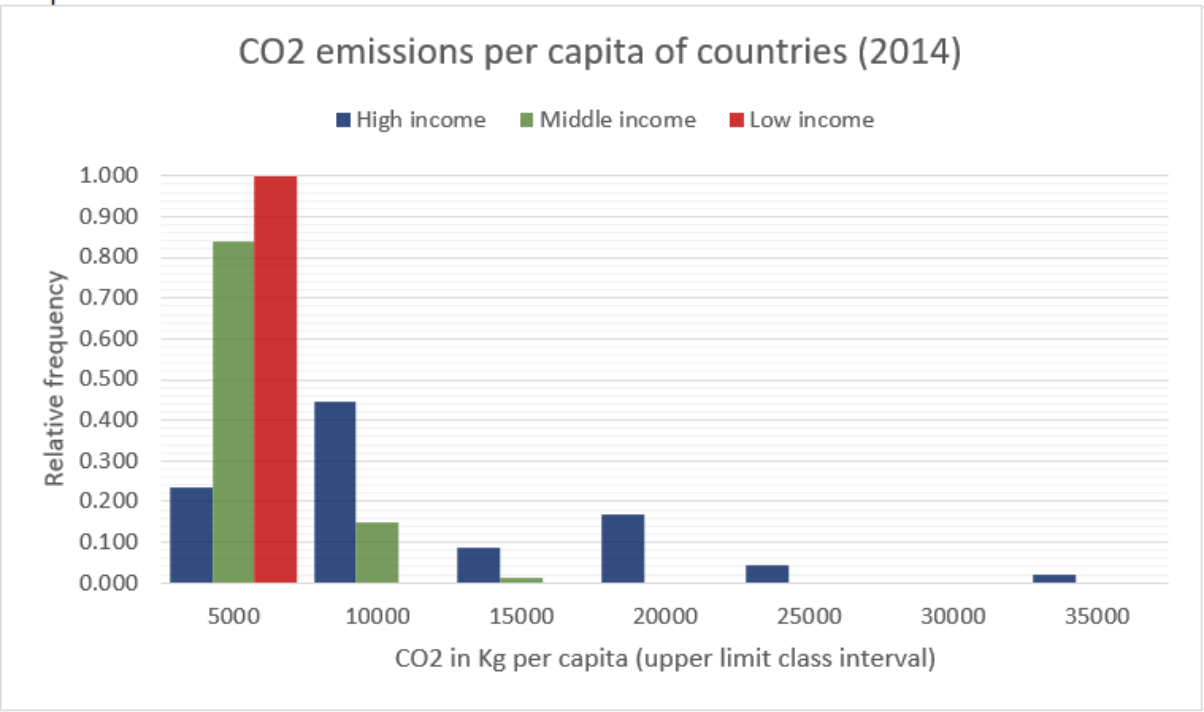
Source: Own computation based on WBG (2020) and OECD (2022)

Table 4. Frequency distribution for GDP per capita (USD)

		High Income		Middle Income		Low Income	
more than	up to	Frequency	Rel. Freq.	Frequency	Rel. Freq.	Frequency	Rel. Freq.
0	10000	0	0.000	65	0.878	8	1.000
10000	20000	10	0.213	9	0.122	0	0.000
20000	30000	11	0.234	0	0.000	0	0.000
30000	40000	3	0.064	0	0.000	0	0.000
40000	50000	8	0.170	0	0.000	0	0.000
50000	60000	8	0.170	0	0.000	0	0.000
60000	70000	3	0.064	0	0.000	0	0.000
70000	80000	0	0.000	0	0.000	0	0.000
80000	90000	2	0.043	0	0.000	0	0.000
90000	100000	1	0.021	0	0.000	0	0.000
100000	110000	0	0.000	0	0.000	0	0.000
110000	120000	0	0.000	0	0.000	0	0.000
120000	130000	1	0.021	0	0.000	0	0.000
Total		47	1.000	74	1.000	8	1.000

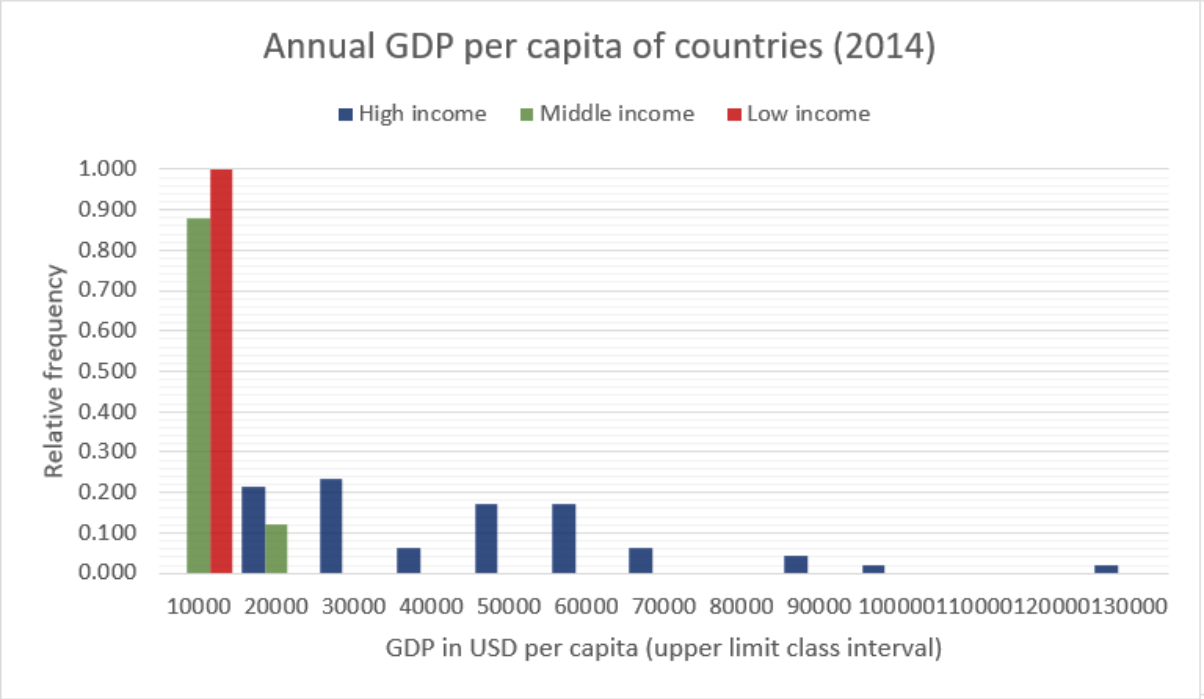
Source: Own computation based on WBG (2020) and OECD (2022)

Graph 3.



Source: Own computation based on WBG (2020) and OECD (2022)

Graph 4.



Source: Own computation based on WBG (2020) and OECD (2022)

As it can be seen from Graph 3 and 4, the CO2 emissions per capita in the high, middle and low income groups are all positively skewed because their median is below their mean (Table 5). Similarly, GDP per capita is positively skewed in every group (Table 6). Nevertheless, as stated above, the high income group is more evenly distributed in both graphs, as 31.9% of the CO2 per capita observations are located between 10000 kg and 35000 kg (1.4% and 0% in middle and low income groups respectively). 55.3% of GDP per capita observations are located between $30000 and $130000 in the high income group, whereas 0% of the observations are located in that range in the middle and low income groups. An important limitation of the analysis is shown by the presence of outliers in such diverse groups comprised of countries having different natural resources and endowments such as fossil fuels. Indeed, even though two countries would be identical in terms of energy intensity, CO2 emissions would certainly be higher in the country that relies more heavily on coal than the other (Baumert et al., 2005). In Graph 5 and 6, middle and low income countries seem to have a steady relationship between the median and average position of GDP per capita and CO2 emissions per capita. Contrary, in the high income group GDP per capita Boxplot, the mean is significantly closer to the median than in the CO2 per capita Boxplot, showing that an important amount of countries in the group does not emit as much CO2 as expected, due to their economic structure and fuel mix in energy supply. Therefore, a study on individual countries on economic development associated to environmental degradation can only suffice to a certain degree of significance. A study on countries divided by income level aims to compensate for the difference in natural endowments.

Table 5.

