

Developmental Factors and Economic Clusters: Analyzing the Pathways to GDP Growth Across Global Economies

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Abstract: This study investigates the developmental characteristics of global economies by analyzing the similarities and differences among countries based on key developmental factors. Utilizing secondary data from the Global Competitiveness Report 2020, cluster analysis was performed to group 37 countries into four distinct clusters. These clusters represent emerging, developed, transitional, and economic powerhouse economies, each distinguished by distinct developmental priorities and challenges. Multiple regression and moderation analyses were employed to explore the relationship between GDP and developmental factors such as governance, infrastructure, education, financial incentives, and public-private collaboration. The results reveal that financial incentives and public-private collaboration significantly influence GDP, underscoring their critical role in economic growth. However, moderation analysis suggests that the effect of developmental factors on GDP is not significantly influenced by economic clusters. These insights offer valuable guidance for policymakers and stakeholders in designing targeted interventions to promote sustainable and inclusive growth globally.

Keywords: Developmental factors, Economic Clusters, Cluster analysis, GDP, Multivariate analysis

1. Introduction

The development of a country is fundamental to improving citizens' quality of life and achieving sustainable and inclusive growth. Progress in governance, education, infrastructure, innovation, and economic systems collectively determines a nation's competitiveness, resilience, and long-term prosperity. Effective governance promotes institutional stability and public trust, while quality education develops a skilled workforce capable of driving innovation and productivity. Likewise, modern infrastructure facilitates connectivity and efficient service delivery, and technological advancement enhances competitiveness and equitable access to essential services. Together, these developmental factors create an environment that supports economic resilience and sustainable development (United Nations, 2023; United Nations Development Programme [UNDP], 2022; Miyamoto et al., 2020).

Countries exhibit varying levels of development and can be classified into emerging, developing, transitional, and advanced economies based on indicators such as gross domestic product (GDP), human development, infrastructure quality, institutional capacity, and innovation performance (World Bank, 2022; UNDP, 2022; Asian Productivity Organization [APO], 2023). Emerging economies are characterized by rapid industrialization and expanding markets but often experience structural and institutional challenges. In contrast, advanced economies demonstrate mature institutions, highly developed innovation ecosystems, and sustained economic performance. These differences highlight the need to understand how developmental priorities vary across groups of countries and how these priorities influence economic growth.

Previous studies have consistently emphasized the importance of education, governance, technology, and innovation in promoting economic development and human well-being (Organisation for Economic Co-operation and Development [OECD], 2016; Mofokeng et al., 2024; Liu et al., 2022; Papadomanolakis et al., 2025). Countries seeking long-term economic growth should strengthen innovation ecosystems and invest in research and emerging technologies, as these are increasingly recognized as key drivers of sustainable development and competitiveness (Qin



et al., 2024). Similarly, reports from the International Telecommunication Union (2023) reveal substantial disparities in digital infrastructure and institutional capacity between advanced and developing economies, contributing to persistent differences in productivity and income levels. Papadomanolakis et al. (2025) and Mofokeng et al. (2024) examined the relationship between public-private partnerships and GDP but did not consider the moderating role of economic clusters. Although these studies provide valuable insights into individual determinants of economic performance, they primarily examine developmental factors independently and often assume homogeneous relationships across countries.

However, limited empirical research has investigated how multiple developmental factors collectively characterize countries into distinct economic clusters and whether these clusters influence the relationship between developmental factors and economic performance. Existing studies rarely integrate cluster analysis with regression and moderation approaches to determine whether the effects of governance, infrastructure, education, financial incentives, research investment, diversity, and public-private collaboration vary across different stages of economic development. Consequently, policymakers have limited empirical evidence for designing development strategies that are tailored to the unique characteristics and priorities of specific economic clusters.

To address this gap, this study adopts a conceptual framework in which developmental factors including governance, infrastructure, education, progressive taxation, financial incentives, research investment, diversity, and public-private collaboration, serve as explanatory variables influencing GDP, while economic clusters are examined as a moderating variable. The framework recognizes that although these developmental factors collectively contribute to economic growth, their relative importance may differ depending on a country's developmental stage, thereby influencing the pathways toward sustainable and inclusive development.

