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The impact of green monetary policy on sustainable economic development in pioneer countries

Vu Mai Chi[1+]
Nguyen Tuan Anh[2]
Nguyen Thi Thu Huyen[3]

[1]*Banking Faculty, Banking Academy of Vietnam, Hanoi, Vietnam.*
Email: chivm@hvnh.edu.vn
[2]*People's Committee of Yen Bai Province, Vietnam.*
Email: tuananhvbardtkpc@gmail.com
[3]*Banking Academy of Vietnam, Hanoi, Vietnam.*
Email: 24a4012067@hvnh.edu.vn

(+ Corresponding author)

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ABSTRACT

Climate change is currently one of the greatest challenges facing humanity, significantly impacting the effectiveness of economic policies. To address this issue, green monetary policy has been proposed as a strengthened measure that not only stabilizes prices and promotes economic growth but also helps reduce negative environmental impacts and supports the transition to a low-emission economy. Our paper aims to assess the impact of green monetary policy in pioneering countries, thereby making recommendations for expanding and perfecting this policy on a global scale. The paper focuses on studying the impact of green monetary policy in pioneering countries, including the United Kingdom, Germany, and China, during a period of intense global economic fluctuations from 2000 to 2020. The paper uses a PVAR model to analyze the impact of green monetary policy through variables such as interest rates, special reserves, inflation, unemployment rates, carbon emissions, and economic growth. Model results and some tests indicate that green monetary policy has a positive impact on long-term economic growth while helping to reduce carbon emissions in the environment. Every country should implement monetary policy in a green direction to contribute to economic and environmental stability. In this analysis, the authors provide recommendations to promote the greening of monetary policies in other countries worldwide.

Contribution/ Originality: This study uses the PVAR model to analyze the multidimensional impacts of green monetary policies in pioneering countries: the UK, Germany, and China during a new and volatile period from 2000 to 2020. The article integrates environmental factors into macroeconomics, provides practical recommendations, and contributes to the development of the global economy.

1. INTRODUCTION TO THE STUDY

Central banks and financial regulatory authorities are increasingly recognizing the effects of climate change on financial stability. According to Grippa, Schmittmann, and Suntheim (2019) climate change has significant impacts on monetary policy, slowing economic growth and increasing inflation volatility. Such an impact poses challenges to traditional monetary policy, which typically focuses on short-term factors such as interest rates and exchange rates, necessitating adjustments to address the long-term effects of climate change. One critical question is whether green monetary policy (GMP) can support advanced economies in achieving sustainable economic development goals. Furthermore, it remains to be seen if this shift towards greener monetary policies could become a global trend, providing opportunities for other nations to learn and implement similar measures. These questions are not only of

theoretical interest but also have strong practical relevance, as developed economies face the dual challenge of post-COVID-19 economic recovery while maintaining efforts to combat climate change.

In this context, many central banks have started to implement green monetary policies. In 2015, the Bank of England (BoE) was a pioneer in integrating climate change issues into its monetary policy objectives, marking the official introduction of the concept of "green monetary policy." Following this, in June 2018, the People's Bank of China included green bonds as eligible collateral for medium-term lending, thereby financially supporting green projects. In Germany, in 2020, the country published research on the effects of climate change on the financial system and began incorporating environmental factors into monetary policy decision-making processes. Currently, approximately 30 central banks have developed long-term strategies over the next 30 years, requiring major domestic financial institutions to carry out tasks related to combating climate change while also enhancing the monitoring of the greening of the financial system (Network for Greening the Financial System (NGFS), 2021). These nations are making efforts to integrate climate change factors into their monetary policies, though the degree of implementation and effectiveness varies depending on each country's economic conditions and regulatory frameworks. Therefore, it is necessary to study the impact of this policy in pioneering countries to offer recommendations for other nations in transitioning to a GMP model.

To date, many studies have been conducted, though most have focused on analyzing the effects of this policy on economic factors (Bacchiocchi, Ille, & Giombini, 2024) or describing the monetary policy approach in this new context (Aguila & Wullweber, 2024). However, there is a lack of empirical research demonstrating the impact of GMP policy on sustainable economic development, particularly in pioneer countries. Recent studies, such as Schnabel (2023), and reports from Network for Greening the Financial System (NGFS) (2021) indicate that despite numerous challenges, the trend toward GMP is gradually becoming a new norm in financial management. When properly implemented, GMP can become a crucial tool for balancing economic growth goals with environmental protection, especially as developed countries move toward low-carbon economies.

Thus, studying the impact of the green transition on monetary policy is essential for evaluating its role in achieving sustainable development goals in advanced economies and offering recommendations for other countries. Therefore, we structure this paper as follows: In Section 2, the literature review focuses on previous studies, especially empirical research on the effects of GMP. In Section 3, the data and research methodology are explained, with a focus on three leading countries: the UK, Germany, and China. In Section 4, the results are presented, including key findings and an analysis of the research data. Finally, in Section 5, the main points are summarized, and suggestions are made for other countries that want to switch to green monetary policies.

2. LITERATURE REVIEW

The world is currently facing numerous dangerous threats due to climate change, most evidently through natural disasters such as storms, floods, earthquakes, tsunamis, and outbreaks of deadly infectious diseases. This peril has been acknowledged by many central banks, which have accordingly adopted monetary policies that will maintain financial stability and mitigate the impacts of climate change. In the UK, the "green economy" concept originated in 1989 when the financial institutions began to analyze the impact of climate-related risks on the financial system's stability. Great GMP value has now been outlined by such reports as those of Carney (2015); Battiston, Mandel, Monasterolo, Schütze, and Visentin (2017); Campiglio et al. (2018); and Reinders, Schoenmaker, and van Dijk (2020). These studies thus raised issues that later became important in subsequent research on several matters relating to GMP, such as.) China's decision to curb green bond yields (Macaire & Naef, 2021), how GMP impacts corporate bonds in European countries (Schoenmaker, 2021), or its role in carbon emission reductions (Roy, 2024). They underline that, given the present circumstances, GMP is not merely a plausible option but rather an essential requirement.

