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Abstract

This research compares the GDP growth paths of four major nations—the US, UK, GERMANY, FRANCE—to examine the economic impact of climate policy. Time series analysis is used to track long-term economic and environmental developments from 1990 to 2022. The study explores the shifting relationship between climate policy interventions and economic indicators, concentrating on GDP growth and CO2 emissions. During the research period, all four nations spotted significant economic growth and variable degrees of CO2 emission reduction. The United Kingdom and France have achieved significant economic growth and pollution reductions, demonstrating effective climate policies and cleaner energy transitions. Due to its focus on renewable energy and sustainability, Germany has strong economic development and low emissions. Despite economic growth, the US has only marginally reduced CO2 emissions, highlighting the need for stronger climate measures. The study emphasises policy formulation, institutional frameworks, and supportive measures in determining climate policy economic consequences. Policymakers, stakeholders, and scholars may use its empirical findings to understand the complicated link between climate action and economic performance. The research adds to climate policy efficacy and sustainable economic growth by explaining the economic aspects of climate policies and comparing them.

Introduction

Climate change is a significant and serious issue of the 21st century, having wide-ranging effects on global economies, cultures, and ecosystems. As a reaction, countries globally have undertaken many climate policy efforts with the goal of reducing greenhouse gas emissions, adjusting to evolving environmental circumstances, and promoting resilience. As policymakers strive to find a balance between environmental goals and economic growth, there has been a growing focus on comprehending the economic consequences of climate policies.

This research aims to evaluate the economic consequences of climate policy by comparing the GDP growth paths of four significant nations: the United States, the United Kingdom, Germany, and France. Although there is increasing agreement on the need for immediate action to address climate change, there is a significant lack of research on the lasting economic impacts of climate policy, particularly when analysed using rigorous quantitative

public opinion and ensuring the efficacy of climate policy need excellent communication and participatory decision-making processes (Corner et al., 2014).

The literature also looks at how national climate policy will be affected globally by multilateral accords like the Paris Agreement. A review of the benefits and drawbacks of international collaboration in climate change mitigation by Victor (2011) and Bodansky (2016) makes clear.

An historical perspective on global efforts to address climate change may be gained by examining previous international agreements, including the Kyoto Protocol (1997), the Paris Agreement (2015), and the Copenhagen Accord (2009). These agreements mark important sea changes in the history of international cooperation and climate management.

Examining the national climate policies of the United States, Germany, France, and the United Kingdom reveals a variety of approaches and commitments. Resolving to achieve net-zero emissions by 2050 and the UK Climate Change Act from 2008 show a strong commitment to sustainability. Changes in U.S. policy, such the Clean Power Plan and the shift in positions from administration to administration, emphasize the dynamic nature of climate policy. Germany's Energiewende, which emphasizes renewable energy and increased energy efficiency, exemplifies a comprehensive energy transformation. France has recently become more reliant on renewable energy sources after previously being reliant on nuclear energy.

The literature also addresses the concerns of the present and the path forward, emphasizing the need for technical improvement, international cooperation, and adaptable legal frameworks. Among the difficulties include the need for continuous innovation in sustainable technology, the complexity of securing fair burden-sharing in international discussions, and the changing nature of national and international climate policy (Sebi, C., & Vernay, A. L., 2020).

A review of previous studies on the connection between climate policy and economic growth is presented, with a focus on noteworthy instances that demonstrate the harmonious coexistence of environmental and economic goals. It is concluded that carbon pricing plans are necessary to reduce greenhouse gas emissions without negatively impacting economic expansion, highlighting the need for well-considered legislation. Stern's study highlights the potential financial benefits of transitioning to a low-carbon economy in addition to the financial costs of doing nothing (Stern, N., & Xie, C., 2023).

Fossil emissions (CO2 emissions)

Fossil emissions measure the quantity of carbon dioxide (CO ₂) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO •includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

Other Economic Indicators

In addition to GDP growth, measures such as employment levels, productivity changes, investment patterns, and income distribution can give useful information on the economic impact of climate policy.

What Empirics Say?

