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How Economic Policies Drive Climate Change: A Comparative Analysis of Groups of Middle- and High-Income Countries

Mohamed R. Abonazel[1]*, Elsayed G. Ahmed[2], Shawky Taha El-Baz[3], Ehab Ebrahim Mohamed Ebrahim[4,5]

[1]Department of Applied Statistics and Econometrics, Faculty of Graduate Studies for Statistical Research, Cairo University, Giza, Egypt, [2]Department of Statistics and Insurance, Faculty of Commerce, Arish University, North Sinai, Egypt, [3]Department of Economics, Faculty of Commerce, Arish University, North Sinai, Egypt, [4]Department of Economics, Faculty of Commerce, Kafrelsheikh University, Kafrelsheikh, Egypt, [5]Department of Economics, College of Business, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia. *Email: mabonazel@cu.edu.eg

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ABSTRACT

Fiscal and monetary policies are considered a main tool for any economy to achieve the desirable goals or to counter-cycle any problem facing the economy and one of the biggest deals facing any society is climate change. Thus, in this paper we are studying the effect of these policies on climate change by using panel data models across various countries according to income levels in the period from 1990 to 2020. The study explores how economic policies influence carbon dioxide (CO_2) emissions to provide valuable insights for policymakers and researchers to integrate environmental considerations into economic decision-making processes. The findings indicate that economic policies significantly influence CO_2 emissions in both middle and high-income countries, except for the tax revenue in high-income countries. Findings reveal significant relationships between fiscal and monetary outcomes, highlighting the role of economic policies in addressing climate change.

Keywords: Climate Change, CO_2 Emissions, Fiscal Policy, Monetary Policy, Pooled Regression Model, Fixed Effects Model, and Random Effects Model

JEL Classification: C1, C33, E01, E03, E5, Q45

1. INTRODUCTION

Climate change is considered one of the most important challenge facing the world, even though no country is immune, the damages are larger in poorer countries, which have limited financial resources and undeveloped institutions, as their socioeconomic systems are typically less able to cope with climate shocks in addition to people there have less resources to adapt, furthermore they tend to reside in hotter areas, where the marginal impact of additional warming is larger (Burke et al., 2015; Mejia et al., 2018).

During the last four decades, economic analysis has evolved from merely protecting the environment to studying the impact of climate change on economic growth, with a focus on three basic axes: how to confront, adapt, and recover from the effects of climate change on the economy (Farid et al., 2016). But how could any economy do that? For any economy, there are two main policies fiscal and monetary policy, which one is more effective in solving the climate issues? In this article, we are trying to answer this question by studying how the economic policy could affect CO_2 emissions which is one of the main causes of the global warming and then climate change through the past three decades starting from 1990. The review of literature on climate change and economic policies will be divided into three subsections to support our empirical study.

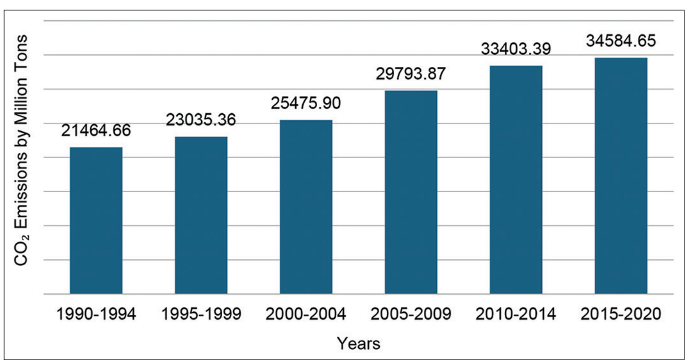
1.1. Climate Change and Global Warming

According to the United Nation, Climate change is defined as the long-term shifts in temperatures and weather patterns which could be caused by natural, due to large volcanic eruptions or changes in the sun's activity, or could be as a result of human activity because of burning fossil fuels like coal, oil and gas which generates greenhouse gas emissions that act like a blanket wrapped around the Earth, trapping the sun's heat and raising temperature. (United Nation, 2024; Climate Change Indicators Dashboard, 2024). In the last century, the world's economy releases several dozen gigatons of greenhouse gases specially CO_2 into the atmosphere which leads to rise the average global temperature making the global warming. Figures 1 and 2 show the relationship between CO_2 emissions and global temperature over different time intervals from 1990 to 2020. The data points represent the average values calculated over 5-year intervals for both CO_2 emissions and temperatures, with the final data point representing the average over 6 years.

Figure 1 depicts the increase in CO_2 emissions, which peaked in the period from 2015 to 2020 at a value of 34584.65 million tons. While Figure 2 shows a clear upward trend in global temperatures, with the most significant rise occurring between 2015 and 2020, where the average temperature reached 1.489°C.

