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Assessing the Effects of Chinese Foreign Direct Investment on Green GDP Development in North and South American Regions

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Abstract: This study aims to investigate the impact of foreign direct investment (FDI) on the growth of green GDP (GGDP) in North America and South America. The research is based on a comprehensive dataset covering the period from 2009 to 2019, drawn from multiple countries. By employing a two-way fixed-effects model, the study analyzes the effects of key factors, including FDI, trade openness, economic development level, urbanization level, population size, and industrial structure on GGDP growth.The findings indicate that, in North America, both FDI and the level of economic development exert a significant positive influence on GGDP growth, whereas trade openness demonstrates a negative impact, suggesting that increased trade activities may exacerbate environmental pressures. In South America, while the level of economic development shows a significant positive correlation with GGDP, the effect of FDI is not statistically significant. The study recommends that policymakers focus on enhancing the effectiveness of foreign investment and implement stricter environmental protection policies to ensure that trade activities do not adversely affect the environment. Furthermore, there is an urgent need to adjust the current industrial structure to promote a transition toward more sustainable development models. Ultimately, this research emphasizes the importance of ensuring environmental sustainability while fostering foreign investment and economic growth to achieve long-term growth in green GDP.

Keywords: Green GDP, Foreign Direct Investment, Two-Way Fixed Effects.

1. Introduction

The North American and South American regions play an increasingly significant role in the context of global economics and environmental sustainability. North America is renowned for its developed economies and abundant energy resources, including countries such as Canada, the United States, and Mexico, which occupy critical positions in the global energy supply chain. In contrast, South America attracts attention for its diverse natural resources and rapidly growing economies, with countries like Brazil, Argentina, and Chile actively seeking sustainable development pathways to address environmental changes and social demands. As concerns over sustainable development continue to rise, the impact of foreign direct investment (FDI) on green GDP (GGDP) growth in these regions has garnered widespread interest. GGDP serves as a vital indicator for measuring sustainable economic development, accounting for the environmental costs associated with economic activities, making it crucial to understand the effects of FDI on GGDP growth.

This study aims to analyze the influence of key factors—including FDI, trade openness, economic development level, urbanization level, population size, and industrial structure—on GGDP growth in North American and South American countries over the period from 2009 to 2019. By conducting an in-depth analysis of data from various countries, including Argentina, Brazil, Colombia, Chile, Canada, the United States, and Mexico, this paper employs a two-way fixed-effects model to explore the economic relationships among these variables.

The significance of this research lies in its ability to elucidate how FDI impacts the energy sectors of North America and South America, providing valuable policy insights for optimizing foreign investment to foster sustainable economic growth. The findings will enrich the academic discourse surrounding regional sustainable development and examine the role of FDI in facilitating energy transitions. Furthermore, considering the differences in economic structures and environmental policies between the two continents, this study will offer new perspectives for understanding the effects of FDI on GGDP in diverse contexts.

2. Literature Review

In recent decades, China's foreign investment has experienced rapid growth, particularly under the impetus of the Belt and Road Initiative, establishing the country as one of the significant global investors. Research indicates that Chinese investments play a crucial role in the economic growth of regions such as Latin America and Africa.

Firstly, Luo Jie (2016) analyzed the characteristics of China's foreign investment and its impact on economic growth, noting that China's investment scale has rapidly expanded on a global scale. Despite still being in its nascent development stage, future investment hotspots are expected to concentrate on countries along the Belt and Road and developed nations [1]. Meanwhile, Song Yiming and Dai Luqing (2024) emphasized that, within the resource-rich context of Latin American countries, the security risks associated with Chinese investments are increasingly pronounced, particularly regarding community interference and external intervention [2].Tabor (2022) explored the impact of Chinese foreign direct investment on economic growth in Sub-Saharan Africa and South America, concluding that Chinese investments significantly promote economic growth in these countries, with a more pronounced effect

observed in South America [3]. Wang Fei (2020) examined the driving factors behind Chinese investments in Brazil and found that market and trade opportunities are more critical than resource-driven motives, contrasting with the views of other scholars [4]. Wei Dan and Tang Yanyan (2020) investigated the consensus between China and Brazil on investment facilitation policies, highlighting the efforts and collaboration of both countries in optimizing their investment environments [5]. Chen Taotao et al. (2020) analyzed the investment environment in Argentina and the opportunities and challenges for Chinese enterprises, noting that although foreign investment policies are open, macroeconomic instability still limits Chinese investments [6]. In the context of globalization and post-national reforms, Ghiggino (2019) examined Chinese investments in Argentina, emphasizing the interrelationship between Argentine government reforms and Chinese investments, arguing that these factors significantly determine the direction of Chinese investments in the country [7]. At the same time, Marquez (2018) assessed the impact of Chinese foreign direct investment on Venezuela's economy, suggesting that due to domestic economic shortcomings and inadequate industry development, Chinese investments have not flourished as expected [8]. Lü Yang (2016) summarized the current status of Chinese investments in Latin America, noting that China's investments in the region are gradually deepening, laying the foundation for broader economic cooperation [9].

