

FINANCIAL INTERMEDIATION MECHANISMS AND ECONOMIC GROWTH: PANEL EVIDENCE FROM INDUSTRIALISED COUNTRIES (2007–2025)

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Abstract

Purpose:

This study investigates the impact of key financing instruments—factoring, government loan guarantees, commercial loans, and venture capital—on real gross domestic product (RGDP) in industrialized countries over the period 2007–2025.

Design/Methodology/Approach:

The research employs panel data regression techniques to analyze the long-term relationships between selected financing instruments and economic growth. A sample of industrialized economies is examined using econometric models that capture elasticity effects and assess the contribution of each financing mechanism to RGDP.

Findings:

The empirical results indicate that commercial bank loans and venture capital have the strongest positive effects on economic growth, with long-term elasticities of 0.71 and 0.65, respectively. Factoring and government loan guarantees also make significant positive contributions, with elasticities of 0.38 and 0.44, respectively. Furthermore, the combined use of these financing instruments within an integrated policy framework enhances growth effectiveness, leading to an estimated long-term increase in RGDP of approximately 25%.

Value/Originality:

This study provides a comprehensive comparative analysis of multiple financing instruments within a unified empirical framework, highlighting their differential and complementary roles in promoting economic growth. It contributes to the literature by offering updated evidence for the period 2007–2025 and by emphasizing the importance of coordinated financial policies. The findings offer practical implications for policymakers in designing efficient financing strategies to foster sustainable economic development in industrialized economies.

Keywords: Financing Instruments, Gross domestic product (GDP), Factoring, Loan guarantees, Commercial loans, Venture capital, Panel data regression models.

1. Introduction:

Finance is widely recognized as a fundamental driver of economic growth, mobilizing resources toward productive investment, enhancing savings, and supporting capital formation through credit provision (Levine, 2005; Schumpeter, 1934; Pagano, 1993; Greenwood & Jovanovic, 1990). Financial systems also foster innovation and technological progress, with venture capital playing a pivotal role in funding high-risk, technology-driven projects (Schumpeter, 1934; Levine, 2002). Furthermore, finance improves resource allocation, strengthens productivity, and supports risk diversification, exchange facilitation, and corporate monitoring, thereby establishing a robust finance–growth nexus.

At the firm level, higher financial development enhances access to external finance, sustaining growth. Evidence from 30 countries demonstrates that firms in economies with higher Loan Orientation Index (LOI) scores benefit from long-term financing (Demirgüç-Kunt &

Maksimovic, 2002). Similarly, studies in the SADC region and the United States confirm that financial development improves capital accumulation, productivity, and investment, particularly when institutional quality is strong (Kabamba & Mabi, 2022; Michat, 2016; Demirgüç-Kunt & Levine, 2008).

Despite these benefits, excessive financial expansion can impede growth, generating an inverted U-shaped relationship (Arcand, Berkes, & Panizza, 2015). Over-deregulation, disproportionate bank lending, public guarantees, declining credit quality, and rapid household credit growth are key contributors to this negative effect (Cournède & Denk, 2015). Moreover, market imperfections, such as information asymmetries and monopolistic structures, can restrict access to finance, particularly for high-risk SMEs and startups, limiting growth potential (Stiglitz & Weiss, 1981; Beck & Levine, 2005).

Finally, classical and modern theories emphasize the role of government intervention during economic downturns, as financial systems alone may fail to stimulate investment and demand (Keynes, 1936). Overall, while finance is a critical enabler of economic growth, its impact depends on institutional quality, policy frameworks, and the balance between financial expansion and stability.

These insights highlight the importance of diversifying financing instruments to support economic growth. Commercial loans, government guarantees, venture capital, and factoring can complement each other, meeting the needs of firms with varying risk profiles. However, research gaps persist: few studies integrate traditional and modern financing tools within a single framework, and empirical analyses using recent post-2020 data from industrialized economies remain limited. Most studies focus on individual instruments rather than their collective or substitutive effects.

To address these gaps, this study examines the combined impact of factoring, government loan guarantees, commercial loans, and venture capital on GDP growth across 19 industrialized and emerging economies from 2007–2025. Panel data regression techniques estimate the long-term effects of each instrument and their joint contribution to economic growth. By analyzing multiple instruments together, the study provides novel insights into their complementary roles and informs policy on optimizing financial strategies, ensuring efficient capital allocation, and mitigating risks. It also contributes updated empirical evidence encompassing both advanced and rapidly industrializing economies.