From an economic perspective, GMP is very important for maintaining price stability and encouraging investment in the low-carbon sector. According to Schoenmaker (2019), this method reduces the cost of capital for businesses undertaking low-emission activities as opposed to high-emission industries, and it also aids in transferring assets as well as collateral to these sectors. It also allows the restructuring of loans and interest rates to develop the economy based on sustainable practices. As noted by Benkhodja, Ma, and Razafindrabe (2023), GMP policy represents a collection of financial tools aimed at fostering environmental conservation activities. The policy includes financing priorities for low carbon emission industries, renewable energy, and green business financing. Those actions achieve the two objectives of GMP: environmental protection and the creation of opportunities for sustainable economic development.

The VAR model family constitutes a very popular tool in quantitative studies of GMP, especially in terms of general monetary policy. An example of such work is that by Bernanke and Blinder (1992), where the authors applied the VAR model using macroeconomic factors—real GDP, bank credit, and a policy interest rate determined by the Federal Reserve—for their purposes. This model has been broadly applied in other works too, including Bagliano and Favero (1999); Favero and Marcellino (2001); Clarida, Galí, and Gertler (1998); and Clarida, Gali, and Gertler (2000) to estimate the monetary policy transmission mechanism with the aid of indicators like price indices (CPI), real economic activity variables, and even policy interest rates (e.g., Fed funds rate). Mishra and Montiel (2013) concluded that models commonly used to measure the effectiveness of monetary policy in developed countries use impulse response functions (IRF) from the VAR model.

However, when studying the impact of GMP across multiple countries simultaneously, the standard VAR model may not be suitable. Instead, the PVAR (Panel Vector Autoregression) model is considered a more effective solution. Holtz-Eakin, Newey, and Rosen (1988) were pioneers in proposing the PVAR model, which is based on panel data and adapted from the VAR model. Achieving success is challenging, especially in relation to Agile Methodology Project Management and its practices on a worldwide scale. However, this issue becomes more complex when the impact of multivariate regression equations is analyzed over large geographic regions, such as the EU from the years 2000 to 2020. It has been claimed that, on average, all EU member nations experience benefits that stem from their integration into the single market. In this specific case, Romania and Bulgaria appear to be at the losing end of the spectrum. Strikingly, any attempt to execute an analysis of the relationships between sets of multidimensional data (like Romania and the rest of the EU) is extremely difficult and arguably impossible if not performed in hindsight in light of the tremendous impact of the economic multivariate analysis that singled Romania out as a blue ocean. The PVAR model has been applied in various studies, such as Acheampong (2018) and Mamipour, Yahoo, and Jalalvandi (2019), to analyze the impact of economic factors on sustainable growth. This model allows for the evaluation of interactions between endogenous variables like interest rates, carbon emissions, and consumer price indexes, clarifying the relationship between GMP and sustainable economic development in the economy.

Due to the high informativeness of the majority of data sets provided by the World Bank, as well as the governments of particular countries, the authors of the research find a strong motivation for using techniques such as the economic multivariate analysis method combined with state forecasting modeling as a solution. This approach not only helps overcome the problems identified above but also provides a valid multivariate regression analysis over a specific period of time, covering all the EU member nations. Instead of looking at certain regions, the researchers are able to analyze core statistical indicators that define a specific set of relations between economic and geopolitical events. The use of this model promises to clarify the relationship between GMP and sustainable economic growth. Based on the analyses, this study will contribute to a clearer understanding of the impact of GMP on sustainable economic development in three key countries—the UK, Germany, and China—and provide relevant recommendations for other countries worldwide.

3. DATA AND RESEARCH METHODS

3.1. Data

Development of Variables to Measure the Influence of GMP: The authors chose from a set of variables based on data from three early adopters of this policy, namely the UK, Germany, and China. To calculate the appropriate sample size, the authors used the software Analytics Calculators with an expected effect size of 0.35, a p-value of 0.05, 5 predictor variables, and a statistical significance of 95%. With the above input data, Figure 1 shows that the required sample size is 63.