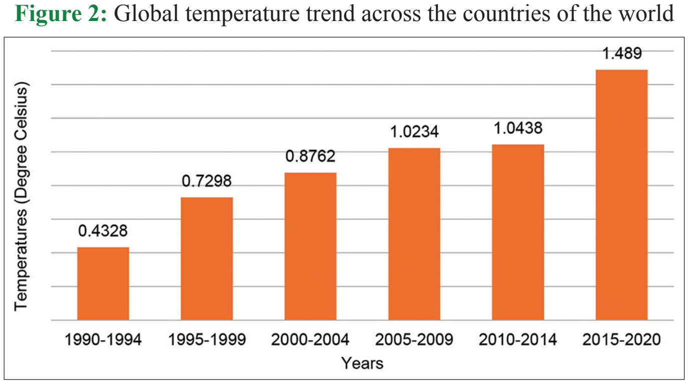
Figures 1 and 2 show that starting from 1990, the more CO_2 emission the higher temperature where the world average temperature increases by high rates and without additional action, the global average temperature probably will rise by at least 1.5°C compared with the 1850-1900 period. Other studies

Figure 1: CO_2 emissions trend across the countries of the world



Source: Authors processed by R-software 4.1.3

Figure 2: Global temperature trend across the countries of the world



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suggest that the global temperature may rise by 4.3°C compared with pre-industrial levels by 2100 (Allen et al., 2018; National Oceanic and Atmospheric Administration, 2019; Westerhold et al., 2020). These patterns highlight a strong correlation between rising CO_2 levels and global temperature increases. Since the early 1990, the substantial growth in emissions has contributed to a more pronounced warming effect. This trend underscores the economic and environmental consequences of unchecked greenhouse gas emissions. Without meaningful interventions, the global temperature is expected to rise even further. This connection between economic activities, CO_2 emissions, and temperature rise serves as a stark reminder of the urgent need for effective climate action.

These dynamics would increase the frequency of extreme weather events causes direct and indirect economic cost, the direct cost of climate change are associated with several types of damages as capital stock and production in addition to the climate-sensitive regions and sectors, for example, lower productivity of the agricultural and industry sector, substitution effects for the tourism sector disruptions to agriculture, lower labor productivity, and also creates food security and water security risks, as well as adverse effects on trade, investment, the health system and migration flows, see, (Bakoup, 2023; Avgousti et al., 2023). Indirectly, there may also be second-round effects of the climate change on inflation owing to supply shortages and on financial asset prices and financial stability specially in developing countries, see, (Dafermos et al., 2018; Andersson et al., 2020). So that without a meaningful mitigation effort, by 2030, it could push over 100 million people into extreme poverty, primarily because of disrupted food production, lower labor productivity due to deteriorating health, and natural disasters (Jafino et al., 2020).

1.2. Fiscal Policy

The economic policies for climate change that aiming mitigation or adaptation was focused on fiscal policy tools like carbon taxes and little attention for monetary policy and that for a lot of reasons, the first one is related to the nature of climate change which is considered as a main result of externalities that is being corrected by fiscal tools like taxation (Golosov et al., 2014). The second reason is related to the time, climate change issues are considered as a long run effect while monetary policy focuses on short term effect (Kunawotor et al., 2022).

Bhattacharya et al. (2021) noted that, if greenhouse gases (GHG) emissions are free or cheaper than its real cost, it will not be any incentive to reduce them and then the benefits will be just for a group of people who produce those goods or the final consumption of them, while the real cost is borne by all. By inverse, if GHG emissions are costly, carbon intensive goods will be more expensive and then decrease the demand for that goods and the best way to make that will be by using carbon taxes.

A lot of papers argued about the effect of carbon tax, although it will raise the price of the carbon intensive goods-energy- which will reduce the demand on it and help in mitigation global warming, it will has a negative effects on investment, wages and employment, where energy is a major input for all business and one of the main items of expenditure for all consumers, then all of producers and consumers will use it more effective but in the same way they will spend more on it as a result of being more expensive and that will lead to decrease the consumption of other goods and services which will make a surplus in its markets and businesses may in turn reduce investment, labor demand and wages (Bhattacharya et al., 2021).

Other articles noted that effect will be in the short term but in the medium term may be offset, the producers will look forward to avoid paying carbon tax by investing more in a new technology to produce low carbon commodities and that will increase the demand for labors and rise the wage rate and removing the side effect of carbon tax on the macro economy, In addition to carbon taxes will increase public revenues for governments and that will rise the fiscal space which increase the ability of decreasing other types of taxes like income and then increasing wages which will rise the demand for commodities and stimulates investment again (Klenert et al., 2017; Behsudi, 2021).