Using secondary data from the World Economic Forum's Global Competitiveness Report 2020, this study employs multivariate statistical techniques, including cluster analysis, multiple regression, and moderation analysis, to examine developmental characteristics of global economies. Specifically, it aims to characterize countries based on developmental factors using cluster analysis, identify which developmental factors significantly influence GDP growth, and examine the direct and moderated effects of developmental factors on GDP across different economic clusters.

2. Methods

This study utilized secondary data from the *World Economic Forum's Global Competitiveness Report 2020* to assess how countries are performing in their recovery efforts from the COVID-19 crisis and their transition toward sustainable, inclusive, and environmentally compatible economic systems. The report is structured around four key pillars: enabling environment, human capital, markets, and the innovation ecosystem. The enabling environment focuses on strengthening institutional and infrastructural factors critical for economic stability and efficiency. Human capital emphasizes the development of skills, education, and workforce capacity to drive productivity and innovation. Markets address the dynamics of economic activity, efficiency, and accessibility, aiming for robust and inclusive growth. The innovation ecosystem highlights the importance of technological advancements and creative capacity in fostering progress and addressing emerging challenges.

This study considered eight out of eleven priorities outlined in the report, as some countries lacked data for the remaining priorities. The selected priorities included strong governance, upgraded infrastructure, and progressive taxation under the enabling environment; updated education curricula under human capital; increased incentives to direct financial resources toward long-term investments and public-private collaboration under markets; and investments in research, innovation, and invention, as well as incentivizing firms to embrace diversity, equity, and inclusion under the innovation ecosystem. GDP was also included as a measure of economic performance, resulting in a total of nine attributes analyzed in the study.

To address the first objective, which involved analyzing groups of countries with similar characteristics based on the nine attributes, multivariate analysis was employed, specifically cluster analysis. Prior to cluster analysis, all variables were standardized using z-scores to eliminate the effects of differences in measurement scales and to ensure equal contribution of each developmental factor to the clustering process. Hierarchical cluster analysis was performed using Euclidean distance as the measure of dissimilarity and the complete linkage method to group countries with similar developmental characteristics. The optimal number of clusters was determined by examining the dendrogram and selecting the solution that provided meaningful separation and interpretable economic groupings.

To address the second objective, multiple regression analysis was employed to examine the relationship between developmental factors and GDP. Prior to model estimation, the assumptions of multiple regression, including normality of residuals, independence of observations, homoscedasticity, and multicollinearity among predictors, were assessed to ensure the validity of the regression results. Model significance was evaluated using the F-test, while the statistical significance of individual predictors was determined using p-values at the 0.05 level of significance.

To address the third objective, moderation analysis was conducted by incorporating economic clusters as a moderating variable. Interaction terms were created by multiplying each standardized developmental factor with the economic cluster variable and including them in the regression model. The significance of the interaction terms was used to determine whether the relationship between developmental factors and GDP varied across different economic clusters.

3. Results and Discussions

3.1. Clustering Global Economies

The dendrogram in Figure 1 shows the four distinct clusters of countries, with each cluster consisting of countries that share similar characteristics in terms of the attributes considered.

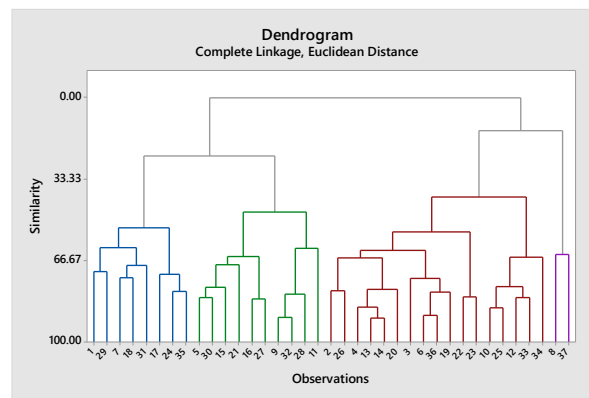


Figure 1. Dendrogram of four clusters

Table 1 presents the countries within each cluster: 8 countries belong to Cluster 1, 17 countries to Cluster 2, 10 to Cluster 3, and 2 to Cluster 4.

