

# Economic Prosperity at a Crossroads Examining the Dynamic Relationship between Carbon Emissions, Environmental Degradation, and Development Strategies

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**Abstract:** Carbon dioxide (CO<sub>2</sub>) emissions stand out as a primary catalyst for severe environmental deterioration, exerting detrimental effects on climate patterns and human endeavors. While numerous studies have delved into the factors influencing CO<sub>2</sub> emissions, the role of institutional quality remains an underexplored dimension. Our research seeks to enrich the existing body of knowledge by scrutinizing the impact of financial development, institutional quality, foreign direct investment, trade openness, urbanization, and renewable energy consumption on CO<sub>2</sub> emissions from 1996 to 2020, employing dynamic autoregressive distributed lag simulations. The empirical findings of our study illuminate a nuanced relationship. Governance indicators, trade dynamics, financial development, and the adoption of renewable energy sources emerge as contributors to a reduction in CO<sub>2</sub> emissions. Conversely, urbanization and foreign direct investment are identified as factors exacerbating environmental degradation. These outcomes underscore the imperative for governments to align environmental and economic policies consistently for effective mitigation of environmental degradation and the pursuit of environmental sustainability. Furthermore, our research emphasizes the pivotal role of financial institutions in steering countries towards low carbon emissions and sustainable development. A focus on green growth, coupled with the promotion of clean production processes, is paramount. Governments are urged to establish financial frameworks that facilitate the reduction of CO<sub>2</sub> emissions, fostering a synergy between economic prosperity and environmental well-being. In essence, our study advocates for a holistic approach, urging nations to embrace environmentally conscious policies and robust financial strategies to achieve a harmonious balance between economic advancement and ecological integrity.

**Key words:** Carbon Dioxide Emissions; Environmental Degradation; Development Strategies; Environmental Well-Being

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## 1. Background

The current era faces a significant environmental challenge—global warming. Scientists agree that carbon emissions, mainly from fossil fuel combustion, are warming the Earth's atmosphere. The rise in greenhouse gas emissions, especially carbon dioxide, has led to climate changes, raising concerns globally due to potential adverse effects on health and economic sustainability. Environmental degradation, linked to greenhouse gas emissions, is a key focus for researchers and policymakers.

China's rapid economic growth has contributed significantly to its environmental degradation. In 2018, China surpassed the United States and the European Union in CO<sub>2</sub> emissions, becoming the world's largest emitter. China's energy consumption and per capita CO<sub>2</sub> emissions have surged, posing a threat to its economy. Despite extensive research on factors influencing China's carbon emissions, the link between financial development and energy consumption, particularly in China, remains understudied.

This study aims to investigate the impact of financial development on carbon emissions in China, considering its pivotal

role in global carbon output. Building on prior research, our empirical study uniquely incorporates variables like institutional quality, FDI inflows, and renewable energy. We introduce a comprehensive institutional quality index and utilize updated data from 1996 to 2020. Employing robust dynamic ARDL simulations, our analysis addresses concerns in time series data, breaking new ground in exploring the nexus among financial development, institutional quality, environmental factors, and CO<sub>2</sub> emissions in China.

In summary, our study addresses the critical issue of global warming, focusing on China's role in environmental degradation. We provide a comprehensive analysis of the impact of financial development on carbon emissions, utilizing advanced econometric techniques and presenting policy implications in the concluding section.

## 2. Research and Discussion

Prior to employing the dynamic ARDL simulation approach, a crucial preliminary step involves examining the stationarity of all variables. Specifically, the dependent variable should exhibit stationarity at first difference (I (1)), while all independent variables must demonstrate stationarity at either the level or first difference, denoted as I (0) or I (1). In this study, augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests were applied to assess the stationarity of the variables. The outcomes of the unit root tests reveal that all variables display stationarity at first difference I (1) (Figure 1).

