

From Investment to Inclusive Innovation: The Business of Technology-Driven Growth

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ABSTRACT

This paper examines how economies convert financial resources into innovation outcomes and long-term competitiveness, focusing on the relationship between GDP, research and development (R&D) investment and technological capability. Using comparative data across high-income and low-income economies, the paper analyzes how differences in capital allocation, institutional quality and innovation ecosystems shape productivity, entrepreneurship and growth trajectories. While wealthier economies leverage sustained R&D investment and digital infrastructure to reinforce competitive advantage, several developing economies demonstrate that targeted, context-specific innovation can generate outsized returns even under resource constraints. Drawing on global case studies - including fintech platforms, renewable energy systems and digital governance models - the paper highlights how innovation outcomes depend not only on investment levels but on execution efficiency, policy coherence and market design. The findings offer strategic insights into how nations, firms and entrepreneurs can build scalable and inclusive innovation ecosystems that balance growth, inclusion and resilience in an increasingly technology-driven global economy.

Introduction

Technology has become one of the most powerful catalysts for economic and social transformation in the 21st century (Elfaki, 2024). Across the globe, governments, businesses and communities are using technologies such as artificial intelligence, renewable energy, automation and fintech to boost productivity, reduce poverty and support sustainable growth (Al Naqbi, 2024). This paper hypothesizes that higher GDP levels are positively correlated with greater innovation, as wealthier economies possess higher investment capacity, stronger infrastructure and more advanced human capital development for fostering technological progress.

This paper was developed as part of my academic coursework, which encouraged me to explore the relationship between economic growth, modernization and technological advancement. My interest in this topic arises from a broader curiosity with how innovation can bridge social and economic divides. I have always been drawn to understanding how technology, whether through digital infrastructure, renewable energy or financial inclusion platforms, can drive development and improve quality of life, especially in the country I come from. Through this research, I sought to understand how technology can support inclusive growth while also recognising the challenges and trade-offs it presents. Ultimately, the paper explores how countries can harness innovation responsibly to achieve fair and sustainable progress.

Methodology

This paper is grounded in a comprehensive review of existing literature to establish a theoretical and empirical foundation for the analysis presented here. Sources included academic journals, reports from international organizations such as the IMF, World Bank, OECD and WIPO, as well as policy documents and industry studies related to innovation, technology adoption and economic growth. In addition, the paper draws on comparative empirical data covering GDP, R&D investment, digital infrastructure and innovation indicators across countries. The literature review helped contextualize observed global patterns, while the empirical data supported cross-country comparisons and case-based analysis, enabling an assessment of how different economies translate technological investment into innovation and development outcomes.

Link Between GDP, Research and Development, Investment and Innovation Capacity

A strong connection exists between a country's economic strength, its investment in R&D and its capacity for innovation. High-income nations consistently invest more heavily in R&D, enabling technological breakthroughs that enhance efficiency, productivity and competitiveness (Arana-Barbier, 2023; Kim, 2025). This investment creates a self-reinforcing cycle: stronger economies can allocate greater resources toward education, infrastructure and healthcare, which in turn stimulate further innovation and technological progress (Fayyaz & Bartha, 2025).

To explore this relationship empirically, Tables 1 and 2 compare the world's largest and smallest economies by GDP in 2024. The top 15 economies, including the United States, China and India, display higher growth rates and greater technological capacity due to sustained R&D spending and strong infrastructure. By contrast, the bottom 10 economies, such as Tuvalu and Nauru, demonstrate lower growth and limited capacity to support technological advancement, reflecting the critical role of resource allocation in driving innovation. These disparities illustrate how economic strength directly influences a country's ability to invest in R&D, infrastructure and human capital, the foundational elements of innovation-driven development.

Table 1: GDP and Growth Rates of the Top 15 Economies

Country	GDP (USD Trillion)	Growth Rate (%)
United States	\$28.78	2.73%
China	\$18.53	4.64%
India	\$3.94	6.81%
Japan	\$4.11	0.86%
Germany	\$4.59	0.15%
United Kingdom	\$3.50	0.62%
France	\$3.13	0.69%
Brazil	\$2.33	2.90%
Italy	\$2.33	0.70%
Canada	\$2.24	1.10%
Russia	\$2.06	2.20%
South Korea	\$1.76	1.90%
Australia	\$1.79	2.30%
Spain	\$1.65	2.20%
Mexico	\$2.02	2.70%

Sources: Statistics Times; World Population Review; IMF (2024)