Table 1. List of Countries per cluster

Cluster 1	Cluster 2	Cluster 3	Cluster 4
Argentina	Australia	Brazil	China
Russia	New Zealand	Slovak	US
Chile	Belgium	Greece	
Indonesia	France	Italy	
South Africa	Germany	Hungary	
India	Israel	Poland	
Mexico	Austria	Czech Republic	
Turkey	Canada	Spain	
	UK	Portugal	
	Ireland	Estonia	

	Japan		
	Korea		
	Denmark		
	Netherlands		
	Finland		
	Sweden		
	Switzerland		

The countries in each cluster can be classified based on their general economic characteristics. *Cluster 1* consists of emerging economies, including Argentina, Russia, Chile, Indonesia, South Africa, India, Mexico, and Turkey. These countries are characterized by rapid economic growth, industrialization, and increasing integration into global markets, though they often face structural challenges and economic volatility. *Cluster 2* represents developed economies, comprising countries such as Australia, New Zealand, Belgium, France, Germany, Israel, Austria, Canada, the UK, Ireland, Japan, Korea, Denmark, the Netherlands, Finland, Sweden, and Switzerland. These nations are highly industrialized, exhibit strong governance and infrastructure, and enjoy high GDP per capita and living standards. *Cluster 3* includes transition economies, such as Brazil, Slovakia, Greece, Italy, Hungary, Poland, the Czech Republic, Spain, Portugal, and Estonia. These countries are in varying stages of development, with many belonging to the European Union. They exhibit characteristics of both developed and developing economies, often facing challenges in achieving full economic maturity. Finally, *Cluster 4* comprises the global superpowers, China and the United States. These nations have the highest GDPs and are characterized by their dominant roles in global economics, innovation, and geopolitics. This classification highlights the economic diversity across clusters and offers information about their unique characteristics and developmental priorities.

Table 2. Cluster Centroids

Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Governance	-0.93	0.83	-0.76	0.57
Infrastructure	-1.28	0.32	0.58	-0.49
Taxation	0.29	0.34	-0.94	0.67
Education	-0.89	0.81	-0.88	1.10
Financial Incentives	-1.19	0.81	-0.31	-0.58
Research Investment	-0.97	0.64	-0.59	1.39
Diversity	-0.64	0.50	-0.67	1.66
GDP	-0.24	-0.15	-0.34	3.90

The construct and characteristics of each cluster described in Table 2 provide a clear understanding of their developmental status and priorities. Cluster 1 represents *struggling economies*, characterized by strongly negative scores for strong governance, infrastructure upgrades, and financial incentives for long-term investments. These countries also show inadequate progress in updating education curricula, investing in research, and embracing diversity, with a slightly below-average GDP. This cluster reflects countries that face significant challenges in governance, innovation, and inclusivity, requiring substantial development efforts across multiple dimensions.

On the other hand, Cluster 2 consists of *stable economies* that exhibit positive values for governance, education updates, and financial incentives, indicating strong institutional frameworks and progressive policies. These countries show moderate progress in infrastructure upgrades and research investments, with a slightly below-average GDP. Overall, this cluster highlights countries with a solid foundation for sustainable development, balancing governance, innovation, and inclusivity efforts.

Cluster 3 includes *transitional economies* that display negative values for most attributes, such as progressive taxation, education updates, and research investments, reflecting slower progress in these areas. However, this cluster shows positive performance in infrastructure upgrades, indicating focused efforts in physical development. With a below-average GDP, these countries are in transition, showing progress in specific sectors while facing challenges in achieving comprehensive and balanced development.

Finally, Cluster 4 comprises *economic powerhouses*, characterized by strongly positive scores for education updates, research investments, and diversity, highlighting leadership in innovation, inclusivity, and human capital development. These countries have exceptionally high GDP values and solid governance and taxation policies, reflecting robust institutional frameworks. As global leaders, countries in this cluster demonstrate advanced economies, strong innovation ecosystems, and inclusive practices, positioning them for sustainable and inclusive growth. This classification underscores the diverse strengths and weaknesses of each cluster, revealing details about their unique developmental trajectories.