We could say that, the overall effect of carbon taxes depends on the way of recycling it, specially it consider an extra source of public revenues and that leads us to slide the lights on public expenditure as a second main tools of fiscal policy and how it could be helpful in the issues of climate change, if carbon taxes aim to reduce carbon emission directly by reducing the production of high-carbon products or indirectly by motivating producers to invest in low-carbon technology, public expenditure is no less important than carbon taxes.

Public expenditure plays a main role in reducing carbon emission through a lot of channels, one of them is the public investment specially in low carbon infrastructure, despite those projects considered as a preventive measure for climate shocks, the private investment avoids them, because of the less private returns of the majority of environment project. And then, the government must do it especially when we consider the positive externality and indirect effects on production, inflation, employment and healthy, it will have a great total return (Hepburn et al., 2020; Batini et al., 2022). In addition to public expenditure could be a main tool for government in mitigating the effects of climate shocks and adapting to new climatic conditions by providing relief, reconstruction and support to those affected especially vulnerable groups (Catalano et al., 2019).

1.3. Monetary Policy

On the other hand, although many economists prefer fiscal policy more than monetary policy in addressing climate issues for the reasons mentioned above, with deep research in climate change effects, the extent of its connection to monetary policy becomes important and clear through two main channels:

- The first channel is inflation, climate change leads to raise inflation rate because of decreasing output due to physical destruction likes crop failures, destruction of facilities and infrastructure, disruption of supply chains and tourism in addition to decline labor and capital productivity due to high temperature and infrastructure destruction (Cevik et al., 2023; Kotz et al., 2023)
- The second channel is the cost of financing the green projects, many investors avoid green projects because there is a large gap between the social and private returns of these projects, as the accounting standards and financial system did not reflect the high return of these projects, which made the cost of financing high and the expected return low, thus withholding investments from these projects (Stern and Stiglitz, 2021).

And then, if monetary policy works on controlling prices, it must consider the effects of climate change and if we wish to move to zero carbon emission, we must mobilize resources for green projects and we cannot do that without the monetary tools especially the interest rate.

The remaining sections in this paper are organized as follows: Section 2 covers the data and methodology of the study. Section 3 presents the empirical results. Section 4 is dedicated to the discussion. Section 5 provides the main conclusions.

2. MATERIALS AND METHODS

2.1. Data

We will analyze the impact of fiscal and monetary policy on climate change according to annual panel data available on the World Bank website for some countries in the world. The panel data included ten countries during the period from 1990 to 2020, this sample was divided into middle-income countries, including (Bhutan, Costa Rica, Nicaragua, Peru, and South Africa) and high-income countries, including (Bahamas, Iceland, Italy, Singapore, and United States). In this application, we utilized annual panel data, where the dependent variable is the logarithm of carbon dioxide (CO_2) emissions, measured in thousands of tons. The data included three independent variables: the logarithm of the general government expenditure (GEXP), measured in current local currency units; the lending interest rate (LEND), expressed as a percentage; and the tax revenue rate (TAXR), measured as a percentage of the gross domestic product (GDP). Table 1 provides some descriptive statistics for various economic variables used in this study for middle-income and high-income countries.

In comparing key economic indicators between middle-income and high-income countries, significant differences emerge across several dimensions. High-income countries exhibit higher average CO_2 emissions, with a mean of 10.84196 compared to 9.25858 for middle-income countries. This disparity indicates potentially greater industrialization or reliance on traditional energy sources among high-income countries, which is also reflected in the larger standard deviation indicating greater variation in emissions levels within this group.

Regarding the GEXP, both income groups show relatively similar figures. The mean for middle-income countries is 24.76140, with a standard deviation of 2.37677, whereas high-income countries have a mean of 25.02275 and a standard deviation of 2.68108. This similarity suggests that government expenditure does not differ significantly between middle-income and high-income countries, although there are slight variations. A pronounced difference emerges in LEND between the two groups, where middle-income

Table 1: Some annual statistics for study variables

Variable	Mean	S.D.	Median	Min.	Max.
Middle-income					
CO_2	9.25858	2.25908	8.74415	5.17643	13.01321
GEXP	24.76140	2.37677	24.61225	18.03546	29.49686
LEND	0.50404	3.44605	0.15854	0.06638	42.60014
TAXR	0.14704	0.04853	0.13585	0.04600	0.26266
High-income					
CO_2	10.84196	3.05478	10.56699	7.27697	15.56919
GEXP	25.02275	2.68108	25.86558	19.80194	28.78736
LEND	0.07433	0.03855	0.06000	0.02328	0.20146
TAXR	0.17029	0.06127	0.14856	0.07904	0.37613

Source: Authors collected and processed from R-software 4.1.3

countries have a significantly higher mean LEND at 0.50404, with a substantial standard deviation of 3.44605, indicating considerable volatility. In contrast, high-income countries have a much lower mean LEND of 0.07433 and a standard deviation of 0.03855, reflecting more stable and lower LEND. These differences could reflect variations in monetary policy and economic stability levels between the two income categories.