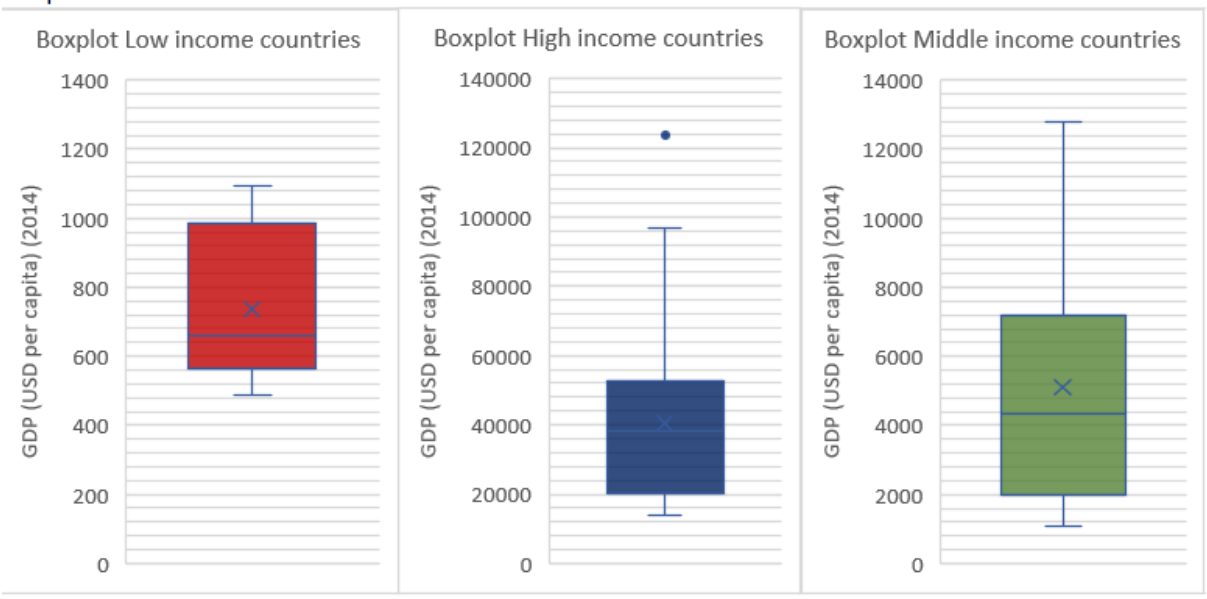
CO2 emissions per capita by income level (Kg)

	High income	Middle income	Low income
min	1820.00	260.00	60.00
max	31290.00	11440.00	420.00
mean	9600.00	2533.11	176.25
Range	29470.00	11180.00	360.00
Std. Dev.	6129.35	2287.72	111.60
Bottom 20%	4704.00	726.00	100.00
Bottom 25%	5315.00	812.50	100.00
Median	7340.00	1770.00	160.00
Bottom 75%	14070.00	3415.00	197.50
Bottom 80%	15578.00	3612.00	208.00
Bottom 99%	27140.80	9023.70	406.00
IQR	8755.00	2602.50	97.50
Ratio 80_20	3.31	4.98	2.08

Source: Own computation based on WBG (2020) and OECD (2022)

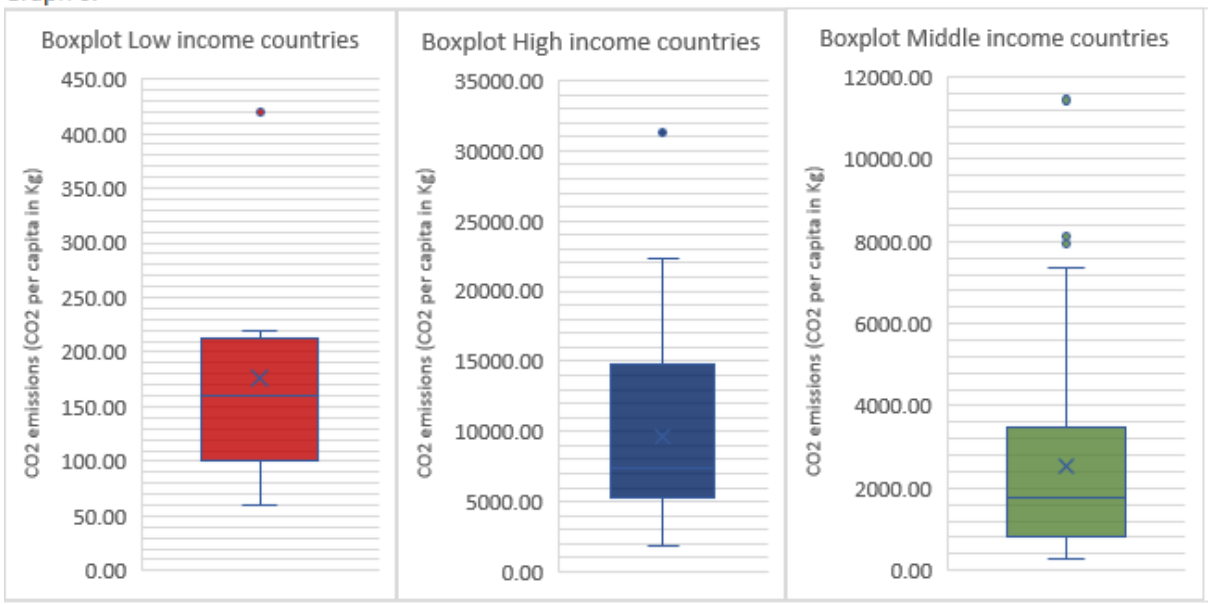
Table 6.			
GDP per capita by income level (USD)			
	High income	Middle income	Low income
min	13762.37	1104.17	486.79
max	123514.20	12807.26	1093.50
mean	40533.20	5088.80	737.71
Range	109751.82	11703.09	606.71
Std. Dev.	24021.36	3350.69	226.48
Bottom 20%	19919.78	1654.59	565.53
Bottom 25%	20252.53	2016.77	566.34
Median	38475.40	4351.27	657.45
Bottom 75%	52273.84	7097.21	891.16
Bottom 80%	54955.34	7656.77	955.99
Bottom 99%	111326.49	12799.09	1089.06
IQR	32021.31	5080.44	324.82
Ratio 80_20	2.76	4.63	1.69
Source: Own computation based on WBG (2020) and OECD (2022)			

Graph 5.



Source: Own computation based on WBG (2020) and OECD (2022)

Graph 6.



Source: Own computation based on WBG (2020) and OECD (2022)

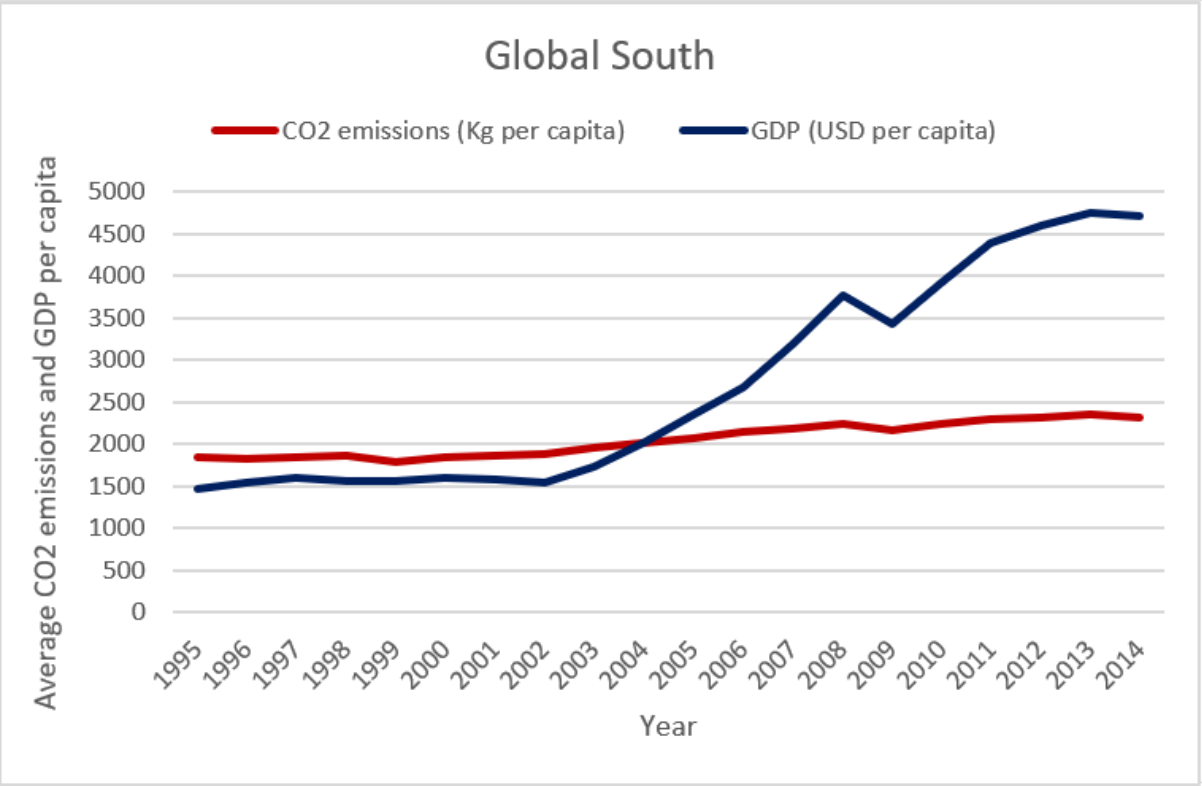
Section 2: Evolution of CO2 emissions per capita by economic development areas

To analyse the recent evolution of average CO2 emissions per capita in relation to GDP per capita, representing economic development, it was necessary to divide the sample of 126 countries (Myanmar and Syria were excluded from the time series due to grave political and economic instability that would have impacted on the research accuracy, whereas Montenegro was excluded due to lack of data) into two groups: Global North (high income) and Global South (low and middle income). The grouping of low and middle income countries was necessary because it is common for countries in long periods of time to reach the middle income GNI threshold of $1045, becoming lower middle income countries, i.e. middle income, impacting on the results of the time series as those countries present values of a middle income group member but are still located in the low income group in the analysis. Furthermore, as the low income group is comprised of only 8 countries (7 without Myanmar), uniting it with middle income countries would only strengthen the results, necessary for understanding the correlation between GDP per capita and CO2 emissions per capita in the long run through economic development lens.