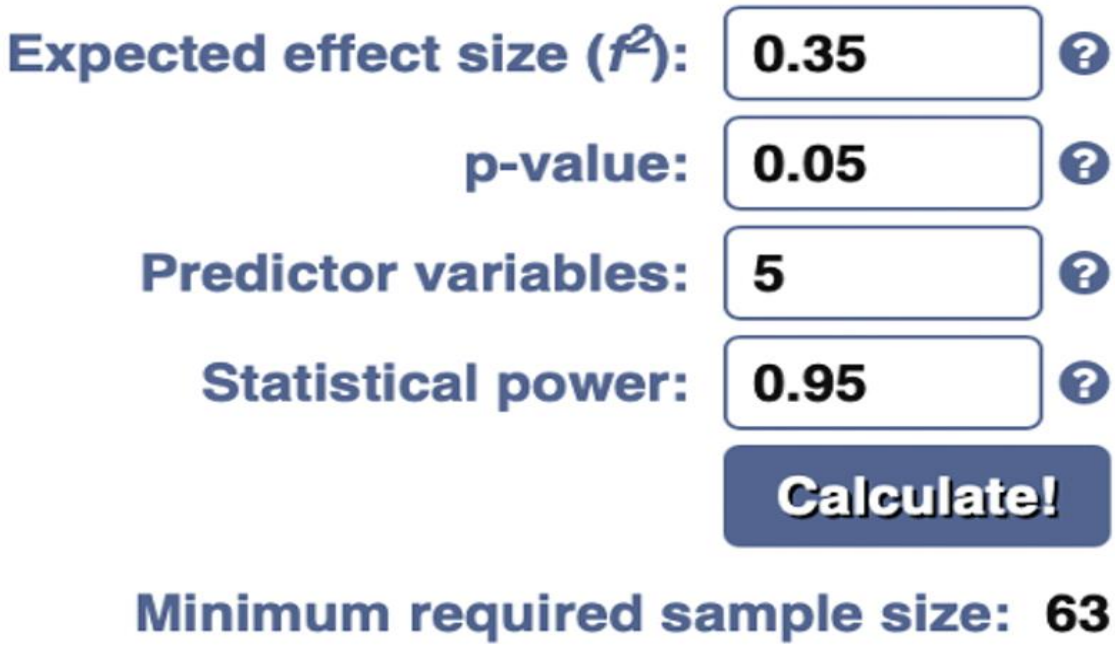


Figure 1. Results of the appropriate sample size calculation conducted by the authors using the analytics calculator software.

The researchers identified the 2000 to 2022 study period based on macroeconomic and environmental factors known to impact GMP. Table 1 summarizes the variables and describes these variables, providing a clearer relationship between GDP, CPI, unemployment rate, carbon emissions, policy interest rate, and special reserve.

Table 1. Statistical summary of variables in the model.

Variable	Definition	Research	Data source
Dependent variable			
lnGDP	Gross domestic product	Roy (2024) and Li, Ren, and Gao (2023)	IMF - International Monetary Fund
Independent variable			
lnCPI	Consumer price index	Aboobucker and Jahufer (2018) and Li et al. (2023)	FRED - Federal Reserve Economic Data
UE	Unemployment rate	Kukaj (2018) and Amaral and Roy (2022)	FRED - Federal Reserve Economic Data
lnE	Carbon emissions	Roy (2024) and Onofrei, Vatamanu, and Cigu (2022)	Our world in data
lnSDR	Special reserves level	Covalenco (2017) and Obstfeld and Taylor (1998)	IMF - International Monetary Fund
R	Central bank policy interest rates	Roy (2024) and Amaral and Roy (2022)	FRED - Federal Reserve Economic Data Trading Economy

The present study applied natural logarithms to all variables, with the exception of R and UE. Thus, the same values are written in absolute form, where data depending on the key value dispersion perspective is entirely different.

We have a huge amount of data, and it is difficult to check when we make changes from time to time. We may have high values, and data may mismatch, so here absolute values can be converted to relative values, which will be fewer in number and easier to track, which might improve the use of natural logarithms instead. This makes the PVAR model analysis easier because each variable only affects past observations from the same system and other random system observations in the PVAR model. This leads to Granger causality and gives a clear picture of the elements' causality relation, which helps figure out the GMP's role in the economy more accurately. As pointed out by Amaral and Roy (2022), the relationship between GDP, CPI, policy interest rates, and unemployment is crucial for a better understanding of economic dynamics.

Gross Domestic Product (GDP) is chosen as the main dependent variable in this study because it is a key indicator reflecting the overall economic condition of a country. The independent variables include the Consumer Price Index (lnCPI), the unemployment rate (UE), carbon emissions (lnE), special reserve levels (lnSDR), and central bank policy interest rates (R). These variables are incorporated into the model due to their significant impact on GDP and to observe the sustainable economic growth process of respective countries. Controlled lnCPI and lnR are closely related to each other, explained by how inflation control and interest rate stabilization are essential for GMP to be successfully implemented (Amaral & Roy, 2022). Furthermore, GMP needs to ensure that carbon reductions are achieved without detrimental effects on economic growth and with sustainable employment and reduced unemployment. Therefore, lnE, representing environmental factors, and UE, measuring the health of the labor market, are important variables for evaluating the effectiveness of GMP.

3.2. Research Methods

In this part, we will use the Panel Vector Autoregression (PVAR) model to show that the GMP exists and has an effect on long-term economic growth as measured by the lnGDP-dependent variable. The main justification for using the PVAR model here is threefold: firstly, the variables are all time-series data, and several of them contain autocorrelation; therefore, the PVAR model would be adequate for the type of data as it accounts for the autocorrelation present in the original time-series data. Second, the PVAR model can examine data across both dimensions of space (multiple countries, regions, or firms) and time. A third benefit of the PVAR model is that it allows you to look at the effect of GMP on multiple sustainable economic factors simultaneously. You can control how these factors interact with each other by using cross-sections (units).

Lastly, the PVAR model has been used in many earlier studies to look at credit channels and monetary policy. This means that results can be compared and contrasted with those from earlier studies, making sure that they are consistent and easy to understand (Holtz-Eakin et al., 1988).

As outlined, the research team will apply quantitative research methods using the PVAR model to assess the impact GMP has on sustainable economic development in three representative countries: the United Kingdom, Germany, and China, during the period from 2000 to 2022. Based on the theory and model of Holtz-Eakin et al. (1988), the empirical PVAR model applied in this study is as follows:

$$Y_{i,t} = A_0 + \sum_{p=1}^{P} A_P Y_{i,t-p} + \mu_i + \in_{i,t}$$

Where:

- $Y_{i,t}$ is a vector of endogenous variables, including lnGDP, lnCPI, unemployment rate (UE), policy interest rate (R), carbon emissions (lnE), and special reserves (lnSDR) of country i in year t.
- A_0 is a vector of intercept terms.
- A_p is the matrix of estimated coefficients of the endogenous variables at lag ppp, reflecting the impact of these variables at previous stages on their current values.
- p is the optimal lag length determined using appropriate model selection criteria.