For struggling economies in Cluster 1, where deficits in governance, infrastructure, education, research, and diversity are most apparent, the establishment of robust investment incentives and transparent public-private partnerships provides a foundation for addressing broader structural challenges. (World Bank, 2018; OECD, 2021; Babatunde et al., 2020; Mofokeng et al., 2024). By prioritizing these measures, Cluster 1 countries can begin transitioning toward greater stability and resilience. Similarly, Cluster 3 countries, which demonstrate strength in infrastructure but lag in taxation, education, and research, must sustain their infrastructure progress while strategically channeling fiscal resources toward innovation, curriculum renewal, and inclusive growth through collaborative partnerships (OECD, 2023; Liu et al., 2022; APO, 2023).

For Cluster 2, which is already characterized by solid governance, updated education systems, and strong institutional frameworks, the pathway to transitioning into Cluster 4 lies in scaling investments in research and innovation, modernizing tertiary and technical education, and embedding inclusivity and diversity in both policy and market practices (Dempere et al., 2023). Cluster 4, the global powerhouses, must maintain their leadership by safeguarding strong investment and collaboration frameworks while deepening commitments to innovation and inclusivity to sustain long-term competitiveness. Taken together, the findings suggest a clear policy sequence: first, prioritize investment incentives and public-private collaboration as universal drivers of growth, and then address cluster-specific gaps identified in the centroid profiles to support transitions toward sustainable, inclusive, and equitable development.

3.2. Relationship of developmental factors to GDP

The multiple regression analysis evaluates the relationship between developmental factors, including governance, infrastructure, taxation, education, incentives, research, collaboration, and diversity, and their influence on GDP. The results are summarized in Table 3.

Table 3. Multiple Regression Analysis Result

Predictors	P-value	Decision
Regression	0.001	Significant
Governance	0.136	Not Significant
Infrastructure	0.411	Not Significant
Taxation	0.411	Not Significant
Education	0.749	Not Significant
Financial Incentives	0.038	Significant
Research Investment	0.720	Not Significant
Diversity	0.107	Not Significant
Public-private collab	0.004	Significant

At 0.05 level of significance

The results indicate that the model is statistically significant overall with $p = 0.001$, explaining 57.04% of the variance in GDP. This suggests that the developmental factors collectively contribute to explaining variations in GDP, though there remains room for additional predictors to improve the explanatory power of the model.

Among the predictors, an increase in incentives with a p-value of 0.038 and public-private collaboration with a p-value of 0.004 are statistically significant. The positive and significant relationship for financial incentives underscores their importance in driving economic growth by encouraging investment and innovation. Similarly, public-private collaboration emerges as the strongest contributor in the model, emphasizing the critical role of cooperative efforts between the public and private sectors in promoting economic performance (Papadomanolakis et al., 2025; Mofokeng et al., 2024). These findings suggest that policies aimed at enhancing collaboration and offering targeted incentives could have substantial impacts on GDP.

The other developmental factors such as governance, infrastructure, progressive taxation, education, research, and diversity, were not statistically significant in this model. While these variables may not have direct effects on GDP within this specific analysis, they could still play a role through indirect effects, interactions, or under different contextual conditions. Overall, the analysis points to targeted financial incentives and fostering public-private partnerships as key strategies for driving economic growth.

In summary, two developmental factors stand out as the most significant drivers of GDP across all clusters: financial incentives that direct capital toward long-term investment and strong public-private collaboration. These levers consistently demonstrate statistically significant effects, making them the most reliable starting points for policymakers seeking to enhance economic performance and promote upward movement across clusters (Paunov & Planes-Satorra, 2022; Paunov & McGuire, 2022).

3.3. Moderated Effects of Developmental Factors on GDP

Table 4. Moderation Analysis

Source	P-value	Decision
Regression	0.009	Significant
Governance	0.822	Not Significant
Infrastructure	0.213	Not Significant
Taxation	0.623	Not Significant
Education	0.391	Not Significant
Financial Incentives	0.636	Not Significant
Research Investment	0.634	Not Significant
Diversity	0.138	Not Significant
Public-private collab	0.715	Not Significant
Cluster	0.130	Not Significant
Governance $\times$ cluster	0.446	No significant moderation effect
Infra $\times$ cluster	0.142	No significant moderation effect
Taxation $\times$ cluster	0.874	No significant moderation effect
Educ $\times$ cluster	0.416	No significant moderation effect
Incentives $\times$ cluster	0.495	No significant moderation effect
Collab $\times$ cluster	0.975	No significant moderation effect

Research × cluster	0.626	No significant moderation effect
Diversity × cluster	0.274	No significant moderation effect

The moderation model was statistically significant overall with $p = 0.009$, explaining 75.27% of the variance in GDP. This indicates that the combined effects of developmental factors, economic clusters, and their interaction terms provide a meaningful explanation of variations in economic performance across the countries included in the study.