The North-South divide theory depicts an economic and political dependency between economically developed and technological countries in the North and economically backward agrarian countries in the South. The latter were colonies of the former and still are indirectly, as the south is dominated in international trade and politics (O'hara, 2004). Nowadays the North-South divide is obsolete and outdated, as the Brandt Line, or the line of partition between the two global regions, proposed in 1980, has succumbed to globalisation that intensified economic and political relationships across borders, causing a concomitant diminution in the significance of territorial boundaries. Globalisation has led to countries once located in the South, such as South Korea and China, to become increasingly technologically advanced and invest in industrial activities and services rather than focusing on the export of primary products (Kacowicz, 2007). However, the Global North and South can be understood to be rather than geographic regions, economic areas displaying different relative power and wealth of countries in distinct parts of the world and their modern interdependency does not exclusively rely on primary products but also secondary (Alison at al., 2019). Nevertheless, this study does not consider solely economic development, but social development as well measured in GNI and GDP per capita, rather than GDP alone. The constructed North-South divide of this research still mostly reflects the old model, and it is relevant to the argument because it is based on the evolution of economic development, a process much more extensive than simple economic growth, which has not dramatically changed in the period that will be analysed, between 1995 and 2014.

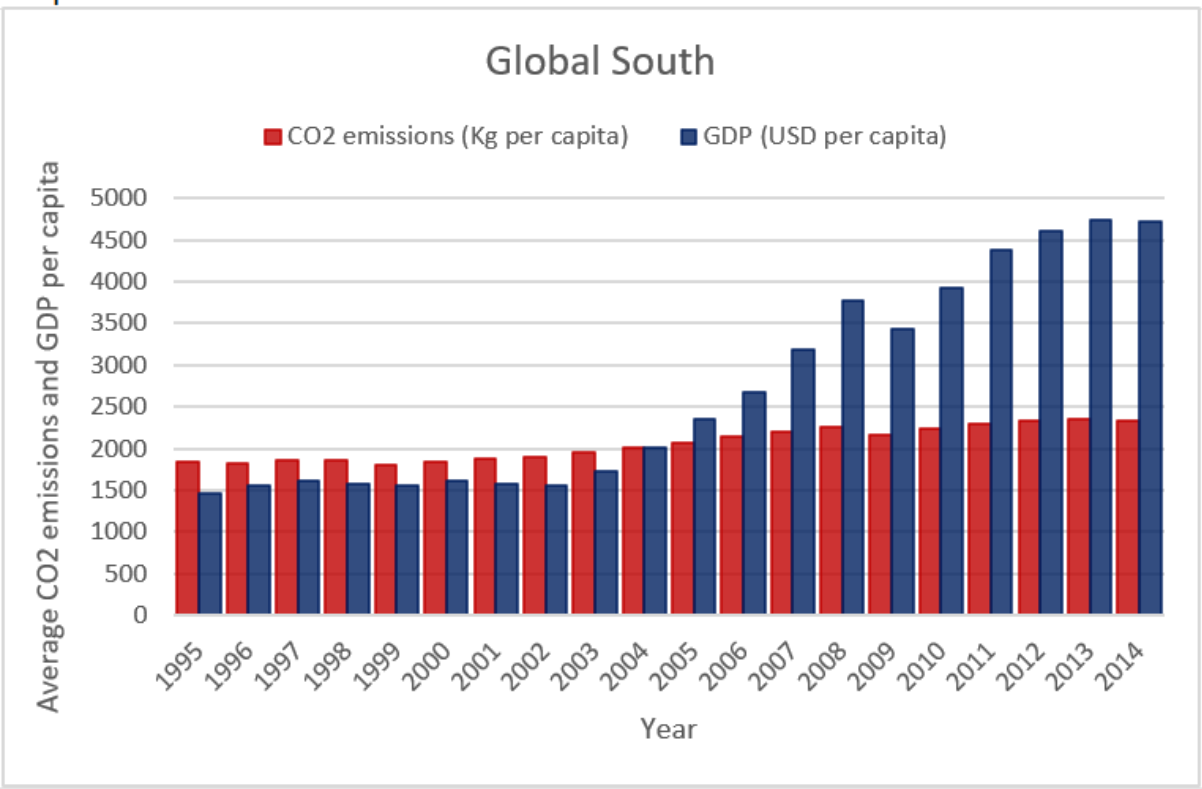
Graphs 7 and 8 represent average CO2 emissions per capita and GDP per capita in the Global South, which further hints at a correlation between the two variables, indeed in 1999 the GDP per capita of the Global South increased slightly accompanied by a rise in CO2 emissions. The 2001 financial recession rebalanced the GDP per capita level until 2002, when it exploded, increasing drastically and possibly leading to a higher CO2 per capita, as shown by the graphs. The 2008 recession led to a decrease in GDP per capita, arguably slowing down the increase in emissions which in the following years rose back up, as did GDP per capita, even if in different proportions.

Graph 7.



Source: Own computation based on WBG (2020) and OECD (2022)

Graph 8.



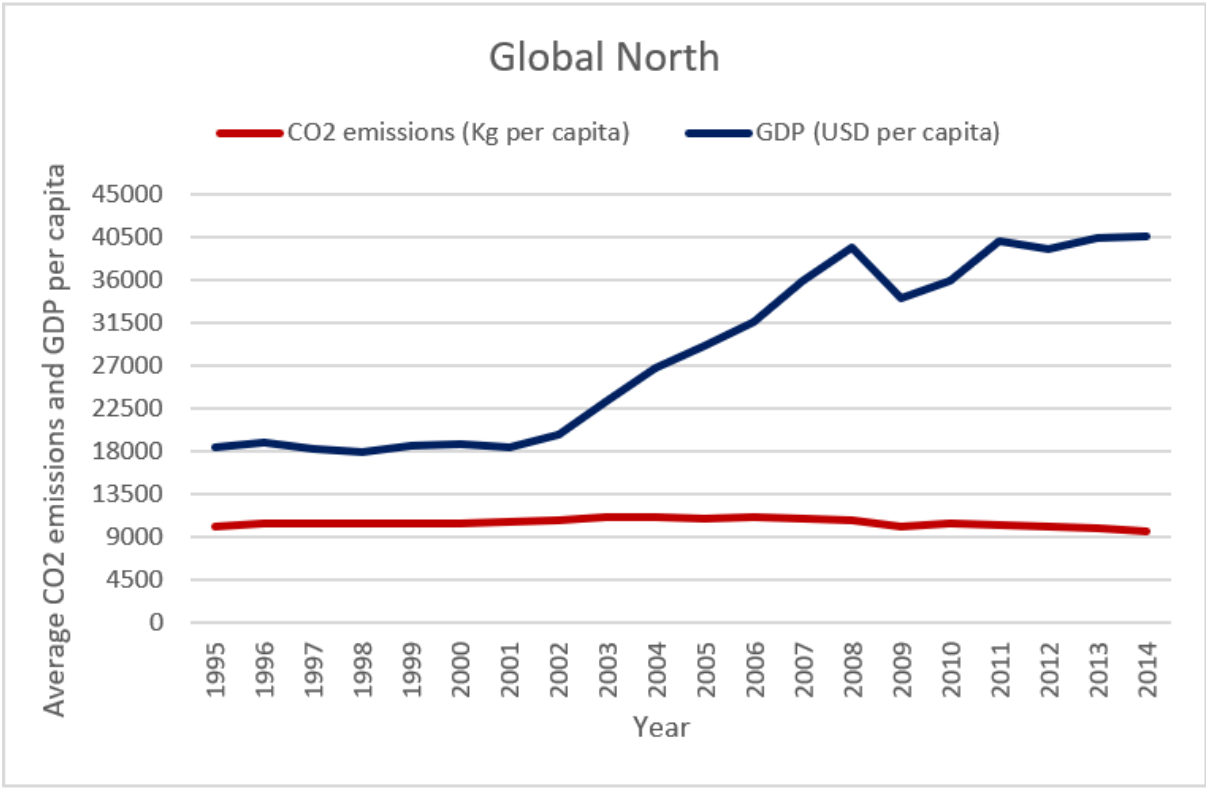
Source: Own computation based on WBG (2020) and OECD (2022)

Graphs 9 and 10 represent average CO2 emissions per capita and GDP per capita in the Global North, which reinforces the suppositions made in the first part of the research. Indeed, it is noteworthy that despite GDP per capita has experienced an increasing trend since 2003, CO2 emissions per capita have experienced a staling trend until 2008. Since 2008, CO2 per capita began stably decreasing until 2014, although GDP per capita recovered from the financial crisis of the year and increased until 2014.