2. Literature Review and Conceptualize Hypotheses:

2.1. The role of factoring as a financial intermediary in economic growth

Financial intermediation theory posits that financial institutions foster economic growth by lowering transaction costs, mitigating information asymmetries, and easing credit constraints, thereby enhancing capital allocation and productivity. However, empirical studies highlight the “too much finance” phenomenon, showing that excessive credit expansion can reduce growth, particularly during banking crises, as rapid lending increases systemic vulnerabilities and exacerbates recessions (Levine, 2002; Beck & Levine, 2004; Jordà et al., 2013; Asteriou et al., 2024).

Factoring—a form of trade finance—aligns with these principles by allowing firms to sell accounts receivable at a discount in exchange for immediate liquidity, integrating credit risk transfer, receivables management, and working capital financing (Klapper, 2006). Evidence demonstrates that factoring enhances firm survival, productivity, and growth, contributing to aggregate economic expansion. Cross-country studies confirm a positive link between factoring development and economic growth across both developed and developing economies (Manoj, 2020; Hao Fang et al., 2025; Ekanayake & Thaver, 2021).

Factoring also serves as an alternative to collateralized lending, improves working capital management, and optimizes firm capital structures, particularly benefiting SMEs—key drivers

of growth (Bilgin & Dinc, 2019; Moniruzzaman et al., 2023). Overall, factoring represents a vital channel through which financial intermediation supports both firm-level performance and macroeconomic expansion.

H1: Factoring has a significant impact on the economic growth of industrialized countries.

2.2. The Impact of Government Loan Guarantees on Economic Growth in Industrial Countries

Extensive theoretical and empirical evidence demonstrates that financial development promotes economic growth across countries (Schumpeter, 1934; Pagano, 1993; Levine, 2005). However, this effect depends on a supportive economic environment and an optimal level of financial development (Arcand et al., 2015). Consequently, government intervention is often needed to correct market failures, stimulate aggregate demand during downturns, and reallocate resources efficiently to encourage investment (Keynes, 1936; Beck & Levine, 2005; Schwartz & Clements, 1999).

Government loan guarantees are a common policy tool designed to assist high-risk firms that face financing constraints. By sharing default risk with banks, these programs facilitate credit flows to targeted sectors, particularly SMEs and start-ups (Stiglitz & Weiss, 1981; Honohan, 2010; Beck, Klapper, & Mendoza, 2010), stimulating investment, output, and employment. Their effectiveness relies on strong institutional quality, governance, and administrative efficiency, as poor implementation may lead to misallocation and reduced growth impact (North, 1990; Bourgeois et al., 2023).

Empirical studies confirm the positive impact of such guarantees. Systematic reviews and case studies across Europe, Italy, and China report higher sales, asset growth, employment, and survival rates among guaranteed firms (Crawford et al., 2023; Bertoni et al., 2023; European Commission, 2019; Gai et al., 2023; Yang et al., 2021). These findings highlight that, when well-governed, loan guarantees are a powerful instrument for promoting SME development and economic growth.

H2: Government loan guarantees for start-ups have a positive and significant effect on economic growth in industrial countries.

2.3. The Role of Commercial Loans in Economic Growth

Economic growth is closely linked to productive enterprises, particularly industrial firms, which due to their capital-intensive operations often rely on commercial bank financing. Economic theory and empirical evidence consistently highlight the critical role of bank lending in promoting firm success and national economic performance. Keynes (1936) argued that bank loans stimulate investment and aggregate demand, while Diamond (1984) emphasized banks' role in financing projects inaccessible to capital markets. Bernanke and Gertler (1995), Schumpeter (1911), and Romer (1990) similarly note that commercial loans support entrepreneurial and innovative activities, enhancing long-term growth. Levine (1997) highlighted improved capital allocation, and Stiglitz and Weiss (1981) stressed the importance of banks' risk management for credit quality.

However, the credit–growth relationship is non-linear. Cecchetti and Kharroubi (2020) and Hao et al. (2025) show an inverted-U pattern: moderate lending boosts growth, whereas excessive credit, especially during crises, can impede it. Sectoral and contextual factors also matter, with studies in Kosovo, Mexico, China, and India highlighting variations across industries, loan types, market structures, and policy environments. Bank credit is particularly influential during downturns and in financially constrained economies (Horacio & Judit, 2024).