Different empirical studies on the economic effects of climate policies have come up with different outcomes, which shows how complicated this issue is. Numerous studies that have looked at the connection between GDP growth and climate policies in various nations have shed light on the possible impacts of these policies on economic performance.

There is conflicting empirical data about the economic effects of climate initiatives in the United States. A carbon tax or cap-and-trade system, for example, might encourage economic efficiency and innovation while lowering greenhouse gas emissions, according to research by Aldy et al. (2010). However, the implementation of comprehensive climate policy at the federal level has been hampered by political obstacles and regulatory ambiguities, which has limited the field of empirical study on this issue.

According to research by Stern (2007), effective climate policies may promote investment in clean technology and innovation in the UK, which will boost economic development. Furthermore, by boosting productivity and generating new employment opportunities in low-carbon industries, the UK Committee on Climate Change (CCC, 2019) determined that enacting ambitious climate policies might support long-term economic growth.

boosted economic activity in areas like energy efficiency, green mobility, and the generation of renewable energy.

Overall, empirical studies on how climate policies affect the economy highlight how crucial institutional frameworks, supportive policies, and policy design are to deciding the results of these policies. A shift to a low-carbon economy has long-term economic advantages, but some studies also point to possible short-term costs, especially in the lack of sufficient legislative support. Furthermore, this thesis's comparative research will provide insightful information on the many ways that nations have implemented climate policy and achieved sustainable economic development.

Methodology

Our methodology for evaluating the economic effects of climate policy employs a comprehensive approach that combines data gathering, analysis, and interpretation. We depend on trusted databases, such as the World Bank's World Development Indicators, to acquire comprehensive and trustworthy data that covers a broad time frame from 1990 to 2022. The long duration of this era enables us to accurately observe and analyze economic and environmental patterns over a lengthy period, ensuring a strong and reliable basis for our study.

The data obtained from trustworthy sources, as described in the approach, will be used for analysis. The tables in the appendix, which provide time series data for GDP and CO2 emissions of the selected nations, will be used as the basis for the charts and the in-depth analysis. This methodology guarantees transparency, reproducibility, and precision in analyzing the economic consequences of climate policy in the United States, the United Kingdom, Germany, and France.

Our investigation focuses on identifying carbon dioxide emissions as a crucial factor. The core of the research is centred around time series analysis, which investigates the correlation between GDP growth and CO2 emissions for each country within the chosen time frame. Carbon dioxide emissions are important indications of a country's role in causing climate change and its influence on the environment. Our objective is to analyze the emissions data for the United States, the United Kingdom, Germany, and France throughout the stated time in order to identify patterns, trends, and changes in each country's environmental impact. This technique allows us to obtain valuable information about the efficacy of climate policies and efforts adopted by these countries over a period of time.

The investigation will employ models, as outlined in this work (Friedlingstein et al., 2023). The selection of these models is based on their appropriateness in portraying the dynamic interactions and possible causal linkages between GDP growth and CO2 emissions over a period of time.

Calculating adjusted GDP growth rates entails factoring in the environmental expenses linked to carbon dioxide emissions. These costs include a range of issues, such as harm to ecosystems, health implications, and spending for remediation. By integrating these

environmental expenses into our research, our objective is to provide a comprehensive viewpoint on economic development that takes into account both economic and environmental aspects.

Results

Fig 1: Change in CO •emissions and GDP, United States

When analyzing the green line that represents the change in GDP, we see that it has been steadily increasing, with a sharp rise until around 2007, followed by a dip during the global financial crisis, and then a continued upward trend with some fluctuations. The red line depicts the change in consumption-based CO2 emissions, which have been relatively low

saw a small decline, with emissions falling from 5.12 billion metric tons in 1990 to 5.06 billion in 2022. This is a moderate absolute reduction of around 63.65 million metric tons, with a tiny relative decline of 1%. Despite the economic expansion, the marginal reduction in CO2 emissions highlights the need for more robust climate policies and measures to decouple economic growth from carbon emissions, such as increased renewable energy adoption, improved energy efficiency standards, and stronger regulatory frameworks.