As shown by Graph 11, the Global North has a lower carbon intensity than the Global south. CO2 emissions per capita are linearly decreasing in the North because less CO2 is emitted per $ of GDP. On the other hand, CO2 emissions in the South are increasing because as the economic area is still developing it has not yet reached the necessary carbon intensity, i.e. GDP per capita, for a diminishment of CO2 emissions per capita. Nevertheless, carbon intensity has been decreasing more quickly in the South than in the North between 1995 and 2014, and it is importantly influencing the total trend.

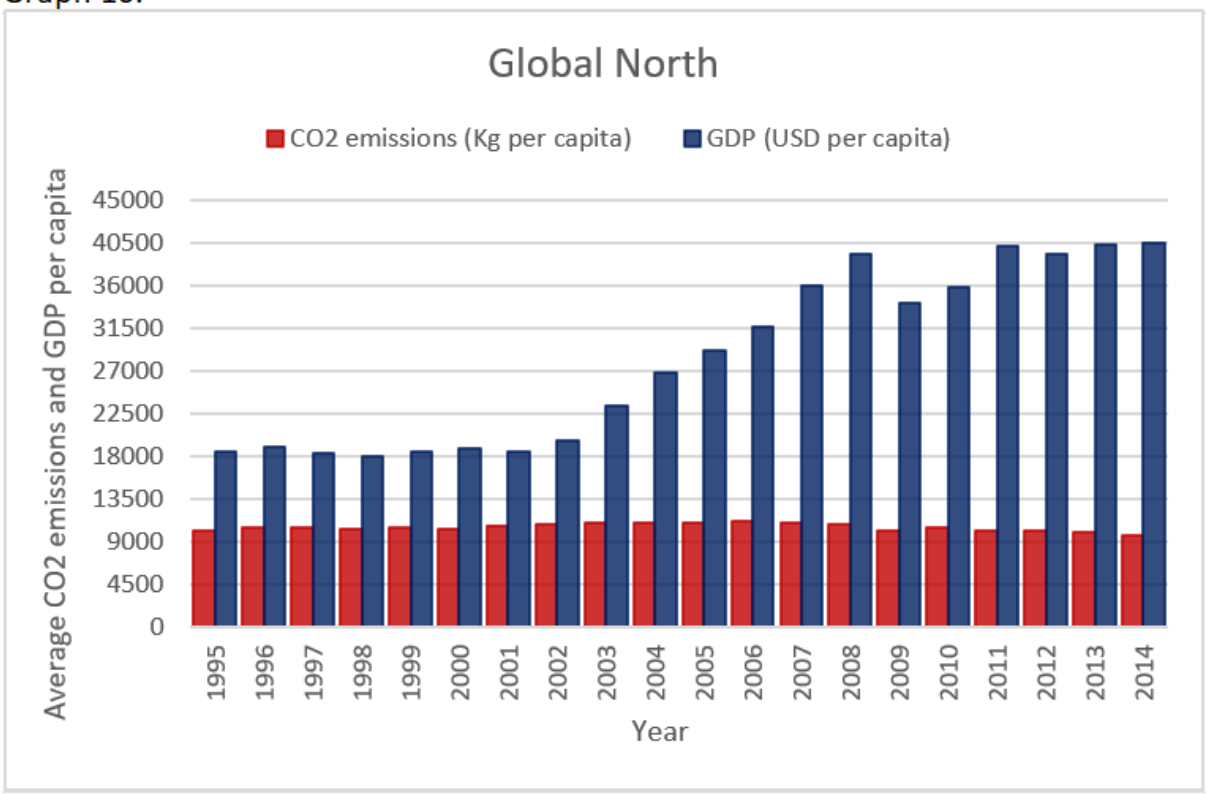
In the Global North economic development appears to be decoupling from CO2 emissions once GDP per capita is high enough to allow for technological innovation, leading to the creation of sustainable industries. The technology developed by the Global North is shared to the Global South, due to globalisation. The latter encouraged by the rising concern for climate change of the former, and sequential investment in new forms of energy, decided to partly invest in sustainable technologies as not doing so would endanger their national wealth because they would depend on fossil fuel deposits from which the Global North is economically detaching itself from. Structural energy diversification is a necessity for the Global South and has led, combined with an increasing industrial specialisation (division of labour), to lower than predicted carbon intensity over the years (IMF, 2017).

Graph 9.



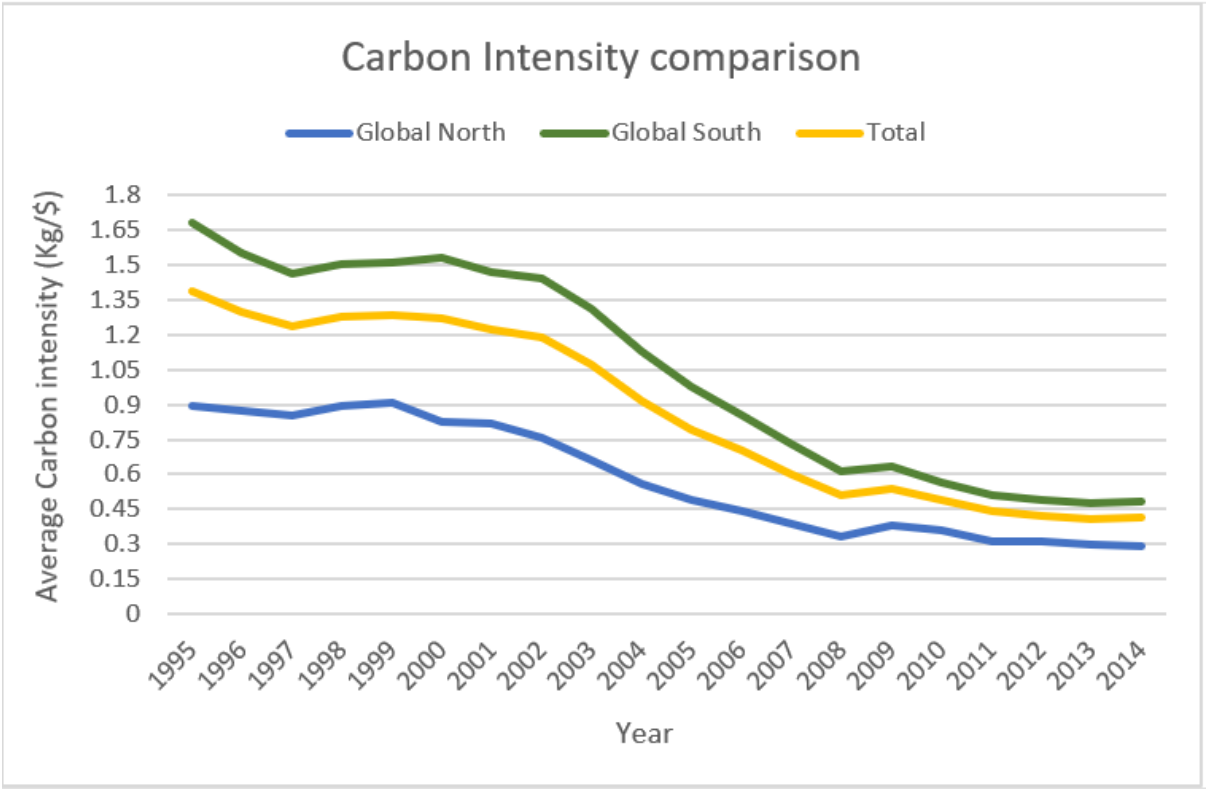
Source: Own computation based on WBG (2020) and OECD (2022)

Graph 10.



Source: Own computation based on WBG (2020) and OECD (2022)

Graph 11.