Table 2: GDP and Growth Rates of the Bottom 10 Economies

Country	GDP (USD million)	Growth Rate (%)
Tuvalu	\$59 (2022)	1.5%
Nauru	\$150	1.2%
Kiribati	\$200	2.0%
Marshall Islands	\$220	2.1%
Palau	\$300	1.8%
Micronesia	\$400	1.7%
Tonga	\$450	2.3%
Sao Tome & Principe	\$500	2.5%
Comoros	\$600	2.2%
Djibouti	\$700	2.0%

Sources: IMF; World Bank; Statista (2024)

The Global Innovation Index (GII), developed by the World Intellectual Property Organization (WIPO), Cornell University and INSEAD, also offers a holistic measure of national innovation performance based on over 80 indicators, including R&D expenditure, patent filings, education, infrastructure and technology exports (Table 3). The 2023 GII ranks Switzerland as the world's most innovative economy (67.6), followed by Sweden (64.2) and the United States (WIPO, 2023). India ranks 40th overall, the highest among Central and South Asian nations, performing well across most innovation pillars except infrastructure. Taken together, the GII rankings and GDP comparisons suggest that higher national income, stronger institutions and supportive policy environments are associated with stronger innovation performance.

Table 3: Key Results of the Global Innovation Index 2023 rankings

- Switzerland, Sweden, the United States, the United Kingdom and Singapore lead
- China, Türkiye, India, Viet Nam, the Philippines, Indonesia and the Islamic Republic of Iran are middle-income economies making most headway in innovation over the last decade.
- The United States, Singapore and Israel are scoring best in particular innovation indicators.
- Top innovation economies by region
 - o Latin America and the Caribbean - 1. Brazil 2. Chile
 - o Northern America - 1. United States 2. Canada
 - o Europe - 1. Switzerland 2. Sweden
 - o Sub-Saharan Africa - 1. South Africa 2. Botswana
 - o Northern Africa and Western Asia - 1. Israel 2. United Arab Emirates
 - o South East Asia, East Asia and Oceania - 1. Singapore 2. Republic of Korea
 - o Central and Southern Asia - 1. India 2. Iran

Ref: Global Innovation Index 2023 Report

Empirical evidence from the IMF (2024) reinforces this relationship, showing that economies with strong digital infrastructure and well-developed innovation ecosystems record higher average annual GDP growth than less digitalised nations. At the same time, global access to digital infrastructure remains uneven. The International Telecommunication Union (ITU, 2024) reports that while global internet penetration reached 68% in 2024, it remains below 40% in Sub-Saharan Africa, highlighting persistent disparities in the foundations required for technology-driven growth.

Beyond digital access, sustained innovation also depends on investment in research and development. Countries that prioritise R&D tend to achieve higher productivity and competitiveness. For instance, South Korea invests approximately 4.9% of its GDP in R&D, followed by Singapore (2.3%), Norway (2.1%) and Estonia (1.7%) (OECD 2024). These economies also exhibit strong digital connectivity and higher levels of technology exports,

suggesting that robust innovation ecosystems are often associated with deeper digital integration and, in several cases, cleaner energy transitions.

However, GDP alone does not guarantee innovation success. While economic size provides the financial capacity for technological investment, innovation outcomes depend equally on governance effectiveness, education quality and policy coherence. Consequently, although higher GDP is frequently associated with stronger innovation capacity, sustained progress ultimately depends on how effectively countries transform economic resources into knowledge, technology and broader social value.

GDP, R&D and Innovation Performance

The relationship between GDP, R&D investment and innovation highlights the central role of knowledge and technology in modern economic growth. As illustrated in Table 4, higher R&D investment is closely associated with stronger innovation performance, reflected in patent activity and startup formation. Large economies such as the United States, China and India invest heavily in R&D, while innovation-intensive economies like South Korea and Japan demonstrate that high R&D intensity can drive substantial technological progress even at moderate GDP levels. India’s expanding startup ecosystem further highlights how entrepreneurial activity, supported by digital transformation, can strengthen national innovation capacity.