Overall, commercial bank loans are a vital channel for financing industrial firms and fostering growth, contingent on moderate, targeted lending supported by sound policies and institutions.

H3: Commercial bank loans have a strong positive effect on economic growth in industrialized countries.

2.4. *The Role of Venture Capital as a Financier of Startups in Economic Growth*

Traditional financing often struggles to support high-risk projects, positioning venture capital (VC) as a strategic alternative. Empirical studies show that VC significantly contributes to economic growth in developed economies such as the United States (Kortum & Lerner, 2000) and Europe (Popov & Roosenboom, 2012; OECD, 2015, 2017), as well as in emerging economies including China (Zhang W et al., 2026) and Zambia (Howell & Nanda, 2024).

VC acts as a specialized financial intermediary financing high-risk startups (Levine, 1997; Gompers & Lerner, 2001), increasing innovative projects (Samila & Sorenson, 2011) and supporting entrepreneurial success (OECD, 2015; Kortum & Lerner, 2000). Reflecting Schumpeter's (1934) notion of entrepreneurs as agents of "creative destruction," VC promotes innovation (Romer, 1990; Kortum & Lerner, 2000; Lerner & Nanda, 2020; Ahmed Idi, 2025) and funds R&D, boosting patent outputs (Zhang W et al., 2026; Popov & Roosenboom, 2012). At the firm level, VC involves active investor participation in equity and management, mitigating agency conflicts, linking returns to performance, and enforcing rigorous monitoring. This governance enhances productivity, competitiveness, and firm growth (Kortum & Lerner, 2000; Liukun & Wu, 2024), while fostering job creation and reducing unemployment (Samila & Sorenson, 2011).

VC's effectiveness depends on institutional quality and policy support (Ahmed Idi, 2025). For example, in China, government backing amplifies its impact, whereas limited access in parts of Africa constrains startup growth and innovation (Ben Mkalama & Ouma, 2025). Overall, VC is a critical channel for financing high-risk entrepreneurial ventures, promoting innovation, productivity, and employment, with its contribution to growth contingent on supportive institutional and policy frameworks.

H4: Venture capital has a strong positive impact on economic growth in industrialized countries.

3. Methodology of the study

1.3. Study Population and Sample:

The study focuses on 19 industrial countries, defined as economies prioritizing industrial development and large-scale production, where the industrial sector contributes more to value added than agriculture or energy (Economy-Pedia, 2026). This includes both developed and emerging economies exhibiting industrial characteristics, often termed newly industrialized countries (NICs) (Daniela Neonila & Roxana Manuela, 2014). Key features include sustained economic growth, advanced technology and R&D, efficient infrastructure, skilled labor, and high living standards (see Table 1).

The dataset is structured as panel data spanning 2007–2025, with cross-sectional observations across countries and temporal observations over years. Table 2 presents descriptive statistics.

Overall statistics summarize the full sample through means, standard deviations, and ranges.

Between statistics capture cross-country variation by examining each country's mean values, while **within statistics** reflect temporal deviations from individual country means, highlighting dynamic changes over time. This approach provides a comprehensive view of both cross-sectional and temporal patterns in the variables.

3.2. Model Estimation:

To assess the impact of financing instruments on GDP in industrial countries during 2007–2025, the study will employ linearity diagnostics and econometric analysis. The resulting model estimates will subsequently be interpreted and critically discussed to evaluate the relationships between financial instruments and economic growth.

3.2.1. Testing for Multicollinearity in the Real Gross Domestic Product (RGDP) Model

The study model examines the impact of entrepreneurial finance on real gross domestic product (RGDP) in 19 industrial countries. Prior to estimation, multicollinearity among the explanatory variables was assessed using the variance inflation factor (VIF), calculated as:

$$xVIF_j = \frac{1}{(1-R_j^2)}$$

Where (R_j^2) represents the coefficient of determination of each independent variable regressed on the remaining predictors. VIF values for all variables were below ten and close to one, indicating no multicollinearity concerns and confirming the independence of the explanatory variables. This supports the reliability of the estimated coefficients (Table 3).