Source: Own computation based on WBG (2020) and OECD (2022)

Subsequently, the average yearly growth rates of average CO2 emissions per capita and GDP per capita were computed in two sub-periods to show that there has been a decoupling between the two variables in the Global North (Table 7). The results proved that from 1995 to 2007 average CO2 emissions per capita have been expanding at 0.64 percentage points and 1.45 percentage points per year in the Global North and South, respectively. Whereas, from 2007 to 2014 average CO2 emissions per capita have been contracting at 1.89 percentage points in the Global North, and have declined in expansionary momentum in the Global South at 0.82 percentage points. The results reinforce my stand on a possible correlation between GDP per capita and CO2 emissions per capita, and decoupling once a certain economic development threshold is reached.

Table 7.

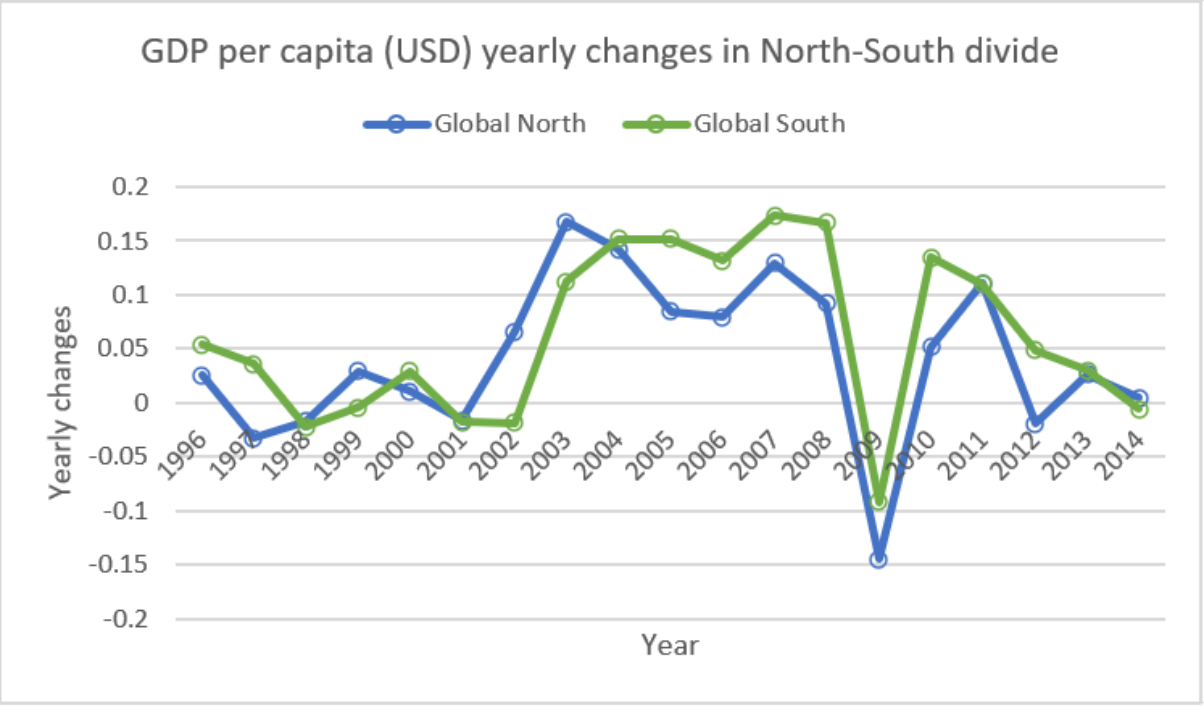
CO2 emissions subperiods between 1995 and 2014

		Global North		Global South	
Initial year	Final year	Year growth rate	Variance of growth rates	Year growth rate	Variance of growth rates
1995	2007	0.0064	0.0009	0.0145	0.0043
2007	2014	-0.0189	0.0012	0.0082	0.0008

Source: Own computation based on WBG (2020) and OECD (2022)

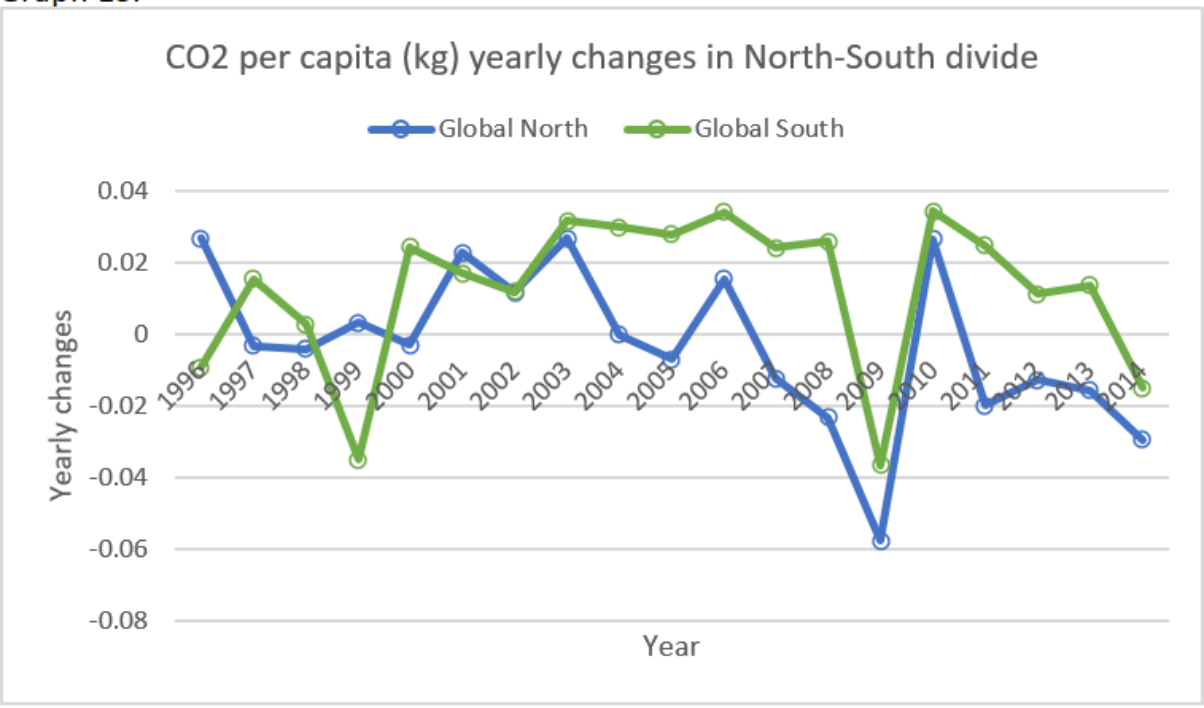
Graphs 12 and 13 show the yearly changes in GDP per capita and CO2 emissions per capita between the Global North and Global South. It can be inferred that both economic areas have mostly experienced yearly growth in GDP per capita between 1995 and 2014 in Graph 12. On the other hand, the Global North in Graph 13 has experienced a decrease in CO2 emissions per capita in the same period, as most of its values are below 0. The decrease of CO2 emissions of the Global North can be attributed to the economic area's involvement in climate change mitigation boards such as the United Nations Framework Convention on Climate Change (UNFCCC) that entered into force in 1994 and was aimed at stabilising CO2 concentrations in the atmosphere at a level that would prevent dangerous human interference with climate change (United Nations, 1992). The Kyoto Protocol that entered into force into force in 2005 further reduced the emissions of CO2 per capita in the Global North and also in the Global South as its framework encouraged the greenhouse gas abatement where it was most cost effective, i.e. developing countries, stimulating sustainable investments, aimed at avoiding financial crises as the Global North detaches itself from its reliance on hydrocarbons (United Nations Climate Change, 2019). Therefore, carbon intensity is decreasing in both economic areas, as represented by their relation in Graph 14.

Graph 12.