Table 4: GDP and Levels of Technology Advancement in the Top 15 Economies

Country	GDP (USD trillion)	R&D Investment (% of GDP)	R&D Investment (USD billion)	Patents (Numbers)	Startups (Numbers)	GII Rank
USA	28.78	2.79	803	350,000	72,000	3
China	35.29	2.07	730	680,000	24,000	14
India	14.59	0.65	94	150,000	38,000	40
Japan	5.38	3.29	177	450,000	11,000	13
Germany	4.94	2.93	145	300,000	11,000	10
UK	3.18	1.70	54	200,000	18,000	4
France	3.15	2.22	70	180,000	12,000	12
Brazil	2.43	1.26	31	50,000	7,000	57
Italy	2.05	1.33	27	120,000	9,000	28
Canada	2.02	1.71	35	110,000	8,500	17
South Korea	2.01	4.23	85	210,000	10,000	5
Russia	1.91	1.10	21	90,000	7,500	47
Australia	1.69	2.11	36	95,000	9,000	25
Spain	1.54	1.24	19	80,000	8,500	30
Mexico	1.51	0.53	8	70,000	7,000	55

Sources: Statistics Times; Visual Capitalist; OECD Data; World Bank (2024)

Technology as a Driver of Global Development

Technology drives global development primarily by raising productivity, efficiency and inclusivity (Tu et al., 2025). The World Bank (2024) estimates that technological adoption accounts for up to 40% of GDP growth in emerging economies by improving efficiency across manufacturing, logistics and agriculture. Automation and artificial intelligence have further strengthened supply chains by reducing human error and optimising production processes (Awan et al., 2023). Evidence from developing economies supports this trend: digital agriculture platforms in Kenya have increased crop yields by over 25% (FAO, 2023), while India's Digital India initiative has expanded access to public services, improved transparency and integrated millions into the formal economy (Mosiashvili, 2020).

Experiences from advanced economies reinforce the link between innovation and resilience. Singapore's Smart Nation strategy has enhanced public and private sector efficiency, with digital industries contributing 17% of GDP (WEF, 2024). Estonia's e-governance system, which delivers nearly all public services online, has reduced administrative costs by approximately 2% of GDP. In Rwanda, drone-based medical logistics have cut emergency delivery times by nearly 80% (WHO, 2023). Meanwhile, Norway and the United Arab Emirates illustrate how clean technologies support economic diversification, with Norway generating over 98% of its electricity from renewables and the UAE targeting 50% clean energy by 2050 (IMF, 2024).

South Korea provides a particularly instructive case of technology-driven transformation. Through sustained investment in education, R&D and infrastructure, alongside coordinated industrial policy, South Korea evolved from a low-income agrarian economy into a global technology leader. Government support for innovation ecosystems and domestic firms such as Samsung and LG enabled global competitiveness in electronics and semiconductors. Today, South Korea invests over 4.9% of GDP in R&D and leads in areas such as 5G, robotics and biotechnology (OECD, 2024), demonstrating how long-term commitment to human capital and innovation policy can drive structural economic change.

Innovation in Low-Income Countries

Low-income and developing countries often face structural barriers to innovation, such as limited financial resources, weak infrastructure, regulatory inefficiencies and skill shortages (Lema, 2021). Yet, several of these countries have adopted context-specific, scalable strategies that demonstrate how innovation can thrive even under constraint. Through focused policies, public-private partnerships and collaboration with international organisations, these countries have developed practical and affordable technological solutions that address local challenges while contributing to broader economic development.

Kenya identified financial exclusion as a key development obstacle, with a large share of its population lacking access to traditional banking. In response, the government established a supportive regulatory framework for mobile finance and partnered with Vodafone and Safaricom to launch M-Pesa, a mobile money transfer platform, revolutionised financial inclusion by enabling millions to transact via mobile phones (World Bank, 2019). Its success expanded to multiple countries, positioning Kenya as a global pioneer in fintech innovation and inclusive digital finance.

Bangladesh's Solar Home Systems (SHS) programme delivered off-grid renewable electricity to millions of rural households (Cabral et al., 2021). The country collaborated with the World Bank and local microfinance institutions to promote SHS. Over six million SHS units have been installed, providing clean electricity to rural households and generating employment in manufacturing and maintenance. The program reduced dependence on fossil fuels and improved educational and health outcomes in off-grid areas, establishing Bangladesh as a leading example of sustainable rural electrification.

Vietnam, despite modest R&D spending, leveraged targeted agricultural innovation to drive economic growth. By investing in agricultural education, irrigation systems and improved seed technologies, often in collaboration with international partners, it transformed into one of the world's largest exporters of rice and coffee. These low-cost, sector-specific innovations boosted productivity and income levels, proving that focused investment in key industries can yield significant developmental gains (FAO, 2023).