- μ_i is the idiosyncratic error for each country (fixed country effects).
- $\epsilon_{i,t}$ represents the white noise, capturing random factors that are not observable.
- $\epsilon_{i,t}$ represents the white noise, capturing random factors that are not observable.

This model allows for the simultaneous analysis of the interrelationships among key macroeconomic variables within the PVAR framework, while also identifying the specific impact GMP has on sustainable economic development factors. In this way, the research team can evaluate the effectiveness of GMP in promoting sustainable economic growth, controlling inflation, reducing unemployment, and lowering carbon emissions in both the short and long term.

3.3. Descriptive Statistics

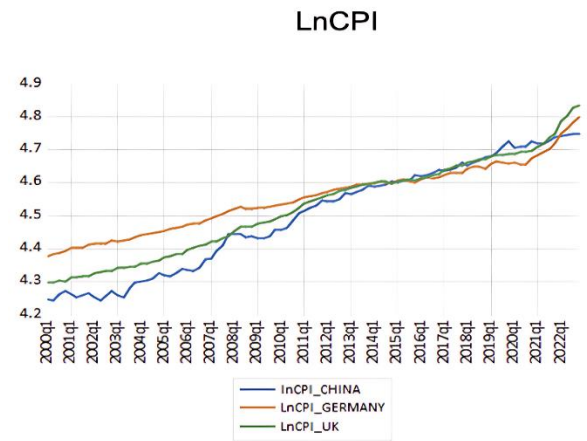
To assess the impact of GMP on sustainable economic development, the research team utilizes the PVAR model and conducts statistical tests to derive the most appropriate conclusions. In Table 2 the dependent variable, lnGDP, is shown along with the independent variables, lnSDR (special reserve levels), lnE (carbon emissions), lnCPI (consumer price index), R (policy interest rate), and UE (unemployment rate).

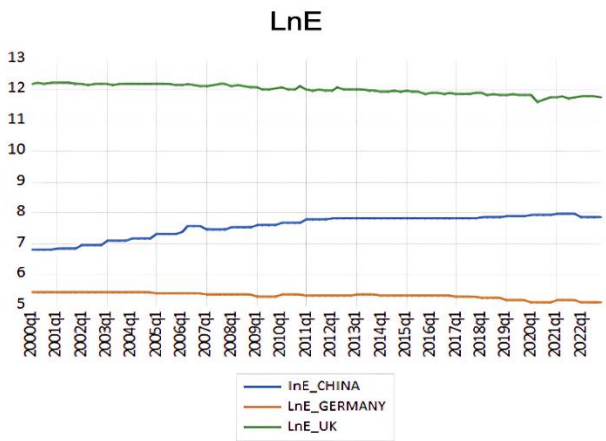
Table 2. Descriptive statistics for the dependent and independent variables.

Variable	Observations	Mean	Standard deviation	Min.	Max.
lnGDP	276	7.259	1.483	5.595	10.416
lnSDR	276	8.483	1.522	5.658	10.884
lnE	276	8.292	2.795	5.083	12.220
lnCPI	276	4.526	0.1421	4.244	4.835
R	276	2.139	1.750	-0.583	5.999
UE	276	7.328	2.715	2.9	14.85

Based on the descriptive statistics in Table 2, it can be seen that the values of the economic indicators exhibit considerable fluctuations over the years, with significant differences between countries. The average lnGDP is 7.259 with a standard deviation of 1.483, indicating significant differences in GDP among the countries during the observed period. All independent variables, lnSDR and R, also vary significantly, indicative of variation in the reserves and the policy interest rates used in those countries. The most significant differences are in lnE (SD = 2.795, Mean = 8.292) and UE (SD = 2.715, Mean = 7.328). On the other hand, the independent variable lnCPI has a standard deviation of 0.142 and a mean value of 4.526, which means the values of CPI are similar among the independent countries during the time frame of the study.

An examination of the diverse variables reveals the intricate influence of governmental monetary policies (GMP) on macroeconomic indicators. So, using a panel vector autoregression (PVAR) model is important for a full investigation of how these economic factors affect each other in many ways.