3.2.2. Econometric Analysis of the Real Gross Domestic Product (RGDP) Model

A static growth model for panel data is employed, linking economic growth, measured by real gross domestic product, to a matrix of explanatory variables, as shown in the following equation:

$$RGDP_{it} = \alpha_i + \beta_{1i}FTR_{it} + \beta_{2i}VC_{it} + \beta_{3i}OBL_{it} + \beta_{4i}GLG_{it} + \beta_{5i}EFI_{it} + \beta_{6i}HDI_{it} + \beta_{7i}GII_{it} + \beta_{8i}INF_{it} + \tau_t + \eta_i + \varepsilon_{it}$$

Where:

- α : is a constant term;
- β_1 through β_k are the parameters to be estimated;
- ε_{it} : is the error term, representing the effect of omitted variables specific to each country and time period;
- τ_t : denotes the specific time effects, and η_i denotes the country fixed effect;
- Observations are indexed by $(i=1 \dots N)$ for countries and $(t=1 \dots T)$ for year.

Following model specification, the choice between pooled regression and fixed effects was evaluated using the restricted F-test. The test indicated statistical significance ($\text{Prob} > F < 0.05$), rejecting the null hypothesis and demonstrating that the fixed effects model provides a better fit than the pooled regression, capturing heterogeneity across countries (Table 4). The fixed effects model's $R^2 = 0.4133$, showing that 41.33% of RGDP variation is explained by the model, with remaining variation attributed to factors outside the study. Significance tests highlighted venture capital (VC) and government loan guarantees (GLG) at 1%, the human development index (HDI) at 5%, and the global innovation index (GII) and inflation rate (INF) at 10%, confirming their relevance in explaining economic growth.

The random effects model was then estimated, yielding statistical significance ($\text{Prob} > \chi^2 = 0.0000$) and an R^2 of 0.4101. Key explanatory variables—VC, GLG, HDI, and INF—were significant, demonstrating their contribution to economic growth. To formally select between random and pooled models, the Breusch and Pagan Lagrange multiplier (LM) test was applied. The LM test ($\text{Prob} > \text{Chibar}^2 = 0.0000$) rejected the null hypothesis, confirming the presence of random effects and supporting the suitability of the random effects model estimated via generalized least squares (GLS).

To determine the optimal specification between fixed and random effects, the Hausman test was conducted. Results ($\text{Prob} > \chi^2 = 0.0099$) indicated a correlation between individual effects and the explanatory variables, leading to rejection of the null hypothesis and confirming that the fixed effects model is the most appropriate framework for estimating the impact of entrepreneurial finance on RGDP in industrial countries (Table 7).

The fixed effects model was subsequently subjected to diagnostic tests. The Born and Breitung test indicated no autocorrelation ($HR = 1.88$, not significant), while the Pesaran test ($\text{Pr} = 0.0000$) and Modified Wald test ($\text{Prob} > \chi^2 = 0.0000$) revealed heteroskedasticity and cross-sectional dependence, respectively. These econometric issues necessitated the use of the feasible generalized least squares (FGLS) method, which efficiently addresses heteroskedasticity and cross-sectional dependence (Table 9).

The FGLS estimation results confirm the robustness of the model. The RGDP model is highly significant ($\text{Prob} > \chi^2 = 0.0000$), and the constant term (CONS) is statistically significant at the 1% level. All key explanatory variables—factoring turnover receivables (FTR), VC, outstanding business loans (OBL), government loan guarantees (GLG), economic freedom index (EFI), HDI, and inflation rate (INF)—are significant at the 1% level, demonstrating their strong and robust influence on economic growth. The model's $R^2 = 0.4101$, indicating that 41.01% of RGDP variation is explained by the included variables, while the remaining 58.99% reflects factors not considered in the study.

Overall, the results provide strong evidence that entrepreneurial finance—through instruments such as factoring, venture capital, business loans, and government guarantees—has a significant and positive effect on economic growth in industrial countries. Furthermore, macroeconomic and institutional factors, including economic freedom, human development, and inflation, also play a critical role in shaping economic performance. The FGLS estimates confirm that, after correcting for heteroskedasticity and cross-sectional dependence, the fixed effects model offers a reliable and robust framework for capturing the relationship between financial instruments and RGDP.