Moreover, high-income countries also demonstrate higher TAXR, with a mean of 0.17029 compared to 0.14704 for middle-income countries. The standard deviation is also higher in high-income countries at 0.06127 than in middle-income countries at 0.04853. This suggests that high-income countries may have more developed tax systems or rely more heavily on tax revenues as a proportion of GDP.

2.2. Contributions of Countries to CO_2 Emissions

The descriptive statistics presented in Table 2 offer a detailed comparison of CO_2 emissions among middle-income and high-income countries, revealing notable variations.

According to Table 2, in the middle-income category, Bhutan exhibits the lowest mean emissions at 6.1567, contrasting with Peru 10.4458 and South Africa 12.7559, which demonstrate higher levels. Standard deviations and variances vary across these countries, reflecting differing levels of emission variability. Conversely, high-income nations like the United States record higher mean emissions at 15.4704, while Italy and Singapore recording intermediate values. The data underscores significant disparities in emissions levels and variability between income groups.

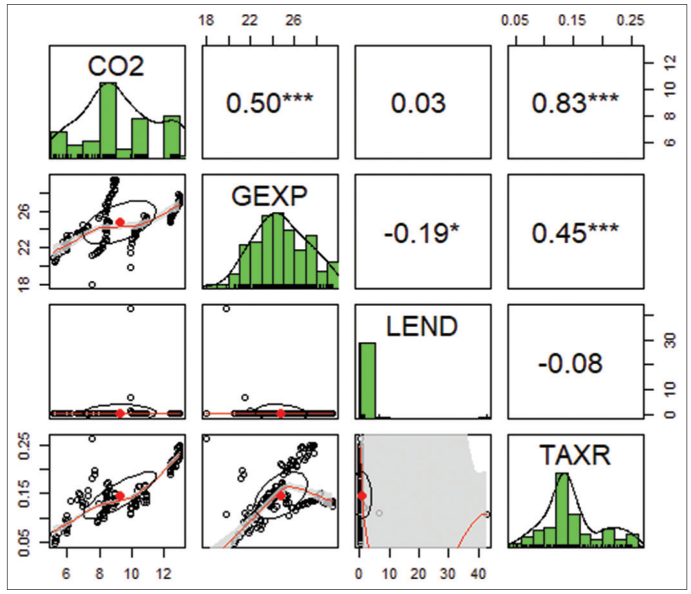
3. RESULTS

3.1. Correlation and Multicollinearity Diagnostics

Figures 3 and 4 present correlation coefficients for the GEXP, LEND, and TAXR in both middle-income and high-income contexts. In middle-income countries, GEXP shows a significant negative correlation with the LEND and a significant positive correlation with the TAXR, suggesting that higher GEXP is associated with lower LEND and higher TAXR, while LEND and TAXR have a very weak and non-significant negative correlation.

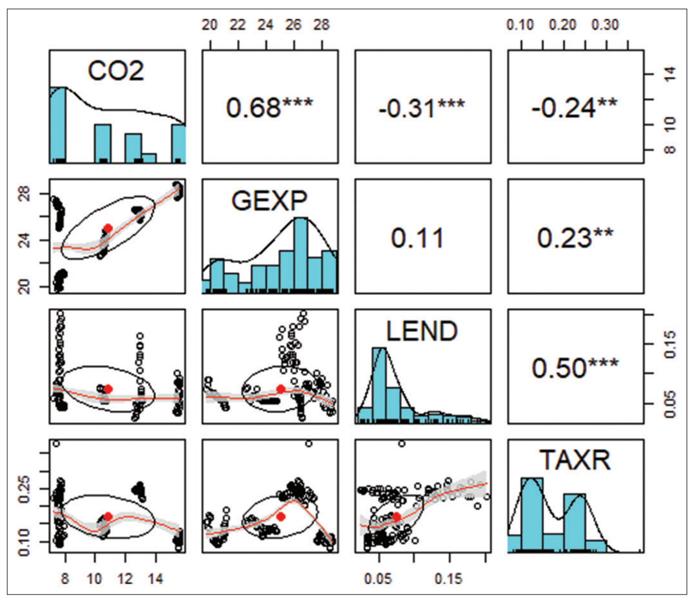
For high-income countries, the Figure 4 indicates that GEXP has a non-significant positive correlation with LEND and a significant

Figure 3: Correlation coefficients in middle-income countries



Source: Authors processed by R-software 4.1.3

Figure 4: Correlation coefficients in high-income countries



Source: Authors processed by R-software 4.1.3

positive correlation with TAXR. This suggests that in high-income countries, increased GEXP is linked with higher levels of both LEND and TAXR. Additionally, the LEND and TAXR exhibit a strong positive correlation, indicating that these variables tend to increase together in high-income settings.