In Rwanda, drone-based medical supply delivery dramatically reduced transport times, illustrating innovation even with limited R&D investment (Nisingizwe et al., 2022). Rwanda made Information and Communication Technology a central pillar of its Vision 2020 development plan. Initiatives such as Smart Rwanda and partnerships with global technology firms accelerated the country's transition toward a digital economy. Rwanda now delivers over 90% of government services online and has become a regional hub for e-health and e-education platforms. Its pioneering use of drones for medical deliveries, reducing transport times by up to 80%, illustrates how innovation can flourish even with limited R&D expenditure.

These case studies reveal a powerful truth, that **innovation does not belong only to wealthy nations with large R&D budgets**. Across the developing world, these lower income countries are proving that creativity, collaboration and context-driven problem-solving can spark transformation even with limited resources. By combining smart policy choices, international partnerships and grassroots ingenuity, low-income economies are finding new ways to leapfrog development barriers. From **Kenya's fintech revolution** to **Bangladesh's solar energy expansion**, these examples show how innovation can emerge from necessity and drive lasting

impact. The following key principles summarize how such approaches are shaping inclusive, technology-enabled growth.

- **Public-Private Collaboration:** Partnerships with private enterprises, as seen in Kenya's M-Pesa, can deliver transformative innovation without extensive government spending.
- **Focus on Basic Needs:** Addressing core national priorities (such as clean energy in Bangladesh or agricultural productivity in Vietnam) creates immediate developmental impact while fostering long-term sustainability.
- **International Cooperation:** Engagements with global organizations provide technical expertise and financial support, as demonstrated by Bangladesh's collaboration with the World Bank.
- **Grassroots and Sectoral Innovation:** Supporting small-scale, context-driven solutions promotes inclusivity and resilience, particularly in resource-limited settings.
- **Digital Leapfrogging:** Investment in ICT infrastructure enables countries like Rwanda to bypass traditional industrial stages and accelerate modernization through technology-enabled governance and services.

Challenges and Risks

Despite these gains, technology-driven development faces persistent inequalities and new risks. The International Telecommunication Union (ITU, 2024) highlights that 2.6 billion people remain offline, primarily in rural and low-income regions. Automation could displace up to 85 million jobs globally by 2025, even as it creates 97 million new roles (WEF, 2023). This shift necessitates investment in digital literacy and reskilling. Countries lacking strong regulatory frameworks risk reinforcing inequality through unequal access to technology and data exploitation. Hence, governance of AI, digital rights and cyber-ethics becomes central to sustainable technological development.

Policy and Governance Implications

Governments must integrate innovation policy with inclusive growth strategies. Empirical analysis from the World Bank (2024) suggests that countries investing more than 2 % of GDP in digital infrastructure experience 1.8 percentage points higher productivity growth annually. The European Union's AI Act (2024) provides a regulatory blueprint emphasising transparency, accountability and human oversight. In developing economies, public-private partnerships can accelerate adoption of responsible technologies (Mwangi & Adjei, 2023). Rwanda's innovation fund, India's Digital Public Infrastructure and Singapore's GovTech collaborations exemplify how coordinated governance strengthens impact. International frameworks such as the Paris Agreement and the Sustainable Development Goals align technological advancement with

climate and equity goals (UN 2023). Data sharing, cross-border digital taxation and AI ethics cooperation will be crucial to ensure technology remains a global public good.

Conclusion

This study demonstrates that innovation is not merely a function of economic size or technological access, but of how effectively resources are transformed into productive capability. Economies that treat R&D as strategic capital, supported by strong institutions, human capital development and market-oriented policies, consistently outperform others in innovation outcomes, productivity and resilience. At the same time, evidence from developing economies shows that entrepreneurship, platform-based business models and targeted innovation can compensate for limited resources and enable rapid leapfrogging.

From a business and entrepreneurial perspective, these findings underscore a critical insight: innovation success depends less on absolute investment and more on execution, incentives and ecosystem design. Countries such as South Korea illustrate how long-term industrial strategy and public-private collaboration can create globally competitive firms, while examples like Kenya's mobile finance ecosystem reveal how regulatory flexibility and market creation can unlock large-scale value. Conversely, weak governance and misaligned incentives reduce the return on innovation investment, regardless of GDP levels.

As global competition increasingly revolves around technology, data and talent, the ability to align investment with institutional effectiveness will define future growth leaders. For policymakers, firms and entrepreneurs alike, the challenge is not simply to invest more, but to invest strategically - building innovation systems that are scalable, inclusive and adaptable. The future of global growth will be shaped by those who can convert technological potential into sustainable economic and social value.

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