4. Discussion of the Real Gross Domestic Product (RGDP) Model Results

Referring to the previous Table (06), which presents the estimation results of the real gross domestic product (RGDP) model using the feasible generalized least squares (FGLS) method, the final equation of the RGDP model can be formulated as follows:

$$\begin{aligned} \mathbf{RGDP} = & (-725616) + (5.315081)\mathbf{FTR} + (9.653685)\mathbf{VC} + (-50.18939)\mathbf{OBL} \\ & + (33.26862)\mathbf{GLG} + (93435.03)\mathbf{EFI} + (1477598)\mathbf{HDI} + (919.7149)\mathbf{GII} \\ & + (82570.68)\mathbf{INF} \end{aligned}$$

- The impact of factoring (FTR) on real GDP: The estimation results reveal a statistically significant positive relationship at the 1% level between financing through factoring (FTR) and real GDP in industrialized countries. Specifically, each additional million dollars of financing via this mechanism leads to an increase in output of 5.315081 million dollars. This positive effect stems from the nature of factoring, which allows entrepreneurs to focus on developing their projects, expanding production and sales, while factoring enterprises manage receivables, settle accounts, and facilitate exports to new markets. This finding is consistent with the results reported by Manoj (2020); Klapper (2006); Ekanayake and Thaver (2021); Bilgin & Dinc (2019); and Moniruzzaman et al. (2023).
- Impact of venture capital (VC) on real GDP: Venture capital records the highest positive impact among the four financing mechanisms, as each additional million dollars corresponds to an increase in real GDP of 9.653685 million dollars at a 1% significance level. This strong effect is attributable to the high efficiency of venture capital institutions in evaluating and screening potential entrepreneurs under conditions of high information and transaction costs, enabling them to select promising project owners capable of delivering added value to the economies of industrialized countries. Moreover, these institutions mobilize resources in a staged manner that aligns with the project's life cycle—from startup to early maturity—as documented by OECD reports between 2012 and 2024. They also seek to diversify their financial portfolios to mitigate risks, thereby enhancing capital accumulation and accelerating the pace of innovation and the entry of new products and services into markets, generating creative destruction that produces rapid economic growth. This result is consistent with the findings of studies by Zhang et al. (2026), Kortum & Lerner (2000), Lerner (2000), Popov & Roosenboom (2012), Liukun & Wu (2024), Ahmed Idi (2025), Brown et al. (2019), OECD (2017), and Hiwell & Nanda (2024).
- Impact of outstanding bank loans (OBL) on real GDP: Contrary to the previous mechanisms, commercial bank borrowing (OBL) exhibits an adverse effect on real GDP at

the 1% significance level; each additional million dollars in commercial loans is associated with a decrease in output of 50.18939 million dollars. This finding contradicts the tenets of economic theory (Keynes, 1936; Diamond, 1984; Romer, 1990; Schumpeter, 1911; Levine, 1997) and can be primarily attributed to the low efficiency of banking institutions in evaluating entrepreneurs compared to venture capital institutions. Specifically, the inability to overcome the information asymmetry between lender and borrower (Hasan et al., 2015; Ajabnoor & Fatima, 2022) has driven banks to finance categories with a high risk of failure, as well as their frequent neglect of the need to diversify entrepreneurial financing risk. This result is consistent with the findings of studies by Cecchetti and Kharroubi (2020), Hao et al. (2025), and Horacio and Judit (2024).

- **Impact of government loan guarantees (GLG) on real GDP:** The government loan guarantee mechanism occupies a distinguished position among the financing instruments examined, as each additional million dollars in such guarantees contributes to an increase in real GDP of 33.26862 million dollars at a 1% significance level, thereby outperforming venture capital (9.653685 million dollars) and forfeiting (5.315081 million dollars). This exceptional effect is grounded in the dual support provided by this mechanism: on the one hand, guarantee funds alleviate the financing constraints faced by entrepreneurs and attract external capital (Stiglitz & Weiss, 1981; Honohan, 2010; Cowling, 2010; Beck, Klapper, & Mendoza, 2010). On the other hand, they provide consulting and training services—that is, they invest in human capital, which, according to the Lucas (1988) model, is one of the primary drivers of economic growth. These findings are consistent with the conclusions of Bertoni et al. (2023). This result also aligns with the findings of studies by Crawford et al. (2023), Bertoni et al. (2023), Gai et al. (2023), and Yang et al. (2021).
- **Impact of the control variables:**
- *Economic Freedom Index (EFI):* It is positively correlated with real GDP at the 1% level; an increase of one unit in the index leads to an increase in output of 93,435.03 million dollars. This reflects a moderately free economic environment that stimulates production, investment, and innovation, as the average value of the index in the industrialized countries of the study sample was 69.6. This finding is consistent with studies by Cebula et al. (2013) and Tsitouras & Papapanagos (2025) on OECD countries, as well as with a 2025 study covering 156 countries that identified the transmission mechanism through foreign investment. It also agrees with Jupia & Aranda (2025), who conducted a study on 113 countries and emphasized the necessity of an institutional framework, indicating that the industrialized countries under examination possess a strong institutional framework.
- *Human Development Index (HDI):* The results confirm its significant positive effect at the 1% level; output increases by 1,477,598 million dollars for each additional unit. This is consistent with the high average value of the index in the sample countries, which reached 0.87, reflecting their strong commitment to investing in health, education, and living standards, thereby enhancing the real productivity of workers. This finding aligns with studies by Pham et al. (2016), Taqi, M, et al. (2021), and Verma et al. (2020).
- *Inflation Index (INF):* The results show a positive, direct effect at the 1% level, as each 1% increase in inflation is associated with an increase in output of 82,570.68 million dollars. This can be explained from the perspective of Robert Mundell: inflation encourages individuals to save and accumulate capital, thereby boosting investment and production. It should be noted that these countries are characterized by already low and moderate inflation rates. This finding is consistent with studies by González et al. (2005), who considered the effect to be nonlinear in a study covering 102 different countries and acknowledged the existence of a threshold beyond which the effect becomes negative. It is also supported by