To enhance the reliability of our findings, we conducted multicollinearity diagnostics before using panel data models. Multicollinearity occurs when there is a very high linear correlation among the regressors in the model. This problem can disrupt data integrity, potentially leading to unreliable statistical conclusions. Consequently, this can cause inaccurate estimates, standard errors of those estimates may be inflated, p-values may incorrectly appear non-significant, and a weakened predictive capability of

Table 2: Some descriptive statistics for CO_2 emissions of study countries

Country	Mean	Median	S.D.	Variance	Min.	Max.
Middle-income						
Bhutan	6.1567	5.9835	0.6480	0.4200	5.1764	7.2823
Costa Rica	8.6850	8.7442	0.2869	0.0820	7.9625	9.0087
Nicaragua	8.2496	8.4059	0.3127	0.0980	7.5596	8.5995
Peru	10.4458	10.3494	0.3442	0.1180	9.9167	10.9503
South Africa	12.7559	12.8472	0.2234	0.0500	12.3833	13.0132
High-income						
Bahamas	7.6537	7.6347	0.1203	0.0140	7.4359	7.9393
Iceland	7.6090	7.6292	0.1195	0.0140	7.2770	7.7761
Italy	12.8884	12.9123	0.1359	0.0180	12.5471	13.0686
Singapore	10.5883	10.5670	0.1194	0.0140	10.2740	10.7648
United States	15.4704	15.4558	0.0740	0.0050	15.2789	15.5692

Source: Authors collected and processed from R-software 4.1.3

the models. The variance inflation factor (VIF) is used to identify multicollinearity among explanatory variables. Generally, VIF values exceeding 10 indicates that there is multicollinearity that requires corrective procedures, see e.g. (Gujarati and Porter, 2009; Youssef et al., 2020). Table 3 shows the VIF for the independent variables for the countries under study.

The results of Table 3 indicate that dataset does not suffer from multicollinearity issue. Therefore, we can conduct our analysis utilizing the independent variables presented in this study.

3.2. Outliers Detection

Figure 5 presents a box plot of CO_2 emissions for two groups of countries based on income levels. It illustrates that the dependent variable does not contain outlier values in either the middle or high-income levels for countries under study.

3.3. Empirical Results of Panel Models

In this subsection, we will evaluate the impact and effectiveness of economic policies on climate change by using the pooled regression model (PRM), fixed effects model (FEM), and random effects model (REM). It is essential to analyze the results using panel data models, because they provide a detailed and comprehensive understanding of how policy measures affect environmental indicators over time and across different regions. For further studies on the use of panel data models, see, e.g. (Biørn, 2017; Abonazel, 2019; Youssef et al., 2024; Abdelwahab et al., 2024).

By comparing the findings from each model shown in Table 4, we can identify consistent trends and robust conclusions. This comprehensive approach allows for a nuanced analysis of the data, ensuring that the conclusions drawn are reliable and actionable. Consequently, policymakers can utilize these insights to design and implement effective strategies to address climate change challenges.

3.4. Evaluate the Performance of Models

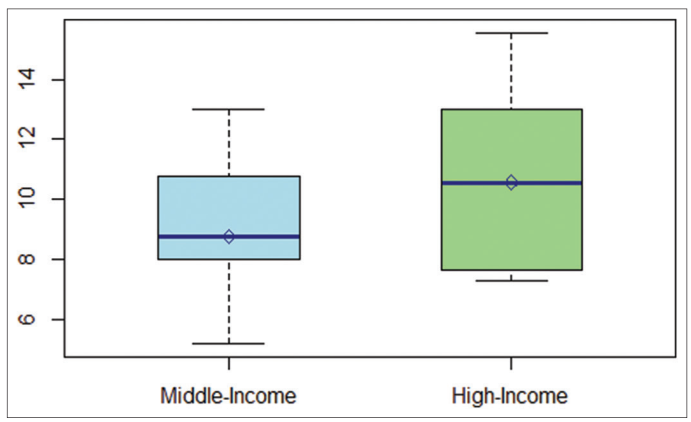
In econometric analysis, selecting the appropriate model for panel data analysis is essential to obtain reliable and accurate results. To determine the most suitable model, we use specific statistical tests, including the individual effects test, the Lagrange Multiplier test, and the Hausman test. Under the null hypothesis for the individual effects test, the efficient estimator is the pooled estimator, indicating that there are no significant individual effects. For the Lagrange Multiplier test, the null hypothesis assumes that the variance of the random effects is zero, suggesting that the pooled estimator is efficient. In the Hausman test, the null hypothesis states that the random effects estimator is consistent and efficient, implying no correlation between the individual effects and the explanatory variables. By conducting these tests, researchers can evaluate and choose the best model, leading to more robust and dependable conclusions in their analysis, see e.g. (Hsiao, 2014; Baltagi, 2015; Youssef et al., 2021).