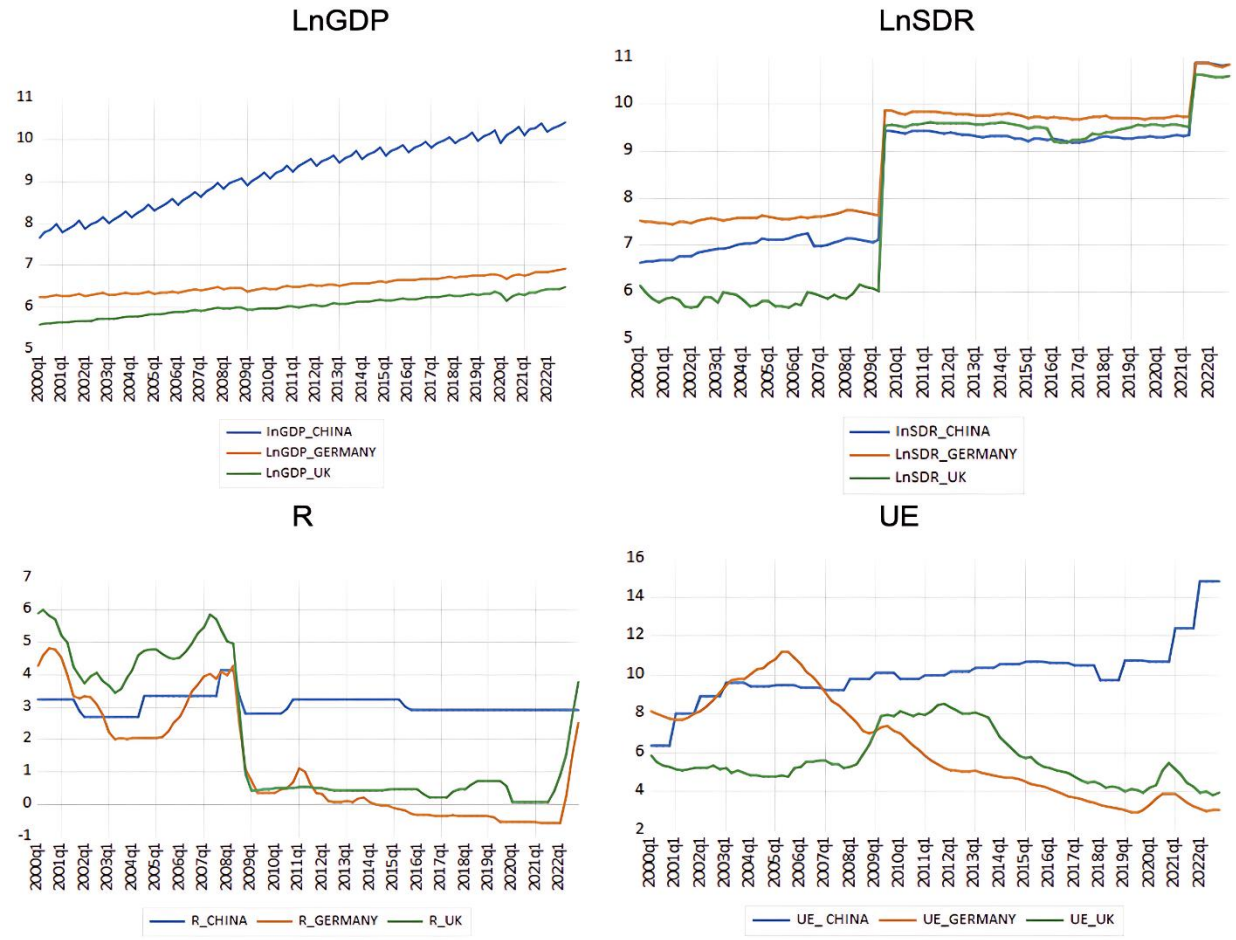


Figure 2. Graph illustrating the value of the observed variables during the period 2000-2022.

Figure 2 presents a graphical representation of the temporal trends of key economic variables across China, Germany, and the United Kingdom from 2000 to 2022. China experienced relatively consistent economic growth, as measured by the natural logarithm of gross domestic product (LnGDP), contrasting with comparatively lower growth rates in Germany and the United Kingdom. A rising trend in the consumer price index (LnCPI) is evident across all three nations, with a marked acceleration after 2020. China exhibited a steady increase, while Germany and the United Kingdom experienced more pronounced inflation towards the end of the period. In the case of carbon emissions (LnE), a persistent upward trajectory was observed in China, whereas Germany and the United Kingdom demonstrated lower and more stable emission levels. Significant increases in special reserve levels (LnSDR) were noted post-2016, particularly within China and the United Kingdom, reflecting adjustments in monetary reserve policies. A considerable decline in the unemployment rate (UE) was registered in Germany after 2005. Conversely, an upward trend in China's unemployment rate emerged in 2015, while the United Kingdom maintained relative stability. Marked fluctuations in policy interest rates (R) characterized the United Kingdom, in contrast to the more stable interest rate environments maintained in Germany and China.

4. MODEL RESULTS

4.1. Stationarity Test

The stationarity of the time series data underpinning the PVAR model was rigorously assessed. Employing the Augmented Dickey-Fuller (ADF) unit root test, the research team verified the fulfillment of the model's prerequisites. This procedure ascertained the time series' suitability for inclusion within the PVAR framework.

- *H_0 (Null Hypothesis): The time series is stationary (No unit root).*
- *H_1 (Alternative Hypothesis): The time series is not stationary (Presence of a unit root).*

Table 3. Unit root test results.

ADF	t-statistic	Prob.
	- 0.244	0.404
Residual variance	0.001	-
HAC variance	0.009	

The test results (Table 3) show that the P-value is 0.404, which is greater than the significance threshold of 0.05. Therefore, we cannot reject the null hypothesis (H0), indicating that the observed variables are stationary, meaning there is no unit root. The stationarity of the data is a crucial factor, as the PVAR model requires time series to be stable to avoid biased and inaccurate estimates.