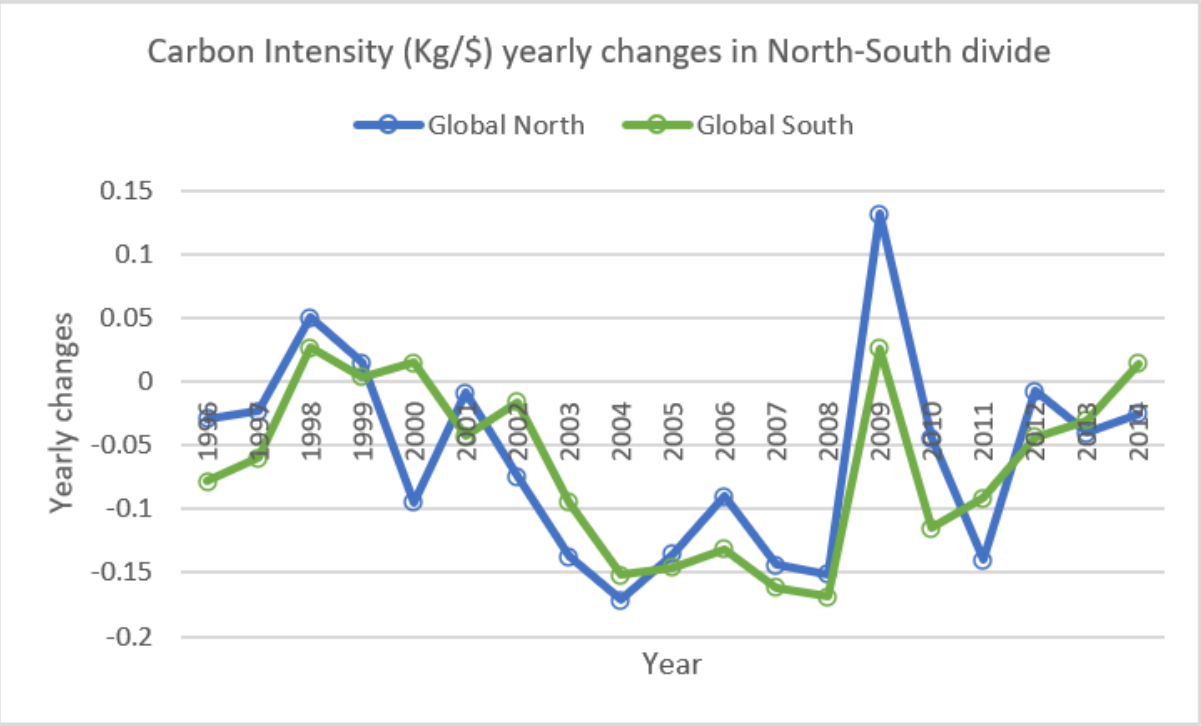
Source: Own computation based on WBG (2020) and OECD (2022)

Graph 13.



Source: Own computation based on WBG (2020) and OECD (2022)

Graph 14.



Source: Own computation based on WBG (2020) and OECD (2022)

Section 3: Regression Analysis

In this section the possible correlation between CO2 emissions per capita and GDP per capita will be examined to determine the degree to which the former impacts on the latter, through correlation and most importantly regression analysis. From Table 8, it can clearly be understood that there is a positive correlation between the 2 variables in both economic areas, i.e. the former increases given an increase of the latter. However, in the Global South, the corelation is weak, contrary to the Global North that exhibits a stronger moderate positive relationship.

Table 8. Correlation Analysis

Global North	*CO2 (Kg per capita)*	*GDP (USD per capita)*
CO2 (Kg per cap)	1.000	
GDPP (USD)	0.279	1.000
Global South	*CO2 (Kg per capita)*	*GDP (USD per capita)*
CO2 (Kg per cap)	1.000	
GDPP (USD)	0.635	1.000

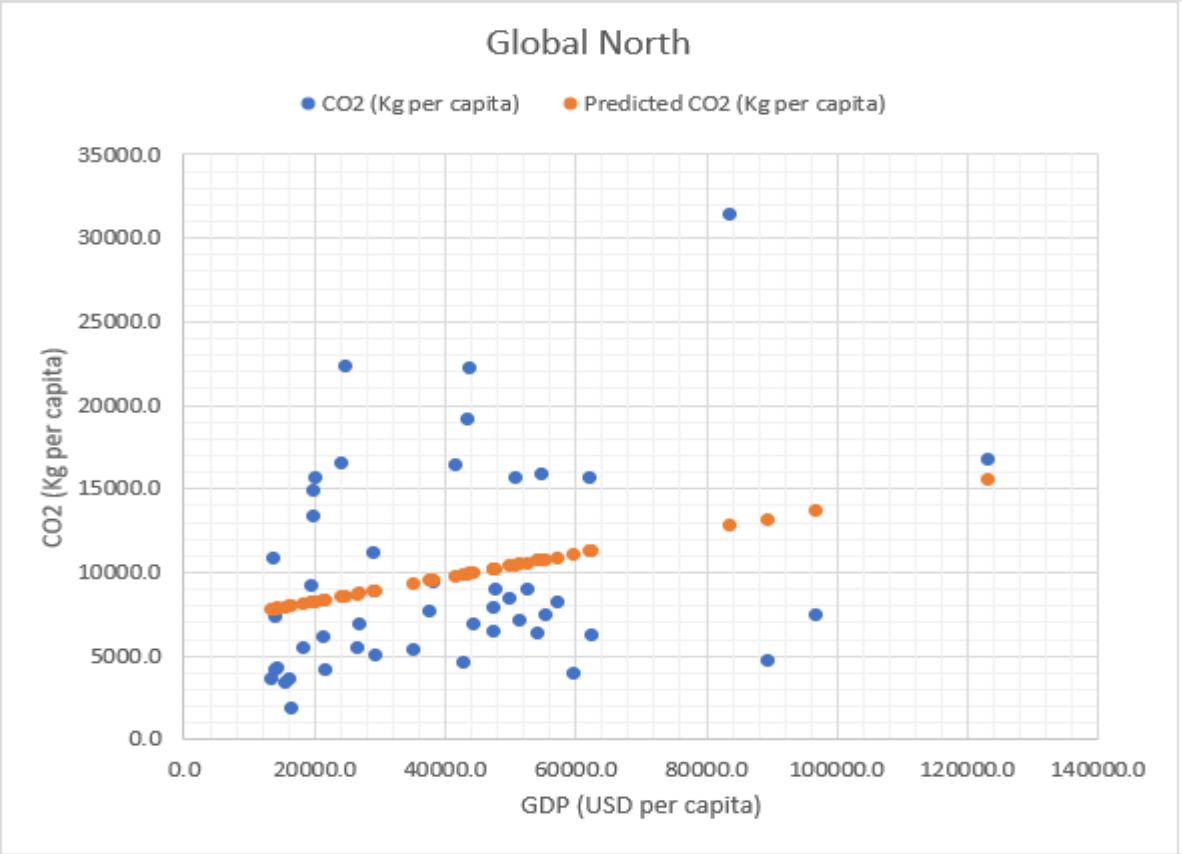
Source: Own computation based on WBG (2020) and OECD (2022)

As the Correlation analysis quantified the relationship between the dependent (CO2 per capita) and independent (GDP per capita) variables, the results were supported through a simple linear regression analysis aimed at computing the influence of GDP per capita on CO2 emissions per capita to show the differences in correlation in the two economic areas. The OLS method to estimate the regression model was applied and fitted models associated to the estimation equations were computed, obtained from $Yi = b_0 + b_1 Xi + e_i$, corresponding to Yi = 6713.111 + 0.071Xi in the Global North and Yi = 334.705 + 0.422Xi for the Global South. If b_0 represents CO2 emissions per capita when there is no GDP per capita, b1 represents how an increase in $1 of GDP per capita corresponds to an increase of 0.071 kg and 0.422 Kg per year in CO2 emissions per capita in the Global North and South, respectively. The regression analysis of both economic areas was computed and Graph 15 (Global North) and 16 (Global South) were created to show how the positive regression of the original data and the line of best fit, i.e. predicted CO2 per capita values, implies that there is a proportional relation between GDP per capita and CO2 emissions per capita, which is weaker in the Global North than in the Global South. The differences between the predicted values and the original data are called residuals and show if the predictions were over or under-estimated.

As seen in Graph 15 and 16, there is a decoupling between GDP per capita and CO2 emissions per capita in the Global North, represented by the flattening of the line of best fit in the North in regards to the South. The suppositions, obtained from Graph 2 hold because apparently as a country develops, its carbon intensity decreases, and its CO2 emissions do not correlate as strongly as in the previous development stage with GDP per capita. In a regression analysis considering both the Global South and Global North (Graph 17), the average of the residuals for the Global North is 1141.1 Kg per capita