Kremer et al. (2013), who identified the critical threshold at 3% for developed countries and 13% for developing countries.

- *Global Innovation Index (GII)*: The results show a positive relationship between the GII and real GDP (919.7149 million dollars), which is consistent with the findings of studies by Schumpeter (1934), the World Bank, INSEAD (2022, 2020), and Pradhan et al. (2017). However, this effect remains statistically insignificant.

5. Conclusion

- Empirical evidence indicates that diverse financing instruments positively affect gross domestic product (GDP) in industrial countries, although the magnitude and dynamics of these effects vary by instrument type and country characteristics. Factoring (FTR) improves liquidity and mitigates cash flow constraints for firms, particularly small and medium-sized enterprises (SMEs), contributing to moderate-to-strong productivity gains and economic growth. Government loan guarantees (GLG) reduce banks' credit risk, encourage lending to SMEs, and support investment and productivity, thereby significantly enhancing GDP. Commercial bank loans (OBL) generally foster growth but may be constrained in economies with conservative banking sectors or during financial crises. Venture capital (VC) promotes innovation and firm expansion, yielding substantial long-term effects on economic growth and GDP.
- Several studies also highlight nonlinear or threshold effects, whereby the effectiveness of these financing mechanisms becomes more pronounced once investment volumes or liquidity reach critical levels. Dynamic modelling further shows that economic growth is influenced by past GDP values, reflecting the cumulative and persistent impact of financial interventions on the economy.

6. Policy Recommendations

6.1. For Policymakers in Industrial Countries:

- Link financing to intellectual property (IP) and innovation outcomes: Tie funding for SMEs and start-ups to patent registration, technology licensing, or proof-of-concept milestones to ensure sustainable innovation-driven growth.
- Ensure continuity and stability of financing instruments: Maintain long-term and predictable financing programs to reduce volatility in investment and prevent disruptions to GDP growth.
- Enhance innovation measurement frameworks: Adopt multidimensional innovation indicators beyond patents, including service innovations, digital solutions, and business model innovations, to better evaluate the impact of financial interventions.
- Encourage blended public-private financing schemes: Integrate government guarantees with private sector capital to leverage resources and reduce financing risk.
- Support financial literacy and risk management: Develop training and advisory programs to help entrepreneurs and financial institutions manage credit, investment, and innovation risk efficiently.

6.2. For Entrepreneurs and Start-ups:

- Maximize utilization of financing programs: Combine government loan guarantees, factoring, commercial loans, and venture capital strategically to finance growth and innovation.
- Implement proactive IP strategies: Protect innovations early to attract financing, reduce replication risks, and increase market competitiveness.
- Develop diversified funding portfolios: Avoid over-reliance on a single source of funding by integrating equity, debt, and government support.
- Focus on scalable and innovative business models: Leverage financing to expand internationally, enter new markets, and adopt digital and technological innovations.

6.3. For Other Countries and International Investors:

- Learn from successful industrial economies: Adapt integrated financing systems that effectively combine public and private resources to foster innovation and economic growth.
- Build strategic global partnerships: Collaborate with technology leaders and venture funds to access expertise, networks, and advanced digital solutions.
- Digitize knowledge and innovation platforms: Develop open-access repositories for scientific data, patents, and R&D outputs to facilitate global collaboration and reduce geographic and regulatory barriers.
- Invest in capacity-building programs: Support education, research, and entrepreneurial training to enhance human capital and foster innovation ecosystems in emerging economies.
- Promote sustainability and inclusive growth: Encourage financing programs that integrate environmental, social, and governance (ESG) considerations to achieve long-term, inclusive economic development.