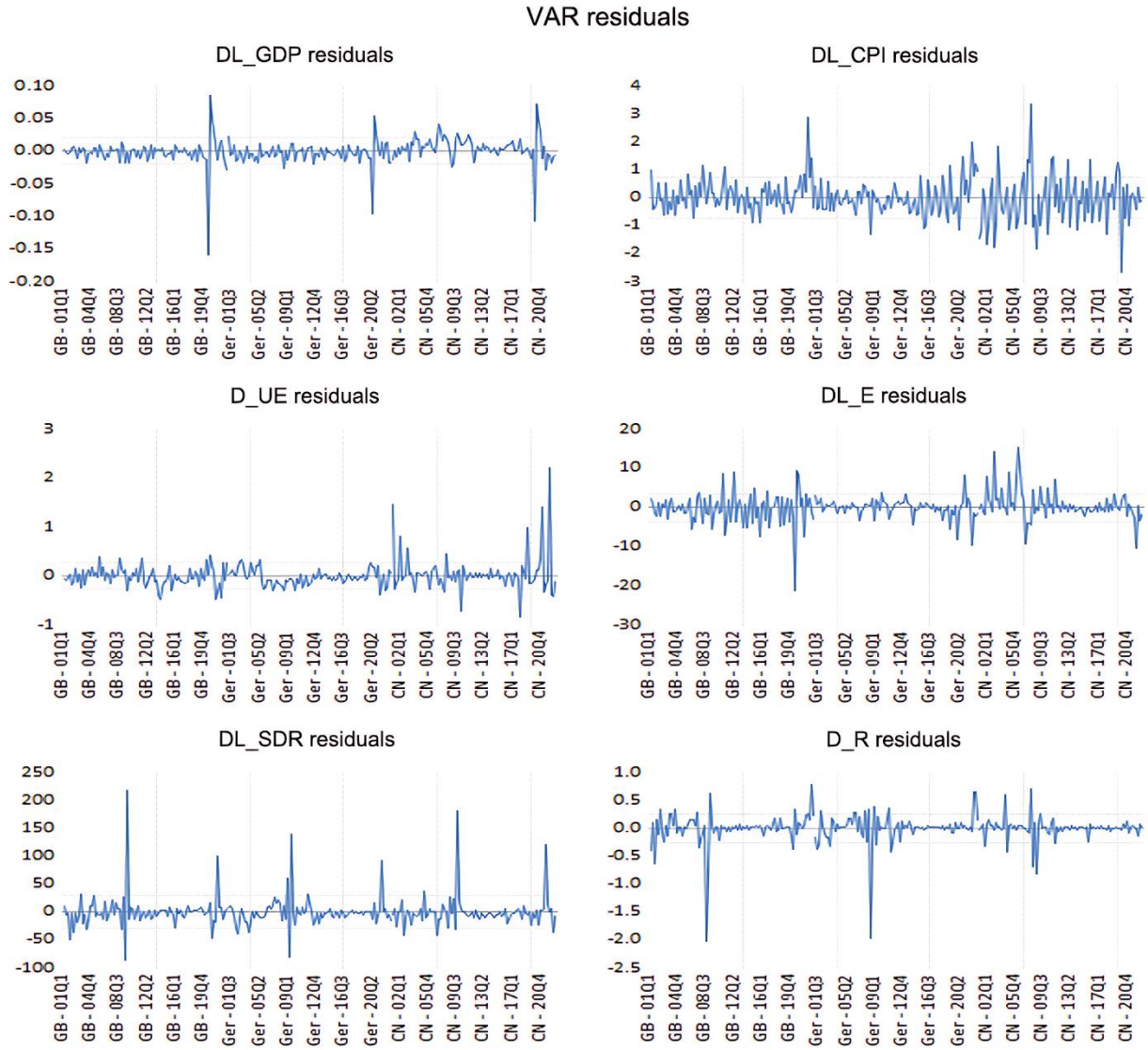


Figure 3. Results of the stationarity test for endogenous and exogenous variables.

Further validation was achieved through a graphical representation of residual behavior. Figure 3 depicts the residuals of the endogenous variables (DL_GDP, DL_CPI, DL_E, DL_SDR, and DL_UE) and the exogenous variable (DL_R). These residuals move back and forth around zero, showing that there are no clear trends or temporal instability. This makes the model even more stable. This finding confirms that these variables become stationary after differencing.

4.2. Optimal Lag Test

Lag length optimization for the PVAR model was achieved through a selection test encompassing eleven potential lags. Employing ordinary least squares, an Augmented Dickey-Fuller (ADF) test predicated on residual analysis, and a subsequent residual cointegration test were implemented. Analysis revealed a satisfactory model fit, with a three-lag structure selected as optimal.

Table 4. ADF test results based on the residual variable (RESID).

Variable	Coefficient	Std. error	t-statistic	Prob.
RESID(-1)	-1.187	-1.186	-7.695	0.000
D(RESID(-1))	-0.095	-0.095	-0.710	0.478
D(RESID(-2))	-0.132	-0.132	-1.273	0.204
D(RESID(-3))	-0.006	0.064	-0.101	0.919

Based on the research results in Table 4, the stationarity of the model was evidenced by a p-value of 0.000 for the RESID (-1) variable. This optimal lag ensured both model stability and data suitability. The findings support the chosen model specification.

4.3. Model Stability Test

The authors conducted a cointegration test for the model using the Kao (1999) method with the following hypotheses.

- *H_0: The model has no cointegration.*
- *H_1: The model has cointegration.*

Table 5. Co-integration test results.

ADF	t-statistic	Prob.
	1.396	0.081
Residual variance	0.001	-
HAC variance	0.000	

Table 5 presents the test results for the cointegration. The test results indicate that the P-value = 0.081 is greater than the significance level of 0.05, so we cannot reject the null hypothesis (H0). This proves that the model does not have cointegration, and therefore, the model is considered stable.

Table 6. Research results on the impact of independent variables on the dependent variable through the PVAR model.