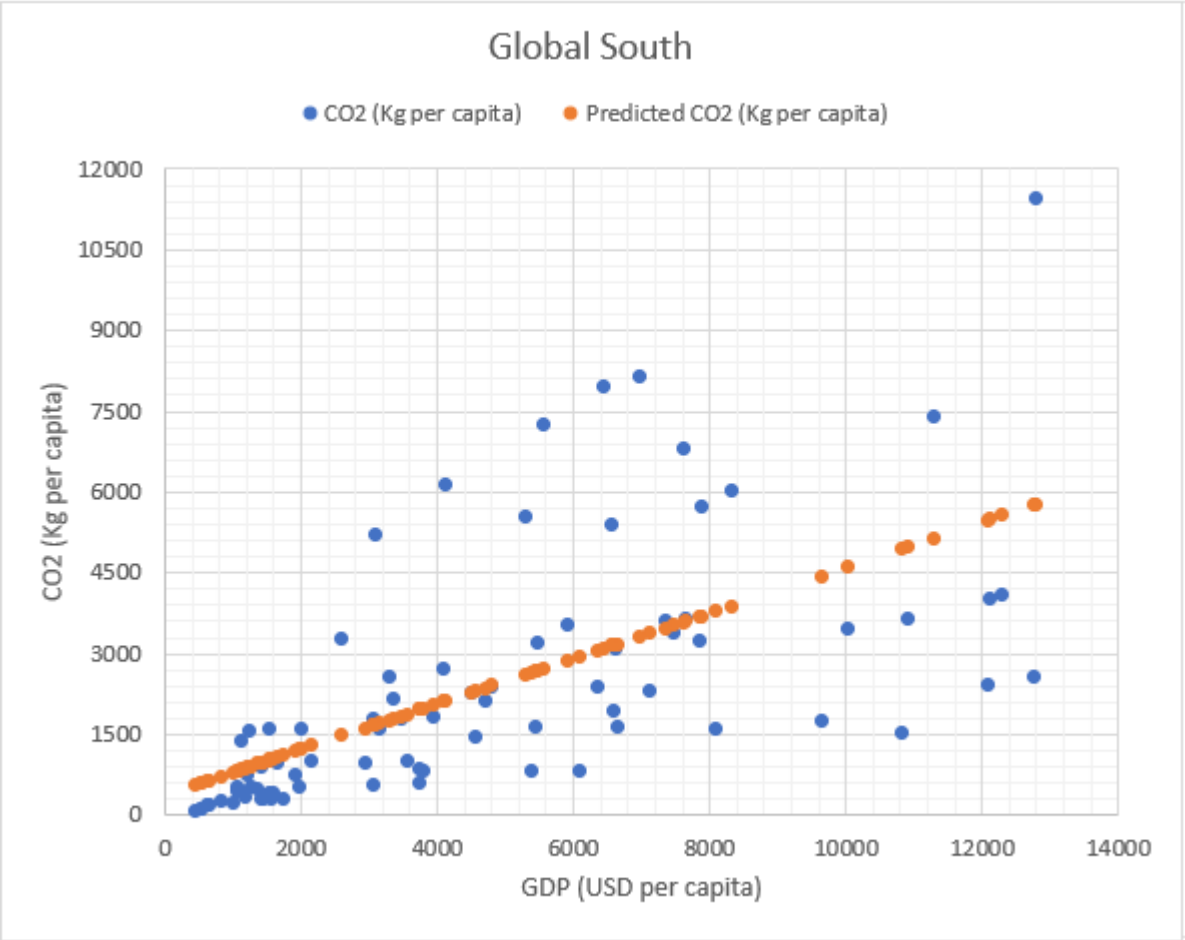
whereas for the Global South is -654.1 Kg per capita, represented in Graph 18. Therefore, despite lowering carbon intensity, the Global North is emitting on average 1141.1 Kg of CO2 per capita more than it should, as would be predicted by GDP per capita. Contrarily, the Global South is emitting on average 654.1 kg of CO2 per capita less than it should. The Global North (the high income group) is still main driver of environmental degradation. The North-South divide has been segmented into income groups in Graph 19 to recreate the lost division between the low and middle income groups, and it can be inferred from it that they are still both underperforming but the low income countries drastically more as they have not yet entered an industrial activity phase of development.

Graph 15.



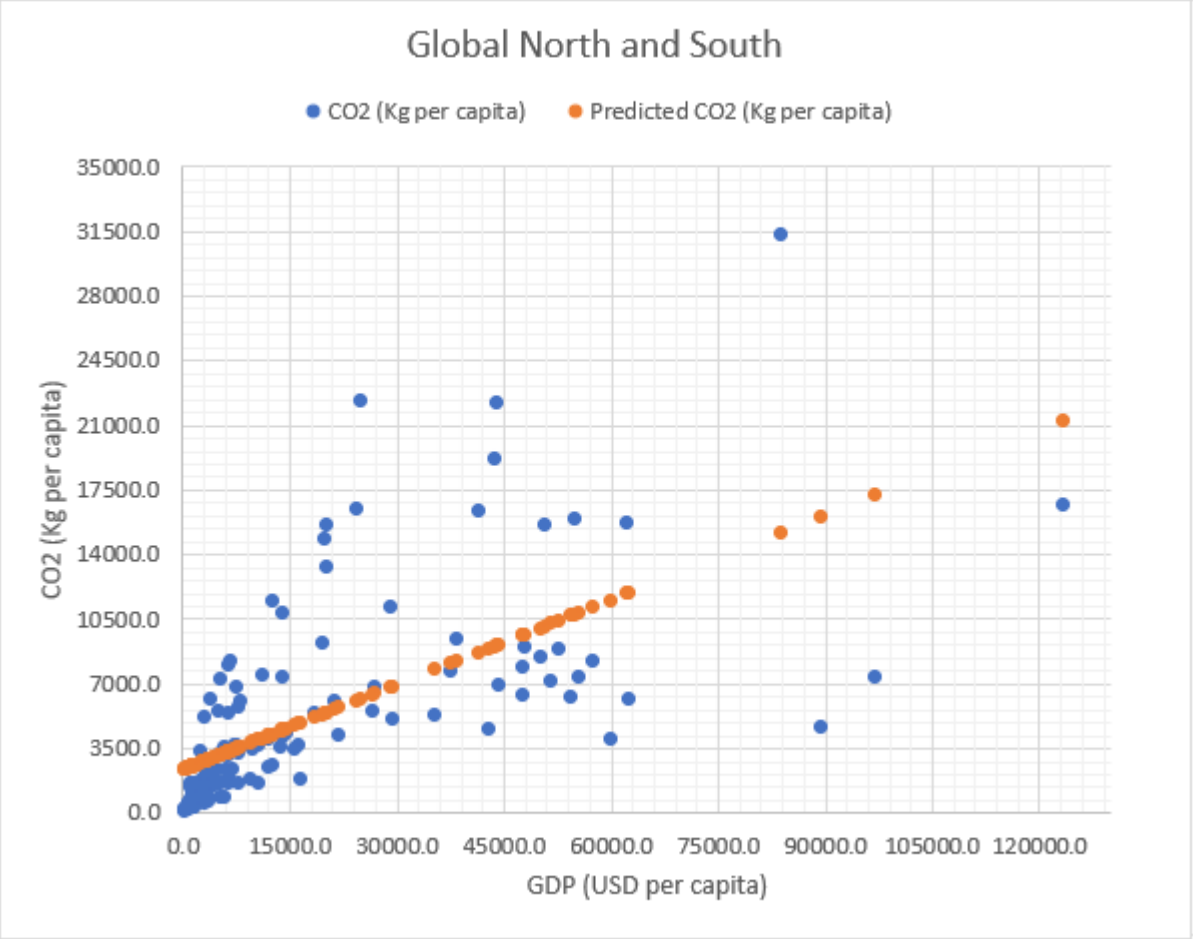
Source: Own computation based on WBG (2020) and OECD (2022)

Graph 16.



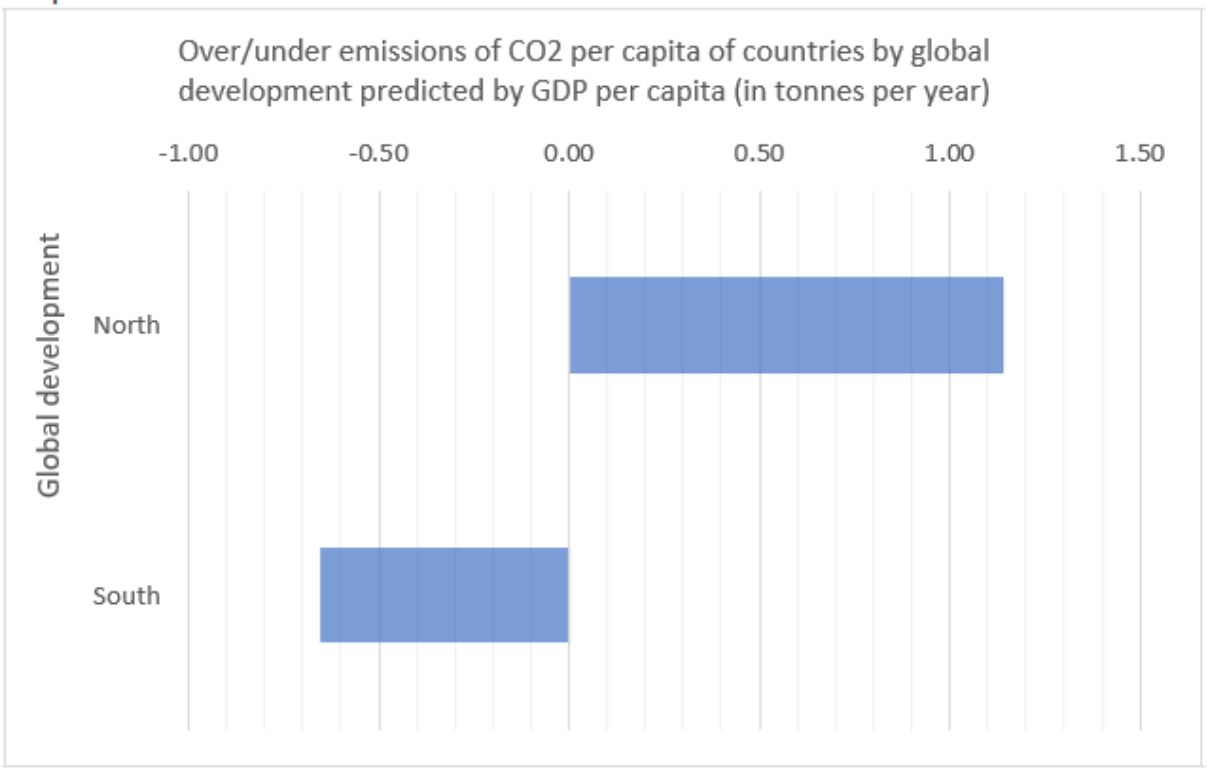
Source: Own computation based on WBG (2020) and OECD (2022)

