Theoretical and Applied Economics
Volume XXXII (2025), No. 1(642), Spring, pp. 303-318

From lab to market: how governments and enterprises compose the future of innovation

Rareș-Mihai NIȚU
Bucharest University of Economic Studies, Romania
niturares18@stud.ase.ro

Abstract. *This study examines the impact of research and development (R&D) investment on economic growth, distinguishing between private and government contributions. Using data from developed and emerging economies, including the United States, China, Japan, South Korea, Turkey, the United Kingdon, and the European Union, the study analyzes the correlation between R&D spending and GDP growth. Findings indicate that private R&D investments have a strong and more direct effect on economic expansion, particularly in technologically advanced economies like China, South Korea and the United States. These countries leverage private sector innovation to drive productivity and competitiveness. The study underscores the necessity of a balanced R&D strategy, integrating private sector agility with government-led foundational research. Countries that successfully foster collaboration between these sectors achieve sustained economic growth, reinforcing the pivotal role of R&D in national and global competitiveness. The findings provide key insights for policymakers to optimize R&D investments for sustainable economic growth.*

Keywords: innovation, economic growth, R&D investment, public-private collaboration, technological development.

JEL Classification: I23, I25, I31, O3, O32.

1. Introduction

Research and development (R&D) plays a key role in boosting national growth and competitiveness. In recent decades, developed and emerging countries have stepped up inventions in R&D, recognizing their impact on innovation, productivity, and economic well-being. Thus, the research and development sector is considered a key factor in maintaining a competitive advantage and overcoming periods of economic crises by creating new technologies, products and services that stimulate economic sectors. As economies become more digitalized and technological, investment in R&D is becoming a key catalyst for sustainable progress. In addition, government policies that favor R&D can create optimal conditions for innovation and long-lasting economic growth.

Inventions in this sector can come as a source of funding from two main directions: the government sector and the private sector. Government research is usually geared towards long-term projects, supporting scientific and technological infrastructure, and developing fundamental knowledge. Thus, these investments create innovation-friendly ecosystems and enable significant advances in areas such as health, energy production and emerging technologies. Government research can also cover areas where the risks are far too high for the private sector. On the other hand, private sector R&D is mainly directed towards immediate commercial results and applicable innovation, with the objective of increasing the efficiency and competitiveness of companies. In an increasingly competitive business environment, companies invest significantly in technological development to stay positive in the market and respond quickly to technological changes and consumer demands.

The differences between government and private inventions in R&D are visible. The public sector tends to support projects with a broad impact on society, which require long-term investment and are not necessarily attractive to private investors. Instead, the private sector focuses on innovations with rapid profit potential, addressing them by investing in applied research and technological developments that can be commercialized. However, collaboration between the two sectors is essential, as government inventions can boost fundamental research, which the private sector can then harness for commercial purposes. In addition, there are examples of public-private partnerships that have led to breakthrough breakthroughs, such as advances in biotechnology and artificial intelligence, where synergy between the two sectors has been key to progress.

The importance of the R&D sector in economic growth is historically demonstrated, as they facilitate the transition to an economy based on knowledge and innovation. In times of crisis, R&D becomes even more relevant, as it helps to find solutions to complex problems, such as economic recessions, climate change or health crises. In this sense, constant inventions in the field of research and development can help economies become more resilient and maintain their growth even in adverse economic conditions. In addition, increasing development capacities through R&D allows economies to remain competitive in the global market and attract significant foreign investment.

The overall objective of this article is to analyze the relationship between private and government contributions to economic growth. The article investigates how these two types of investments influence GDP. Various countries, which have different economic strategies and different financial capacities, have been selected in order to provide a more coherent and pertinent overview. The inventions of the public sector denote the encouragement that companies have regarding the allocation of sums in avant-garde fields, while the inventions of the state reveal the importance that countries have in their own development process and on the national strategy to become pioneers in certain industries, of national interest.

2. Literature review

Econometric analysis of investment in research and development (R&D) has highlighted the strong link between R&D spending and economic growth. Studies on advanced economies show that investment in R&D contributes to increased total factor productivity and long-term technological development (Alam et al., 2019). At the same time, the analysis of emerging economies suggests that high levels of investment in R&D attract foreign capital and stimulate local innovation. However, there are significant differences between the types of financing and their effectiveness on economic growth.

Another aspect of interest is how investment in R&D influences employment and wage levels. Fundamental research indicates that economies with high levels of investment in R&D benefit from a more dynamic labour sector where high value-added jobs are created. Also, companies that invest heavily in R&D are more likely to implement advanced technologies that improve their efficiency and competitiveness in international markets (Kacprzyk & Doryń, 2017).

It has been shown that investments in R&D can have spill-over effects on adjacent sectors. For example, technology companies that invest heavily in innovation can stimulate the creation of related services, such as digital infrastructure, advanced logistics and the production of innovative materials. This generates a multiplier effect that increases the long-term economic benefits.

Another important dimension for the impact of R&D on economic performance is represented by increasing energy efficiency and reducing environmental impact. Technologies developed through investment in R&D can lead to more sustainable production methods and reduced dependence on renewable resources. They not only improve an economy's competitiveness position, but also contribute to global sustainability and environmental goals (Shah, 2024).