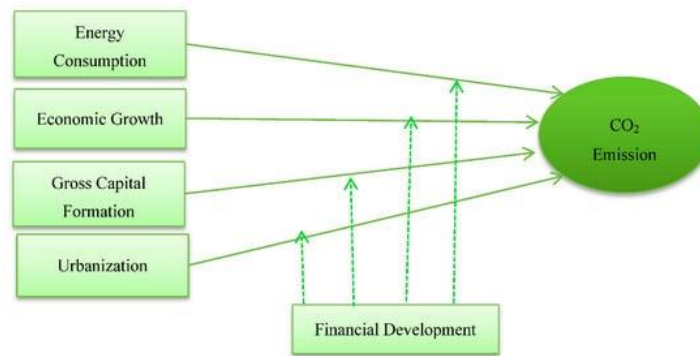


Figure 1 Research model

Building on the framework proposed by Jordan and Philips (2018), this study adopts dynamic ARDL simulations, a sophisticated econometric approach designed to surmount complexities inherent in the conventional ARDL methodology. The outcomes of the dynamic ARDL simulations are detailed. Notably, the proxies for the governance index, namely RL (Rule of Law) and RQ (Regulatory Quality), indicate a negative correlation with CO<sub>2</sub> emissions. The positive sign associated with governance indicators suggests that an escalation in the rule of law and regulatory quality corresponds to an increase in CO<sub>2</sub> emissions in China. Remarkably, these findings align with those reported by Abid (2016).

The trade coefficient exhibits a significant and negative association with CO<sub>2</sub> emissions, suggesting that trade plays a pivotal role in alleviating environmental pollution. This phenomenon may be attributed to China's accelerated economic growth and rising income, which have concurrently diminished trade barriers, fostering an enhancement in environmental quality. Additionally, China's strategic modifications in its manufacturing structure, driven by heightened demand for traded goods, result in the production of low-polluting commodities, thereby significantly reducing CO<sub>2</sub> emissions. This finding aligns with the conclusions drawn by Jayantha Kumaran et al. (2012), Shahbaz et al. (2013), Hao and Liu (2015), Yazdi and Beygi (2018), Chen et al. (2019), and Fatima et al. (2021a).

The coefficient associated with financial development (FD) manifests a noteworthy and negative impact on CO<sub>2</sub> emissions (Figure 2). The negative FD coefficient implies that advancements in financial development stimulate investments in research and development (R&D), facilitating the growth of high-tech and environmentally friendly energy initiatives. This, in turn, acts as a deterrent to carbon emissions. Moreover, the development of the financial sector plays a crucial role in curbing CO<sub>2</sub> emissions by guiding the banking sector to extend loans for the establishment of eco-friendly investment projects. This finding resonates with the observations of Shahbaz et al. (2013), Hafeez et al. (2019a), Hafeez et al. (2019b), Shoaib et al. (2020), and Szymczyk et al. (2021).

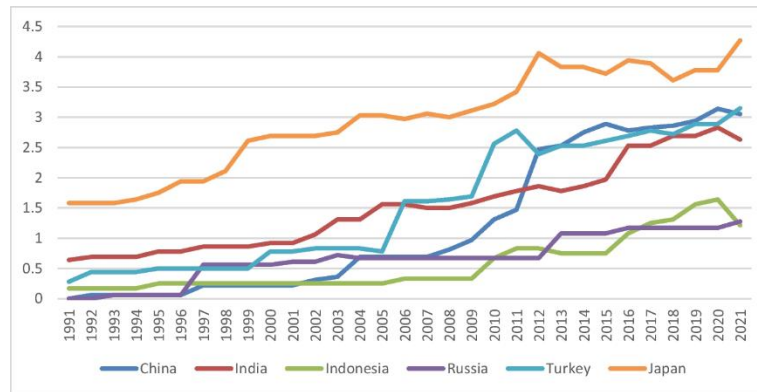


Figure 2 Trend of environmental policy stringency

In relation to the coefficient of renewable energy consumption (REC), an increase in the proportion of renewable energy consumption is found to have an adverse effect on CO<sub>2</sub> emissions in China. This underscores the imperative for China to shift towards renewable energy sources, given the escalating concerns regarding the health and environmental ramifications of CO<sub>2</sub> emissions. As the demand for energy continues to surge and nonrenewable energy consumption remains substantial, the adverse impact on the environment is exacerbated. This outcome concurs with the findings of Bilgili et al. (2016), Danish et al. (2017), Ito (2017), Sarkodie and Adams (2018), Bekun et al. (2019), Wang et al. (2020), and Anwar et al. (2021).