Table 3: Variance inflation factor

Model	GEXP	LEND	TAXR
Middle-income	1.2898	1.0377	1.2513
High-income	1.0536	1.3275	1.3823

Source: Authors collected and processed from R-software 4.1.3

Figure 5: The box plot of CO_2 emissions for the countries



Source: Authors processed by R-software 4.1.3

Based on the results presented in Table 5, each statistical test indicates different outcomes for selecting the appropriate panel data model for middle-income and high-income countries. For both middle-income and high-income countries, the test statistics of the individual effects test are 1501.2 and 10352, respectively, which are significantly high, and the $p < 0.0001$. This suggests rejecting the null hypothesis that there are no significant individual effects. As a result, the fixed effects estimators are appropriate. The Lagrange Multiplier test statistics for middle-income 676.76 and high-income countries 982.82 are also high, with $p < 0.0001$.

Table 4: Estimates of panel data models for economic policies variables

Variable	Middle-income			High-income		
	PRM	FEM	REM	PRM	FEM	REM
Intercept	−0.4171	2.6318***	2.2404***	−7.3903***	8.7326***	2.7107*
GEXP	0.1799***	0.2461***	0.2443***	0.8854***	0.0819***	0.3283***
LEND	0.0828**	0.0161***	0.0199*	−19.5163***	1.9176***	3.6431**
TAXR	35.2183***	3.5676***	6.5200***	−14.5195***	−0.4778	−2.0843

The superscripts ***, **, and * refer to the statistical significance at a level 0.001, 0.01, and 0.05, respectively. Source: Authors collected and processed from R-software 4.1.3

Table 5: Results of comparison tests for various models

Test	Middle-income		High-income	
	Test statistic	p-value	Test statistic	p-value
Individual effects	1501.2	< 0.0001	10352	< 0.0001
Lagrange multiplier	676.76	< 0.0001	982.82	< 0.0001
Hausman	9.7853	0.0205	27.111	< 0.0001

Source: Authors collected and processed from R-software 4.1.3

This indicates rejecting the null hypothesis. Therefore, the pooled estimators are inefficient, and the random effects estimators may be more suitable.

Based on the results of the individual effects test and the Lagrange Multiplier test, it is evident that both the FEM and REM are appropriate. Therefore, we conduct the Hausman test to choose between these two models. The results of the Hausman test show a test statistic of 9.7853 with a $p = 0.0205$ for middle-income countries, and a test statistic of 27.111 with a $p < 0.0001$ for high-income countries, which strongly supports the FEM. Thus, the Hausman test indicates that the FEM is more suitable for middle-income and high-income countries to study the impact of economic policies on climate change.

3.5. Final Model

Based on the results of Table 5, we can exclude both the PRM and the REM from our analysis and rely on the FEM to understand and explain the impact of economic policies on climate change in countries around the world.

Evaluating the effectiveness of the FEM requires the use of some statistical measures to assess its ability to explain, its accuracy, and overall significance. These measures provide insights into how well the FEM fits the data and how accurately it can predict outcomes. They are particularly useful when comparing different economic contexts, such as middle-income versus high-income countries, as they help assess whether the model captures the relevant economic dynamics in each group. For middle-income countries, the R-squared of 0.7783 indicates that the model explains about 77.83% of the variation in CO_2 emissions, indicating a strong explanatory capability, whereas for high-income countries, the R-squared is much lower at 0.1829, indicating that only 18.29% of the variation is explained. Similarly, the adjusted R-squared values are 0.7678 for middle-income countries and 0.1440 for high-income countries, showing that even after adjusting for the number of predictors, the model remains significantly more robust for middle-income countries.

The F-statistic values are high and statistically significant for both groups 3209.121 for middle-income countries and 18366.17 for high-income countries at the 0.001 significance level, confirming the overall significance of the FEM in both cases. However, the lower R-squared values for high-income countries suggest that additional or different explanatory variables might be needed to better capture the dynamics in these economies. Overall, the FEM is more effective in explaining variations in CO_2 emissions for middle-income countries, potentially due to differences in economic structures or other unobserved factors.