Overall, existing literature indicates that while Chinese foreign investment propels economic growth, it also faces multiple challenges, including security risks, policy environments, and market structures. Future research could further explore the specific mechanisms through which Chinese investments exert their influence and their performance in different regional and economic contexts, providing theoretical foundations for relevant policy formulation.

3. Empirical Research

3.1. Data and Variables

Table 1. Variables and Sources

Variable	Sources of variables
Green GDP	The database is sourced from reference [10].
FDI	World Bank
Trade Openness	World Bank
Economic Development Level	International Monetary Fund (IMF)
Urbanization Level	World Bank
Population Size	World Bank
Industrial Structure	World Bank

This empirical study is based on a dataset covering the years 2009 to 2019 for a selection of North American and South American countries, including Argentina, Paraguay, Brazil, Bolivia, Ecuador, Colombia, Guyana, Peru, Suriname, Venezuela, Uruguay, Chile, Barbados, Panama, Belize, the Dominican Republic, Costa Rica, Cuba, Honduras, Canada, the United States, Mexico, Nicaragua, El Salvador, Trinidad and Tobago, Guatemala, and Jamaica. This comprehensive dataset serves as an ideal foundation for analyzing the impact of foreign direct investment (FDI) on green GDP (GGDP) growth in these regions. Table 1 presents the dependent and explanatory variables, along with their sources, facilitating a thorough examination of the relationships between these key factors.

3.2. Model Setup

To investigate the spatial relationships among Middle East and North Africa (MENA) countries, this study employs panel regression analysis with log-transformed data. The model is specified as follows:

$$GGDP=\alpha+\beta1\times FDI+\beta2\times \text{Trade Openness}+\beta3\times \text{Economic Development Level}+\beta4\times \text{Urbanization Level}+\beta5\times \text{Population Size}+\beta6\times \text{Industrial Structure}+\epsilon t \quad (1)$$

3.3. Empirical Results

3.3.1. North America

The empirical research results are shown in Table 2.

Table 2. Regression Results

Variable	Coefficient	P>|z|
FDI	0.0028	0.001
Trade Openness	-0.0394	0.000
Economic Development Level	0.9385	0.000
Urbanization Level	-0.0623	0.473
Population Size	1.1345	0.000
Industrial Structure	0.0018	0.721

This study employs a two-way fixed-effects model to investigate the relationship between green GDP and several key variables, including foreign direct investment (FDI), trade openness, economic development level, urbanization level, population size, and industrial structure. Utilizing a dataset consisting of 165 observations from 15 countries over the period from 2009 to 2019, the analysis aims to elucidate how these factors influence green GDP growth.

The model results indicate a high level of explanatory power, with R-squared values showing Within = 0.9919, Between = 0.9971, and Overall = 0.9971. These figures suggest that the model effectively captures the variations in green GDP, particularly highlighting that the Within R-squared value is close to 1, which signifies a strong explanatory capacity for intra-country variations in green GDP. The F-test statistic confirms the overall significance of the model, indicating that at least one of the independent variables has a statistically significant linear relationship with green GDP. This result reinforces the validity of the model in capturing the dynamics at play.

Among the independent variables, FDI demonstrates a significant positive impact on green GDP. This finding suggests that increased foreign direct investment is instrumental in fostering sustainable economic growth. Conversely, trade openness shows a notable negative impact on green GDP, potentially reflecting the environmental burdens associated with increased trade activities. Moreover, the economic development level exhibits a significant positive correlation with green GDP growth, highlighting the potential for economic resources to support environmental protection initiatives. Urbanization level presents no significant effect on green GDP, suggesting the need for further investigation into its long-term implications. Population size affirms a positive correlation with green GDP growth, likely due to increased economic activities and environmental investments.

Lastly, the industrial structure reveals no significant impact on green GDP, which may necessitate deeper exploration into its potential effects. The constant term also fails to reach significance, indicating that the green GDP value does not

significantly differ when all independent variables are set to zero.

In summary, the findings underscore the significant roles of FDI and economic development in influencing green GDP growth, while trade openness appears to exert a negative impact. The effects of urbanization and industrial structure on green GDP remain insignificant, suggesting these variables may not be primary drivers within the current model. Future research could benefit from examining the specific mechanisms through which FDI influences green GDP, as well as the underlying causes of trade openness' effects on environmental sustainability, to achieve a more comprehensive understanding of the multifaceted determinants of green GDP.

3.3.2. South America

The empirical research results are shown in Table 3.

Table 3. Regression Results

Variable	Coefficient	P>|z|
FDI	0.0031	0.805
Trade Openness	-0.1931	0.091
Economic Development Level	0.3917	0.000
Urbanization Level	0.5956	0.794
Population Size	0.8123	0.169
Industrial Structure	-0.8821	0.000

This study employs a two-way fixed-effects model to analyze the relationship between green GDP (Y) and several key variables, including foreign direct investment (FDI), trade openness, economic development level, urbanization level, population size, and industrial structure. Utilizing a dataset comprising 132 observations from 12 countries, the analysis aims to elucidate how these factors influence green GDP growth.