Despite the overall significance of the model, none of the individual developmental factors, economic cluster, or interaction terms were statistically significant at the 0.05 level. Specifically, governance, infrastructure, taxation, education, incentives, research investment, diversity, and public-private collaboration did not exhibit significant direct effects on GDP after controlling for the other variables in the model. Likewise, none of the interaction terms between developmental factors and economic clusters reached statistical significance, suggesting that economic cluster does not significantly moderate the relationship between these developmental factors and GDP.

These findings imply that while developmental factors collectively account for a substantial proportion of the variation in GDP, their individual effects are not sufficiently distinct to emerge as significant predictors within the moderation framework. The absence of significant interaction effects further indicates that the influence of developmental factors on GDP is relatively consistent across economic clusters rather than varying according to a country's developmental classification. These findings suggest that the relationship between developmental factors and GDP does not significantly differ across economic clusters, indicating that their effects are relatively consistent across countries with different developmental profiles.

4. Conclusion

This study examined the developmental factors influencing GDP across different clusters of economies using data from the World Economic Forum's *Global Competitiveness Report 2020*. The findings highlight the critical role of financial incentives for long-term investment and public-private collaboration as universal drivers of economic performance, regardless of a country's developmental stage. While the specific developmental gaps vary across clusters, ranging from deficits in governance, infrastructure, and education in struggling economies to the need for scaling innovation and inclusivity in stable and advanced economies, the results demonstrate the value of tailored yet evidence-based interventions.

The study provides a clear policy pathway: strengthen foundational drivers of growth through investment incentives and collaborative partnerships, while addressing cluster-specific developmental gaps to support upward mobility. By doing so, countries can accelerate their recovery from systemic challenges, reduce disparities, and build more sustainable and inclusive economic systems. Furthermore, by integrating cluster analysis with multiple regression and moderation analysis, this study offers a comprehensive framework for examining how developmental factors shape economic performance across heterogeneous economies. The findings demonstrate that while countries differ in their developmental profiles, the effects of key developmental factors on GDP remain relatively consistent across economic clusters, providing empirical support for universal yet context-sensitive development strategies..

6. Limitations and Further Study

This study is limited by its reliance on secondary cross-sectional data from the *Global Competitiveness Report 2020* and a sample of only 37 countries, which may not fully capture the dynamic nature of economic development or represent all global economies. The relatively small sample size in relation to the number of predictors and interaction terms may have limited statistical power and increased the possibility of Type II errors. In addition, the unequal distribution of countries across economic clusters may have further limited the ability to identify meaningful moderating relationships. Future research should employ longitudinal or panel datasets, incorporate a larger and more diverse sample of countries, and include additional developmental indicators to provide a more comprehensive understanding of the determinants of economic growth.

Funding

This research received institutional funding from Bukidnon State University

Ethical Approval

This study utilized secondary data obtained from publicly accessible international databases, including the Global Competitiveness Report and related economic datasets. The research did not involve human participants, primary data collection, or identifiable personal information. Therefore, ethical approval and informed consent were not required in accordance with institutional research ethics guidelines.

Data Availability

The data presented in this study are publicly available from the World Economic Forum (WEF) in *The Global Competitiveness Report Special Edition 2020: How Countries Are Performing on the Road to Recovery*. The report is available at <https://www.weforum.org/publications/the-global-competitiveness-report-2020/>. The data used in this study were derived from the recovery priorities and country indicators presented in the report and are accessible in the public domain through the World Economic Forum website.

Acknowledgement

The author is deeply grateful to Bukidnon State University-Research and Development Unit for its financial and moral support, and for fostering an environment that encourages research and scholarly initiative.

Conflict of Interest

The author declares no conflict of interest.

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