4. DISCUSSION

In Table 6, the relationship between economic policies as explanatory variables and CO_2 emissions as dependent variable has been presented. We can find that all independent variables are significant except the TAXR in high-income countries, it is crucial to recognize that all significant explanatory variables have a positive relationship with the dependent variable in both middle and high-income countries. With more of focusing on our result we could explain the impact of fiscal policy and monetary policy on CO_2 emissions as follows:

For fiscal policy, which represented by tow variables the GEXP and TAXR. We could recognize that in the middle-income countries the effect of the GEXP on CO_2 emissions are positive and statically significant at 0.001 level. This suggests that a 1% increase in the GEXP within the middle-income countries leads to an approximate 0.25% increase in CO_2 emissions. It seems no difference in the high-income countries but with little effect, where it indicates that a 1% increase in the GEXP leads to an approximate 0.08% increase in CO_2 emissions. This means that the more public expenditure, the more carbon dioxide emissions.

A possible explanation for that result that general government spending is not directed effectively towards sustainable investments and focuses more on achieving some economic goals such as reducing unemployment rate or increasing economic growth and this is at the expense of increasing levels of CO_2 emissions, moreover, in the middle-income countries, which are aiming to be more rich countries, a large part of government spending is directed to fuel and energy subsidies to increase the competitive ability for local producers or resettlement of carbon-intensive industries which have been abandoned by the majority of developed countries.

On the same way, in the high-income countries where a large part of the public expenditure is directed to unemployment grants and

Table 6: Estimates of final panel model

Variable	Middle-income			High-income		
	Estimate	Standard Error	t-value	Estimate	Standard Error	t-value
Intercept	2.6318***	0.3127	8.4161	8.7326***	0.5092	17.1512
GEXP	0.2461***	0.0135	18.2331	0.0819***	0.0193	4.2373
LEND	0.0161***	0.0047	3.4447	1.9176***	0.3541	5.4153
TAXR	3.5676***	0.6592	5.4124	−0.4778	0.4208	−1.1354
R^2		0.7783			0.1829	
Adj. R^2		0.7678			0.1440	
S.E. of Regression		0.1864			0.1057	
S.S of Residuals		5.1096			1.6413	
F-Statistic		3209.121***			18366.17***	

The superscript *** refers to the statistical significance at a level 0.001. Source: Authors collected and processed from R-software 4.1.3

other social transfer and other types of subsides which lead to an increase in purchasing power and thus an increase in demand, which encourages the expansion of production which leads to rise the levels of CO_2 emissions.

The second variable that represented fiscal policy is the TAXR, the results show that there is no significant relationship between the TAXR and CO_2 emissions in high-income countries where there is a positive direct effect and statically significant in middle-income countries at 0.001 level, indicating that an increase in the TAXR by 1% will increase CO_2 emissions by approximate 3.57%. In normal cases increasing taxes will lead to decrease CO_2 emissions by reducing the activity in the economy directly and indirectly by decreasing the income and then declining the aggregate demand but our result does not show that.

In spite of the inconsistent of last result with the majority of economic views, we have a reasonable explanation for that; firstly, in middle-income countries where tax system is not as perfect as developed countries so if tax increases, some of the client will evade or avoid paying tax by disappearing in the informal economy which is considered a big sector in that countries and then the deflationary effect of raising tax will not be achieved. Secondly, in high-income countries where citizens feel more luxury than others in addition to the weak sensitive of demand to prices, furthermore inefficient estimation of taxes in comparing with the negative externality of CO_2 emissions all that lead TAXR to be not significant.

On the other hand, in monetary policy which is represented by the LEND, the results show that there is a positive effect of it on CO_2 emissions in both middle and high income countries, furthermore the relationship is statically significant, however the effect of the LEND on CO_2 emissions in high-income countries is more than its effect in middle-income countries, our results recognize that in high-income countries, an increase in the LEND by 1% will increase CO_2 emissions by 1.92%, while in middle-income countries, an increase in the LEND by 1% will increase CO_2 emissions by 1.61%.

That is mean the more rising in interest rate, the more emissions of CO_2, and that also is considered as uncommon result because any raising in interest rate is supposed to decrease CO_2 emissions by raise the cost of investing plus the cost of consumption and that possibly will decrease the aggregate demand and then the economy is heading towards contraction, however we have a reasonable comment which may be able to explain that relationship.

The main point is the degree of risks, as low-carbon investments are more risky than carbon-intensive activities as these projects are needed high upfront capital costs furthermore uncertainty about climate change policy in the future (Donastorg et al., 2017), that mean the higher the interest rate, the more risky green investments become and become less preferable for investors in comparing with high carbon intensive investments.