The model results reveal substantial explanatory power, with R-squared values indicating Within = 0.6021, Between = 0.9789, and Overall = 0.9750. These values suggest that the model effectively captures variations in green GDP, particularly emphasizing that the Between R-squared is significantly high, indicating a strong ability to explain differences among countries.

Among the independent variables, FDI demonstrates a coefficient of 0.0031, which is not statistically significant, indicating that its impact on green GDP may be limited. In contrast, trade openness exhibits a negative coefficient of -0.1931, suggesting that increased trade activities could exacerbate environmental pressures, despite its benefits for economic growth.

The economic development level shows a significant positive correlation with green GDP, reflecting how higher economic activity can enhance environmental protection initiatives. However, urbanization level and population size do not yield significant effects, indicating the need for further exploration of their roles.

Lastly, the industrial structure presents a negative coefficient of -0.8821, implying that the current industrial setup may hinder green GDP growth. Overall, the findings underscore the importance of economic development while cautioning against the negative impacts of trade openness and the need for structural adjustments in the economy.

3.4. Policy Recommendations

3.4.1. North America

Based on the findings from the study conducted in North America, foreign direct investment (FDI) and the level of economic development significantly influence the growth of green GDP (GGDP). To promote GGDP growth effectively, policymakers should actively attract FDI, particularly in the green energy sector. This can be achieved by offering incentives such as tax reductions and subsidies, as well as streamlining the approval processes for foreign investments in renewable energy and clean technology projects. These measures will not only stimulate economic growth but also foster a win-win situation for environmental protection.

Additionally, the negative impact of trade openness on GGDP necessitates the development of relevant environmental protection standards while promoting trade. Policymakers should focus on formulating trade policies that minimize environmental pressures associated with increased trade activities. Establishing environmental standards and encouraging the creation of environmentally friendly trade agreements with other countries can facilitate the exchange and cooperation of green products and technologies.

Furthermore, enhancing support for economic development, particularly in infrastructure and innovation investments, is essential. This will improve the overall competitiveness of the nation, create more green job opportunities, and strengthen environmental protection capabilities. In regions experiencing rapid urbanization, prioritizing investments in sustainable infrastructure projects will help mitigate environmental impacts.

Lastly, it is crucial to reinforce environmental regulations and supervisory mechanisms to ensure the effective implementation of all policies. Establishing an effective evaluation system to regularly monitor the relationships between FDI, economic development, and GGDP will allow for timely policy adjustments to achieve sustainable development objectives.

3.4.2. South America

In the context of South America, although there is a significant positive correlation between the level of economic development and GGDP, the impact of FDI appears to be insignificant. Therefore, policymakers should concentrate on enhancing the effectiveness of foreign investment, particularly by directing investments toward specific industries or projects that could improve the contribution of FDI to GGDP. This targeted approach may require incentives and support to attract FDI to critical sectors that promote environmental sustainability.

Moreover, given the potential negative relationship between trade openness and GGDP, the government should implement stricter environmental protection policies to ensure that trade activities do not exacerbate environmental pressures. This includes establishing guidelines and regulations that align trade practices with environmental sustainability goals.

Additionally, addressing the current industrial structure is imperative. Policymakers should implement structural adjustments that promote industrial upgrades, particularly transitioning toward greener and more sustainable development models. This shift is vital to enhancing GGDP growth potential while aligning economic activities with environmental goals.

In summary, the policy recommendations for both North America and South America emphasize the necessity of balancing foreign investment and economic growth with environmental sustainability to achieve long-term growth in green GDP. By adopting these strategies, policymakers can

foster a coordinated approach that supports both economic development and environmental stewardship across the regions.

4. Conclusion

This empirical study explores the dynamics influencing green GDP (GGDP) growth in North America and South America, focusing on the roles of foreign direct investment (FDI), trade openness, economic development level, urbanization level, population size, and industrial structure. The analysis is grounded in robust datasets covering various countries between 2009 and 2019, employing two-way fixed-effects models to capture the intricate relationships among these variables.

In North America, the findings reveal that FDI and economic development level significantly drive GGDP growth. The positive coefficient for FDI underscores its critical role in fostering sustainable economic development, while the significant correlation between economic development and GGDP highlights the necessity for resource allocation to support environmental protection initiatives. Conversely, trade openness exhibits a detrimental impact on GGDP, suggesting that increased trade activities may exacerbate environmental pressures. The limited significance of urbanization and industrial structure calls for further investigation into their long-term effects.

In South America, while economic development shows a significant positive correlation with GGDP, the impact of FDI is not statistically significant, indicating the need for strategies that enhance the effectiveness of foreign investment. The negative coefficient associated with trade openness necessitates the implementation of stricter environmental policies to mitigate the adverse effects of trade on the environment. Additionally, addressing the current industrial structure is vital for promoting greener development models.

Overall, the study emphasizes the importance of balancing foreign investment and economic growth with environmental sustainability. By implementing targeted policy recommendations, such as attracting FDI in the green energy sector and enforcing stricter environmental regulations, both regions can achieve long-term growth in green GDP while fostering economic development and environmental stewardship. Future research should further explore the mechanisms through which these factors interact to enhance our understanding of sustainable economic practices in different contexts.

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