Fig 2: Change in CO •emissions and GDP, United Kingdom

When looking at the green line that represents the change in GDP, which has been steadily increasing, with a sharp rise until around 2007, followed by a dip during the global financial crisis, and then a continued upward trend with some fluctuations. The red line depicts the change in consumption-based CO2 emissions, which have been de (he g)10.5 (r)ave b10np6 (p)1nta.6 (on r

responsible for these developments, which indicate a successful decoupling of economic growth from carbon emissions.

Fig 4: Change in CO •emissions and GDP, France

The green line representing the change in GDP has been steadily increasing over the time period, with a sharp rise until around 2008, followed by a dip during the global financial crisis, and then a continued upward trend with some fluctuations. The red line depicting the change in consumption-based CO2 emissions has been relatively stable, with some fluctuations over the years, but showing a decreasing trend in recent years. The blue line shows the change in CO2 emissions, which follows a similar trend to the consumption-based emissions, with a more pronounced decrease in recent years. The graph suggests that France has been able to decouple its economic growth from CO2 emissions to some extent, with emissions remaining relatively stable or decreasing while the GDP continues to grow, particularly in recent years.

During the time under consideration, France saw substantial economic expansion, as its Gross Domestic Product (GDP) rose from $1.96 trillion in 1990 to $3.05 trillion in 2022. This is an absolute increase of almost $1.08 trillion and a relative increase of 55%. Simultaneously, France effectively reduced its CO2 emissions, lowering them from 393.43 million metric tons in 1990 to 297.53 million metric tons in 2022. This signifies a total reduction of around 95.90 million metric tons and a proportional drop of 24%. These patterns indicate a strong economic growth together with successful environmental regulations, which may include a transition towards cleaner energy sources and improved efficiency measures.

Fig 5: Change in CO •emissions and GDP for US, UK, Ger.6 .4H7 Tw/a10.5 0lns andr.6 aa10.5 0ncns

Table 2: United Kingdom GDP and CO2 Emissions (1990-2022)

Year	GDP, PPP (constant 2017 international $)

Table 3: Germany GDP and CO2 Emissions (1990-2022)

Year	GDP, PPP (constant 2017 international $)	Annual CO2 emissions	Annual consumption-based CO2 emissions
1990	2.91515E+12	1054740600	1194926000
1991	3.06406E+12	1016870300	1144321500
1992	3.12299E+12	969474200	1207437600
1993	3.09248E+12	959367200	1160422500
1994			

Table 4: France GDP and CO2 Emissions (1990-2022)

Year	GDP, PPP (constant 20 international $)	Annual CO2 emissions	Annual consumption-based CO2 emissions
1990	1.96441E+12	393430700	493079870
1991	1.985E+12	417775000	504327330
1992	2.01675E+12	407717280	545937800
1993	2.00407E+12	388397980	504507140
1994	2.05133E+12	381576320	492354750
1995	2.09454E+12	386456830	502071140
1996	2.12414E+12	402893150	504597700
1997	2.17377E+12	395511900	490037570
1998	2.25178E+12	413964540	509896960
1999	2.32882E+12	412369630	513189000
2000	2.42019E+12	406507520	519230820
2001	2.4682E+12	411016480	518791550
2002	2.49623E+12	406431040	511183000
2003	2.51678E+12	412456700	521593860
2004	2.588E+12	413663400	542455360
2005	2.63104E+12	416151140	551656450
2006	2.69548E+12	406309800	550430200
2007	2.76084E+12	396198180	550306100
2008	2.76788E+12	389427330	543767900
2009	2.68835E+12	370965630	504964220
2010	2.74076E+12	376563900	503268540
2011	2.80085E+12	354089100	501104600
2012	2.80963E+12	356444540	479554240
2013	2.82582E+12	358487460	466584800
2014	2.85284E+12	327009470	434584830
2015	2.88459E+12	331414430	422465020
2016	2.91619E+12	334005060	429594300
2017	2.98301E+12	336895900	427413500
2018	3.03864E+12	322078560	426542900
2019	3.09465E+12	315449730	413963360
2020	2.85374E+12	281539040	