Variable	DL_GDP	DL_CPI	D_UE	DL_E	DL_SDR	D_R
DL_GDP (-3)	0.2907	-3.4997	3.3507	20.6916	-75.6105	0.6342
DL_CPI (-3)	-0.0014	0.0432	-0.0254	-0.6066	2.2448	0.0122
D_UE (-3)	0.0014	0.081	0.034	0.5260	2.0682	-0.0127
DL_E (-3)	0.0006	0.0412	-0.0074	-0.1280	0.5528	-0.0038
DL_SDR (-3)	3.49E-06	3.30E-05	-0.0006	-0.0037	-0.0364	0.0006
D_R (-3)	-0.0091	0.0159	-0.0160	-0.2858	-63.4526	-0.0228
C	0.0102	0.4302	-0.0673	-0.7529	2.2402	-0.0462

4.4. Model Results

Based on the research results in Table 6, the dependent variable, a key metric for assessing economic performance and the effects of green monetary policy, is GDP (DL_GDP). Its fluctuations show how well policies are working to support sustainable growth. It represents the total value of goods and services produced within an economy. With the coefficient for DL_CPI (-3) being -3.4997, the model indicates that the consumer price index has an inverse effect on economic growth. Other independent variables that have a substantial impact on GDP are DL_CPI, DL_SDR,

and D_R. Special reserves and policy interest rates hurt GDP growth at the third lag because of stricter monetary policies or bad financial market conditions. This is shown by the negative coefficients of both DL_SDR (-3) and D_R (-3).

- CPI (DL_CPI): The CPI calculates inflation by taking into account shifts in the costs of goods and services throughout the economy. The findings demonstrate a positive correlation between CPI and variables such as DL_E (carbon emissions) and DL_SDR, suggesting that special reserves and emissions are similarly impacted by price increases.
- Unemployment (D_UE): One important measure of the state of the labor market is the unemployment rate. The findings show that, although its coefficient is lower than that of other variables, unemployment has a direct impact on GDP. This conclusion implies that although the labor market has an impact on economic growth, it is not as significant.
- Carbon emissions (DL_E): The economy's effects on the environment are reflected in carbon emissions. This variable's negative correlation with GDP highlights the trade-off between environmental conservation and economic growth, suggesting that rising emissions may accompany economic expansion.
- Special reserves (DL_SDR): One of the most important indicators of a nation's capacity to withstand economic shocks is its special reserves. Reserves have a favorable effect on CPI but a negative effect on GDP, indicating that while accumulating foreign reserves may assist in controlling inflation, it may also slow growth.
- Interest rates for policy (D_R): Both GDP and CPI are significantly impacted by interest rates, highlighting the significance of monetary policy in controlling the economy. The negative coefficient for D_R shows that higher interest rates can reduce GDP.

In conclusion, the model results indicate that GMP significantly affects economic growth through changes in CPI, unemployment, emissions, and interest rates. The relationship between GDP and carbon emissions clearly demonstrates the trade-off between growth and environmental protection.

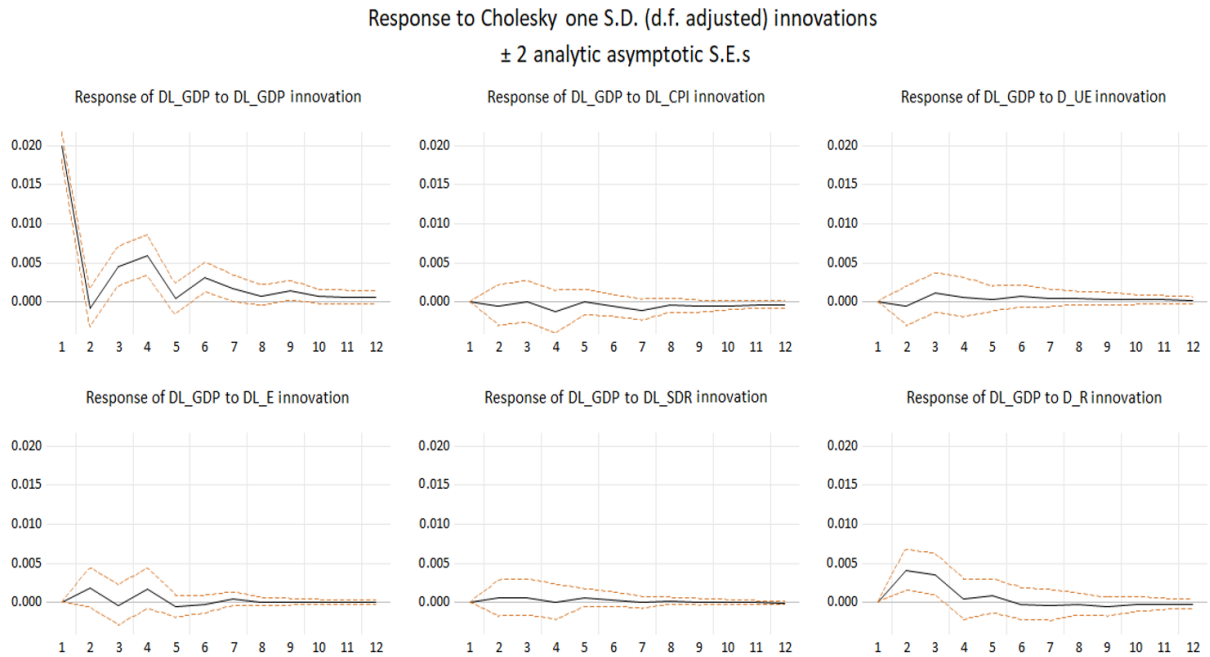


Figure 4. Research results on the impact of independent variables on the dependent variable.

Based on Figure 4, it can be observed that economic variables significantly influence GDP in the early stages, with strong fluctuations in the first few quarters that gradually stabilize in later quarters. The response curves of the variables remain within the standard error limits, confirming that the results hold economic significance.