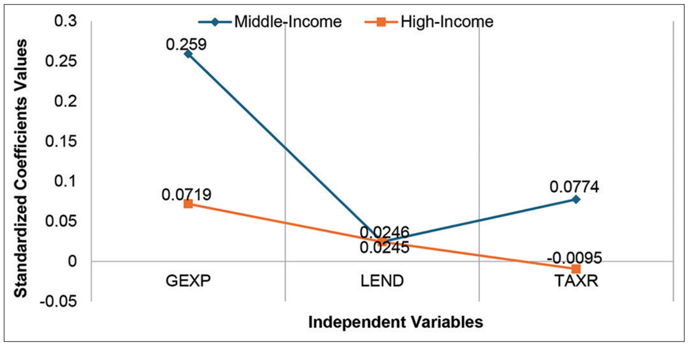
Figure 6 presents the standardized coefficients of the FEM for comparing the impact of independent variables between high and middle-income countries. The standardized coefficients convert values into a common scale, making them comparable and facilitating direct comparisons across different variables.

In this context, Figure 6 shows that for middle-income countries, the GEXP, LEND, and TAXR have positive effects, where GEXP having the highest standardized coefficient at 0.259. This indicates a relatively stronger influence of the GEXP on the CO_2 compared to the LEND and TAXR, which have a smaller but positive impact. In contrast, in high-income countries, the GEXP and the LEND have a modest positive effect, while the TAXR has a slight negative impact with a coefficient of −0.0095.

These differences highlight how the same economic policies may affect countries differently depending on their income levels, emphasizing the importance of tailoring economic strategies to the specific contexts of middle-income versus high-income nations. Where, this comparison shows the differing relationships between these variables and economic performance depending on a country's income level, with the GEXP playing a more prominent role in middle-income countries.

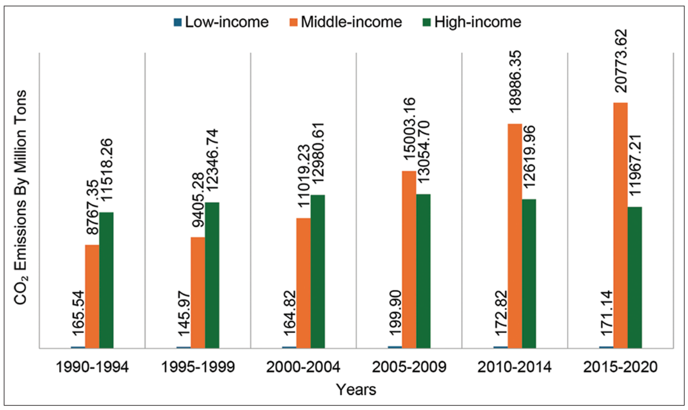
This study focuses on middle and high-income countries due to the availability and reliability of comprehensive data required to analyze fiscal and monetary policy impacts on climate change. Additionally, middle and high-income countries are generally more active in implementing economic policies, where middle and high-income countries have reliable and consistent data availability, as well as the significant role these countries play in both implementing fiscal and monetary policies and contributing to global climate change. making them more relevant to the scope of this study. In contrast, low-income countries often have incomplete or inconsistent data, which can introduce biases or inaccuracies into the analysis. Moreover, as illustrated in Figure 7, the CO_2 emissions from low-income countries are significantly

Figure 6: Standardized coefficients of final panel model



Source: Authors processed by R-software 4.1.3

Figure 7: CO_2 emissions for the countries according to income levels



Source: Authors processed by R-software 4.1.3

lower compared to those from middle and high-income countries. Figure 7 demonstrates that emissions from low-income countries are minimal compared to those from middle-income countries and high-income countries across different time periods from 1990 to 2020. Focusing on middle and high-income countries, therefore, provides a more robust and comprehensive analysis of their contributions to CO_2 emissions and climate change.

5. CONCLUSIONS

Despite the risks of climate change, economic policies in both middle and high-income countries are not helping to reduce CO_2 emissions, so we have to rebuild for these policies to able to adapt and mitigate climate change consequences, a set of recommendations can be made based on the results we obtained from the final model. For high-income countries, our model shows that monetary policy is more effective in comparing with fiscal policy, so it will be better if these countries aiming to declining interest rate or at least keeping it at low levels to decrease the cost of financing for green projects, furthermore these countries have to work on increase the effectiveness of their fiscal policy by re-pricing carbon taxes to reflect the externalities generated by carbon-intensive projects and goods in addition to raising public investments in green projects specially in generating the energy.

On the other hand, for middle-income countries, it seems that fiscal policy is more effective than monetary policy, so that they can reduce CO_2 emissions by restructuring the tax system in a way to decline the size of informal economy in addition to reprising taxes and taking into account to be lower for low-carbon investments as well as working on restructure public spending by reducing subsidies to fuel as well as raising spending on energy research, Thus, a low-carbon economy will be an engine of economic growth and rising income.

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