The coefficient associated with foreign direct investment (FDI) reveals a positive and significant correlation with CO<sub>2</sub> emissions, indicating that FDI inflows contribute to an increase in the host country's carbon emissions through the establishment of additional industrial units. Furthermore, the allure of foreign investors towards countries with less stringent environmental regulations pertaining to CO<sub>2</sub> emissions accentuates this trend, resulting in higher levels of CO<sub>2</sub> emissions. This aligns with the findings of Paramati et al. (2016), Shahbaz et al. (2018), Chishti et al. (2021), Farooq (2021), and Mehmood (2021).

Urbanization displays a positive and significant relationship with CO<sub>2</sub> emissions, underscoring its role as a substantial driver of environmental degradation in China (Figure 3). On one hand, urbanization fosters an increase in household energy consumption, contributing to a rise in CO<sub>2</sub> emissions. On the other hand, the urbanization process in China coincides with heightened consumption of goods and services such as housing and automobiles, leading to indirect household CO<sub>2</sub> emissions. Additionally, the rapid urbanization in China is attributed to the contemporary preference for living and working in urban areas, resulting in a swift migration to urban centers. Our estimated coefficient mirrors the observations of Hossain (2011), Al-Mulali et al. (2013), Pata (2018), Mahmood et al. (2020), Gao and Zhang (2021), and Mignamissi and Djeufack (2021).

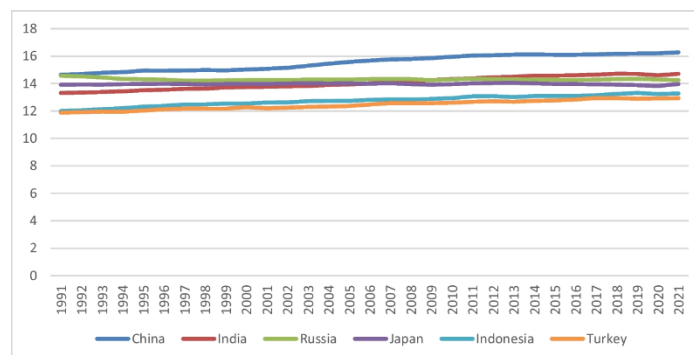


Figure 3 Trend of CO<sub>2</sub> emissions

The coefficient value indicates that the interaction term between financial development and trade is not environmentally friendly. This implies that a higher (lower) level of financial sector development in China corresponds to a higher (lower) share of exports (imports) and a more favorable trade balance in the financial sector. Over the past decades, numerous studies have underscored the influential role of financial development in shaping a country's economic variables. Notably, King and Levine (1993a), King and Levine (1993b), and Levine (1997) established a close relationship between the level of financial

development and both microeconomic and macroeconomic growth. Additionally, research by Demircuc-Kunt and Maksimovic (1998), Beck and Levine (2001), and Rajan and Zingales (1998) highlighted that a well-established financial sector facilitates countries in securing external financing for investment projects. Moreover, Svaleryd and Vlachos (2005) and Beck (2003) identified a significant and positive correlation between financial development and international trade, emphasizing the role of financial development in enhancing comparative advantage.

### 3. Conclusion

Climate change has become a global concern jeopardizing sustainable development. CO<sub>2</sub> emissions, a major contributor to global warming, demand scrutiny to identify escalating factors. This study, spanning 1996-2020, examines the impact of financial development, governance, foreign direct investment, urbanization, trade openness, and renewable energy on CO<sub>2</sub> emissions in China. Utilizing dynamic ARDL simulations, overcoming limitations in the existing model, the research explores the relationship between CO<sub>2</sub> emissions and governance, trade, financial development, renewable energy, foreign direct investment, and urbanization. Findings reveal a negative correlation with governance indices, trade, financial development, and renewable energy, while foreign direct investment and urbanization show a positive association. Policy implications advocate supporting local institutions, enhancing financial structures, and adopting eco-friendly policies to curb CO<sub>2</sub> emissions. Strengthening economic and environmental institutions promotes green energy adoption, contributing to environmental mitigation. Emphasizing renewable energy's role in sustainable development, policymakers should align economic and environmental policies for a greener future. Acknowledging limitations, future research could broaden the analysis with panel data encompassing diverse countries.

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