Graph 17.



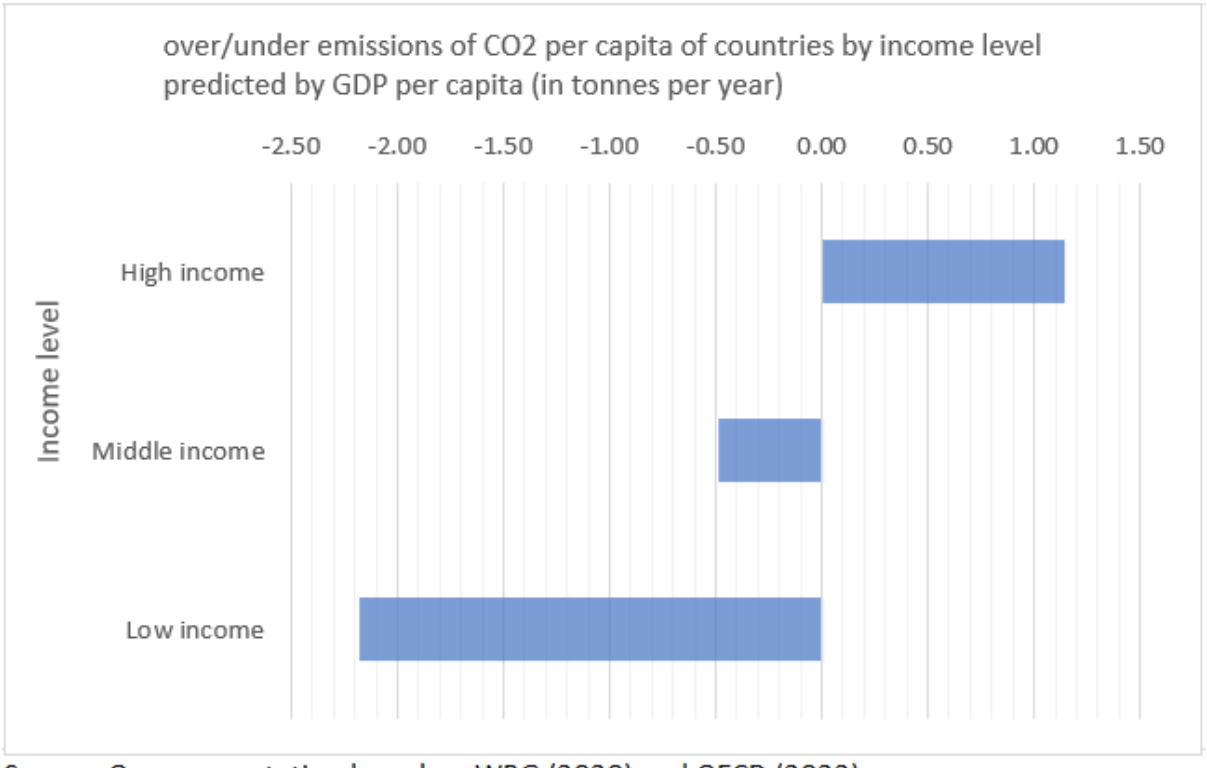
Source: Own computation based on WBG (2020) and OECD (2022)

Graph 18.



Source: Own computation based on WBG (2020) and OECD (2022)

Graph 19.



Source: Own computation based on WBG (2020) and OECD (2022)

Enough analysis has been made on evaluating a correlation between GDP per capita and CO2 emissions per capita in the Global North and South, represented in Table 9 and 10. The GDPP (GDP per capita) coefficients are positive, implying that there is a direct relationship between CO2P (CO2 per capita) and GDPP in both the Global North and the Global South. However, according to the p value, the marginal effect of GDPP on CO2P is not statistically significant at the 5% level in the Global North since its value is greater than 0.05. On the other hand, the correlation between GDPP and CO2P in the Global South is significant at the 1% level as the p value is smaller than 0.01.

Table 9.

Global North OLS estimation results of a linear regression of GDP per capita (USD) on CO2 per capita (Kg)

	Observations	47							
	regressors	1							
Y	Dependent variable: CO2P								
		Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 99.0%*	*Upper 99.0%*
	Intercept	6713.1107	1716.1927	3.9116	0.0003	3256.5211	10169.7003	2097.2645	11328.9569
X	GDPP	0.0712	0.0365	1.9499	0.0574	-0.0023	0.1448	-0.0270	0.1695

Source: Own computation based on WBG (2020) and OECD (2022)

Table 10.

Global South OLS estimation results of a linear regression of GDP per capita (USD) on CO2 per capita (Kg)

	Observations	82							
	regressors	1							
Y	Dependent variable: CO2P								
		Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 99.0%*	*Upper 99.0%*
	Intercept	334.7045	331.6531	1.0092	0.3159	-325.3061	994.7151	-540.4253	1209.8343
X	GDPP	0.4220	0.0574	7.3565	1.45E-10	0.3079	0.5362	0.2707	0.5734

Source: Own computation based on WBG (2020) and OECD (2022)

Paradoxically, despite the two variables exhibit correlated trends, it is not implied that one is affecting another because conventional (model-blind) methodology avoids using causal lens as human intuition operates under logic of causation, while data conform to the logic of probabilities and proportions (Pearl and Mackenzie, 2019).

Policy recommendations

The results of the regression provide grounds to assert correlation between GDP per capita and CO2 emissions per capita in developing countries, which as develop economically decrease in carbon intensity, leading to a decoupling of the two variables as it can be inferred from the Global North analysis. The results align with the Environmental Kuznets Curve (EKC) arguing that although initially the level of environmental degradation surpasses the income per capita level, the trend reverses as high income countries technologically evolve, leading to environmental upgrading through a reduction of carbon intensity (Ekins, 1997). According to the EKC, economic growth leads to a rapid increase in emissions through rapid industrialisation, urbanisation, weak environmental laws and regulations, limited sustainable technologies and infrastructure, and heavy reliance on fossil fuels. Therefore, to mitigate the necessary effects of economic development, countries are required to develop technologically through sustainable production techniques, enforce laws against environmental degradation such as emission zones, apply carbon taxes, promote sustainable urbanisation, and diversify their economic structure towards low-emitting service sectors. Unfortunately, these recommendations would work only if the Global North would weaken its globalised reliance on the Global South for manufacturing products and sustain itself by investing in a sustainable secondary sector (Ota, 2017).

Conclusion

This project was able to confirm a positive correlation at the 1% significance level between economic development and GDP per capita in countries experiencing a developing stage, but not in developed countries, as they have already reached a decoupling process of the two variables as argued by the EKC. The Global North (high income group) exhibits a lower carbon intensity than the Global South (low and middle income groups) as it was able to reach a GDP per capita threshold that allowed it to invest in technological innovation, which in turn, combined with environmental boards, led to a more sustainable economic activity, lowering CO2 emissions in the economic area. Sustainable technologies were also adopted by the Global South, which is experiencing a rapid decrease in carbon intensity, but has not yet reached the GDP per capita threshold of the high income group, impeding a decrease of CO2 emissions. Nevertheless, the Global North is still responsible for most of CO2 emissions per capita and the Global South is expected to increase its emissions per capita. Therefore, policies aimed at sustainability and interrupting the North-South dependency are a must to maintain an acceptable level of environmental degradation that satisfies the economic development objectives of the Global South.

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