- DL_CPI: In the first quarter, the consumer price index has a small inverse effect on GDP (~0.04%) and reaches its lowest point in the fourth quarter (~0.12%). Afterward, the impact gradually diminishes and stabilizes around the eighth quarter. This aligns with the theory that rising inflation erodes purchasing power, limiting consumption and negatively affecting GDP (Kyo, 2018).
- D_UE: The unemployment rate initially has a negative impact on GDP, but from the third quarter onward, this effect turns positive (~0.12%), peaking in the fifth quarter before stabilizing. Although unemployment and GDP typically have an inverse relationship (per Okun's Law), government intervention could explain why unemployment may positively influence GDP in certain periods.
- DL_E: Carbon emissions have a stronger and more variable impact in the early quarters, reflecting the relationship between industrial development and economic growth. As industries recover, rising emissions are often accompanied by GDP growth (Singh, 2024). However, this relationship stabilizes as green technologies and environmental policies are introduced.
- DL_SDR and D_R: Interest rates and special reserves have a positive effect on GDP; they peak in the second and third quarters and level off in the sixth. Because increased savings and capital inflows assist in managing inflation and stable exchange rates, interest rates in particular have a greater impact and foster an environment that is conducive to economic growth (Davcev, Hourvouliades, & Komic, 2018; Przeworski & Vreeland, 2000).

All things considered, the study's conclusions support accepted economic theories and emphasize how crucial GMP is to controlling economic variables to meet sustainable development objectives.

5. DISCUSSION AND CONCLUSION

5.1. Discussion

This essay provides a comprehensive analysis of GMP's role in developed countries, which have to strike a balance between maintaining environmental preservation and economic stability. The results demonstrate that incorporating environmental factors into monetary policy decisions not only reduces the negative effects of climate change but also supports national financial stability. Such an effort is a significant step in moving away from a traditional economic paradigm and toward one that prioritizes sustainable development. The study also gives other nations a way to integrate monetary policy with objectives for sustainable development in the context of globalization.

Pioneering countries such as the United Kingdom, Germany, and China, which have implemented green monetary policies, have demonstrated considerable promise in building new economic models based on green principles. The achievements of these countries send a positive signal to policymakers and create a foundation for promoting a global shift toward a low-carbon economy while ensuring long-term development.

5.2. Conclusion

The report underlines the importance of GMP in achieving sustainable economic development in industrialized countries. The study's findings suggest that GMP, through economic parameters like interest rates, inflation, and so on, or environmental measures such as carbon emissions, contributes to the creation of a balanced economic framework, hence striving for sustainable economic growth. Experience from pioneering countries such as the UK, Germany, and China has demonstrated that integrating environmental factors into policies will contribute to stabilizing the economy and aiming for sustainable development in the long term.

5.3. Limitations

Although the study yielded encouraging results, several limitations need to be considered. The research focuses only on three developed countries, which may limit its applicability to developing or transitional economies. Developing or transitional economies often face greater financial and environmental challenges. Therefore, the results

from developed nations may not fully reflect the global context, especially in regions heavily affected by climate change but with fewer resources to cope. Secondly, the variables used in the study are primarily macroeconomic, such as GDP, inflation, and interest rates, without accounting for social, cultural, or political factors. These limitations could lead to an incomplete evaluation of the practical implementation of GMP. Lastly, the data analyzed spans from 2000 to 2022. Given the rapid changes in economic and environmental conditions, especially after the COVID-19 pandemic, there may be factors not fully captured in this research.

5.4. Recommendations

Based on the findings, the authors propose several key recommendations for GMP.

- Flexible inflation control through GMP: Inflation control should be managed through reasonable interest rate policies that maintain price stability while encouraging investment and savings. Central banks should closely monitor CPI and GDP indicators to ensure flexible policy adjustments while maintaining economic stability.
- Promote investment in green infrastructure: Public investment in green infrastructure projects, such as renewable energy and public transport, will reduce unemployment and facilitate sustainable development. Policies should offer tax and credit incentives to encourage the private sector to actively participate in green projects.
- Advance green technology and innovation: Developing green technology is key to reducing carbon emissions and laying the foundation for sustainable growth. Governments should support research and development of advanced technological solutions and encourage the transition to high-tech and service sectors.
- Strengthen foreign exchange reserves and maintain exchange rate stability: Strong foreign exchange reserves are crucial for stabilizing exchange rates and mitigating the impact of global economic shocks. This procedure not only ensures economic stability but also promotes exports and controls imported inflation.
- Foster international cooperation on sustainable development: International cooperation plays a vital role in learning from others' experiences and attracting foreign investment in green projects. Developing countries may use green finance efforts from industrialized countries to attract money and support sustainable development.

These proposals attempt to assist nations in achieving sustainable economic development by balancing growth and environmental preservation while maintaining the stability of the national financial and monetary systems.

5.5. Suggestions for Future Research

The intricate relationship between monetary policy, climate change, and sustainable development presents difficulties for the young and promising field of GMP research. The majority of current research focuses on industrialized countries with substantial financial foundations and notable accomplishments in the green economy, such as China, Germany, and the United Kingdom. To gain a more comprehensive understanding of the impact of GMP and develop effective solutions for other nations, future research should expand to developing countries and transitional economies, where climate change pressures are more severe but financial resources are limited. Future research should concentrate on nations with a range of political, economic, and environmental traits to offer insightful guidance for the global green transition. Furthermore, nations in Southeast Asia, Brazil, India, and other growing economic centers have the potential to strongly embrace GMP. Research conducted in these areas will assist in determining adaptable policy approaches that can be used anywhere in the world and will shed light on whether green policies are feasible in various economic environments.

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