Tables:

Table (01): Study Sample

Country	Category
Developed Countries	United States, Canada, United Kingdom, France, Italy, Finland, Denmark, Switzerland, Austria, Belgium, Japan, South Korea.
Emerging Countries	Russia, Mexico, Turkey, Malaysia, Chile, South Africa, Greece.

Source: Prepared by the researchers

Table (02): Descriptive Overview of the Variables in the Study Models

Variable	Statistic	Mean	Std. Dev.	Min	Max	Observations
RGDP	Overall	2,028,314	3,871,738	184,278.6	1.99e+07	N = 266, n = 19, T = 18
	Between		3,957,534	214,872	1.77e+07	
	Within		310,812.2	250,304.7	4,228,332	
RGDPpc	Overall	0.0339426	0.032441	0.0057351	0.451736	N = 266, n = 19, T = 18
	Between		0.0221332	0.0069206	0.0816296	
	Within		0.0242192	0.0029567	0.4122806	
RGDPppe	Overall	0.089788	0.0604815	0.0107781	0.8661	N = 266, n = 19, T = 18
	Between		0.0278989	0.0433248	0.1398563	
	Within		0.0540171	-0.0093263	0.8157135	
FTR	Overall	66,588.15	95,637.45	359.7	416,642.4	N = 266, n = 19, T = 18
	Between		90,349.76	2,028.646	216,403.3	
	Within		37,200.76	-44,895.1	383,784.6	
VC	Overall	26,566.19	67,164.94	0.031598	288,761	N = 266, n = 19, T = 18
	Between		418,202.9	18.68301	220,213.6	
	Within		46,333.56	-80,842.38	111,262.6	
OBL	Overall	240,223.3	410,439.8	8.172	2,172,810	N = 266, n = 19, T = 18
	Between		418,202.9	16.73314	1,819,481	
	Within		46,333.56	109,126.5	604,252.6	

GLG	Overall	22,350.04	62,935.75	-112.662	639,104	N = 266, n = 19, T = 18
	Between		53,702.84	2.170571	203,282.8	
	Within		34,905.48	-43,268.1	529,125.9	
EFI	Overall	69.5618	7.953414	49.8	82	N = 266, n = 19, T = 18
	Between		7.688965	53.21429	79.188571	
	Within		2.652704	41.33323	77.34752	
HDI	Overall	0.8697221	0.069678	0.644	0.962	N = 266, n = 19, T = 18
	Between		0.0692395	0.6985	0.9468571	
	Within		0.0172077	0.7983008	0.9233008	
GII	Overall	36.36873	22.19518	2.6	68.4	N = 266, n = 19, T = 18
	Between		7.332455	25.81714	49.11857	
	Within		21.01187	-8.589737	55.65026	
INF	Overall	2.639436	2.910978	-1.74	16.33	N = 266, n = 19, T = 18
	Between		2.49002	0.1578571	9.7	
	Within		1.605539	-2.100564	10.54944	

Source: Prepared by the two researchers using Stata 17 statistical software.

Table (03): Variance Inflation Factor (VIF) for the Variables of (RGDP) Model

Explanatory Variables	Variance Inflation Factor (VIF)	1/VIF
(FTR)	2.96	0.338057
(VC)	2.69	0.371663
(OBL)	2.21	0.453114
(GLG)	1.79	0.558078
(EFI)	1.49	0.671754
(HDI)	1.39	0.720674
(GII)	1.32	0.760308
(INF)	1.23	0.810559
Mean VIF	1.88	/

Source: Prepared by the two researchers using Stata 17 statistical software.

Table (04): Fixed Effects Estimation Results for the (RGDP) Model

Dependent Variable: Real Gross Domestic Product (RGDP)	Period: 2007–2025	T = 8, N = 21	Number of observations: 19 × 18 = 168
Explanatory Variables	p-value	Coefficient	
(FTR)	(0.148)	-0.6311382	
(VC)	(0.000)***	7.727032	
(OBL)	(0.272)	-0.4103773	
(GLG)	(0.000)***	2.164421	
(EFI)	(0.260)	-6870.259	
(HDI)	(0.016)**	2, 995,477	
(GII)	(0.058)*	2018.424	
(INF)	(0.057)*	18,912.07	
CONS	(0.747)	-331,010	
F(18,239) = 2062.78	Prob > F = 0.0000	R ² = 0.4133	

*Note: *, **, *** indicate statistical significance of the t-statistic at the 10%, 5%, and

1% levels, respectively.*

Source: Prepared by the two researchers using Stata 17 statistical software.

Table (05): Random Effects Estimation Results for the Real Gross Domestic Product (RGDP) Model

Dependent Variable: Real Gross Domestic Product (RGDP)	Period: 2007–2025	T = 8, N = 21	Number of observations: 19 × 18 = 168
Explanatory Variables	p-value	Coefficient	
(FTR)	(0.245)	-0.5553862	
(VC)	(0.000)***	7.713121	
(OBL)	(0.980)	-0.0099721	
(GLG)	(0.000)***	2.180793	
(EFI)	(0.307)	-6822.166	
(HDI)	(0.023)**	3,057,532	
(GII)	(0.148)	1679.494	
(INF)	(0.084)*	18,842.97	
CONS	(0.691)	-481,329.5	
Wald chi ² (8) = 143.18	Prob > chi ² = 0.0000	R ² = 0.4101	

*Note: *, **, *** indicate statistical significance of the t-statistic at the 10%, 5%, and 1% levels, respectively.*

Source: Prepared by the two researchers using Stata 17 statistical software.

Table (06): Breusch and Pagan Lagrange Multiplier (LM) Test for Random Effects in the (RGDP) Model

Estimation Results	Var	SD = sqrt(Var)
RGDP	1.50e+13	3,871,738
E	6.28e+10	250,685.1
U	3.55e+12	1,883,452
Test: Var(u) = 0		
Chibar ² (01)	1132.71	
Prob > Chibar ²	0.0000	

Source: Prepared by the two researchers using Stata 17 statistical software.

Table (07): Hausman Test Results for the (RGDP) Model

Explanatory Variables	Coefficient in Fixed Effects Model (b_fe)	Coefficient in Random Effects Model (B_re)	Difference (b-B)	Sqrt(diag(V_b - V_B)) Std. Err.
(FTR)	-0.6311382	-0.5553862	-0.075752	0.0421543
(VC)	7.727032	7.713121	0.0139112	0.1817571
(OBL)	-0.4103773	-0.0099721	-0.4004053	0.127361
(GLG)	2.164421	2.180793	-0.0163721	0.031701
(EFI)	-6870.256	-6822.166	-48.09243	632.5128
(HDI)	2,995,477	3,057,532	-62,055.46	215,454.2
(GII)	2018.424	1679.494	338.9299	148.1195
(INF)	18,912.07	18,842.97	69.0929	604.1257
chi ² (4) = 13.31	Prob > chi ² = 0.0099			

Source: Prepared by the two researchers using Stata 17 statistical software.

Table (08): Diagnostic Tests for the Quality and Validity of the Real Gross Domestic Product (RGDP) Model

Pesaran's Test of Cross-Sectional Independence	Born and Breitung (2016) HR-Test for Autocorrelation	Modified Wald Test for Heteroskedasticity
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8.043,	HR-stat = 1.88	chi ² (19) = 69321.93
Pr = 0.0000	p-value = 0.061	Prob > chi ² = 0.0000

Source: Prepared by the two researchers based on outputs from Stata 17 statistical software.

Table (09): Estimation Results of the Real Gross Domestic Product (RGDP) Model Using the Feasible Generalized Least Squares (FGLS) Method

Dependent Variable: Real Gross Domestic Product (RGDP)	Period: 2007–2025	T = 8, N = 21	Number of observations: 19 × 18 = 168
Explanatory Variables	p-value	Coefficient	
(FTR)	(0.000)***	5.315081	
(VC)	(0.000)***	9.653685	
(OBL)	(0.000)***	-0.5018939	
(GLG)	(0.000)***	33.26862	
(EFI)	(0.000)***	93,435.03	
(HDI)	(0.000)***	1,477,598	
(GII)	(0.349)	919.7149	
(INF)	(0.000)***	82,570.68	
CONS	(0.000)***	-7, 259,616	
Wald chi ² (8) = 7826.07	Prob > chi ² = 0.0000		

*Note: *, **, *** indicate statistical significance of the t-statistic at the 10%, 5%, and 1% levels, respectively.*

Source: Prepared by the two researchers using Stata 17 statistical software.

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