Therefore, the impact of R&D on economic performance is multifunctional and extends beyond the simple correlations between expenditure and economic growth. Institutional factors, educational infrastructure and the ability to implement research results are essential elements in determining the efficiency of investments in this field.

Another central aspect of research on investment in research and innovation is how public and private funding alter the effectiveness of innovation. Government investment is essential for the early stages of technological development, providing the necessary infrastructure and resources for large-scale projects. On the other hand, private sector investments are geared towards short-term deliverables and the commercialisation of innovations (Yu, 2021). A comparative analysis of Asian economies shows that privately funded R&D has a more direct impact on firms' competitiveness, while public funding contributes more to creating a robust technological infrastructure.

The analyses suggest that in order to maximise the benefits of investments in this area, a balanced strategic approach between public and private creation is needed. Countries that have succeeded in creating an innovation-friendly legislative framework and fostering public-private partnerships have achieved superior results in terms of economic growth and industrial competitiveness. In addition, the development of policies to support small and medium-sized companies to access funding for research and innovation has been identified as a critical factor for the long-term sustainability of economic growth.

Therefore, the analysis of R&D investments confirms that they are an essential part of economic growth, but their effectiveness depends to a large extent on institutional structure, the level of integration of research policies and the collaboration between the public and private sectors. Econometric models and empirical studies indicate the need for a differentiated approach, adapted to the context of each economy, to ensure a maximum impact of R&D on sustainable economic development.

3. Methodology

The study analyzes a sample of countries with developed and emerging economies, selected based on their share of R&D relative to the Burt Domestic Product and their impact on economic growth. The identified countries contain the Member States of the European Union (taken aggregated as an annual average of the entire analyzed interval), China (without consolidated data from Hong Kong), Japan, Russia, South Korea, Turkey, the United Kingdom and the United States of America. The analysis period starts in 2012 and ends in 2023, the last year for which reporting was possible. Comparing these savings allows to highlight effective investment models and provides internationally applicable recommendations. In addition, the analysis of these economies allows for a deeper understanding of government R&D strategies, regional and sectoral differences, and the long-term impact of these investments on sustainable economic development.

The nature of the data used in this study includes official statistics collected from the Eurostat and MFI databases. The data has been processed to ensure consistency and comparability across countries. The data processing source was selected to allow longitudinal analysis of investment trends in the R&D sector and correlation of data with economic developments. In addition to these official sources, research reports published

by various economics, academic studies and additional data from independent sources were also used to improve the robustness of the analysis.

The missing data allocation methods were required in China for the year 2013, for Russia for the years 2021, 2022 and 2023, Japan for the year 2015 and for Turkey for the years 2014 and 2016. The imputation mode was linear interpolation, in order to maintain the integrity of the analysis and avoid distortions in the interpretation of the results. In addition, statistical modelling techniques have been applied to verify data integrity and reduce estimation errors. The approach allowed us to identify more accurately the relationships between growth and the R&D sector, providing solid and fundamental conclusions. The methodology used contributed to the creation of a re-applicable analytical framework, which could be extended to examine other economies or industrial sectors.

4. Finding

By comparing the correlations between R&D expenditure and GDP growth, the study highlights the differences between each country's funding models and their effectiveness in driving innovation and productivity. The results are structured in such a way as to provide a clear picture of the relationship between private R&D and economic growth, respectively between government R&D and its impact on GDP. The analysis allows the identification of trends specific to each economic model and highlights lessons that can be extracted from successful strategies. In addition to quantitative aspects, the interpretation of the results takes into account factors such as the institutional context, economic structure and public policies that influence the efficiency of investments in research and innovation. Next, the data obtained are detailed for each region and the economic implications of different strategic approaches to R&D funding are analysed. This section thus contributes to understanding how research and development can become a key driver of economic growth, depending on the specificities of each economy.

Table 1. *Level of correlations of R&D investments of private & government companies and GDP*

Country	Correlation R&D Business / GDP	R&D Government / GDP
EU - 27	0.19492703	0.27466054
China (w/o Hong Kong)	0.65497721	0.67395858
Japan	0.13515833	0.05176252
Russia	0.33059064	0.15356539
South Korea	0.31087371	0.40160167
Türkiye	0.04225368	0.15887483
United Kingdom	0.03364950	0.00658473
United States	0.43204943	0.17792540

Source: author's own process of data using RStudio.

Table 1 shows that the highest recorded values are those of China for both private investment in the research and development sector (0.6549) and government investment (0.6739). The data suggests that the Chinese economy is strongly supported by research and development, with a balanced strategy between the public and private sectors. The high

level of correlation indicates a close relationship between R&D investment and economic growth, which confirms the central role of innovation in China's economic strategy.

The European Union analyzed as an average of the 27 member states registers lower values for both government inventions (0.2746) and private inventions (0.1949). The low values indicate a fragmentation of investment between Member States, where some countries invest heavily while others have a low level of existence. There is also an economic model in which innovation is not the main driver of growth, but rather supported by other economic and industrial policies. It is noted that the analysis was carried out on the basis of aggregated data from all Member States, but the rationale for comparing economic powers requires this. Taken individually, EU Member States have a limited capacity to counter the external policies of the other countries mentioned. Overall, the European Union's modus operandi is an aggregate one that takes into account a unilateral move for all participants. As such, the rationale behind it is to compare similar economic centers. The United States of America, for example, can be seen as a totally different mode of government from the European model, but multi-state administration is the central element that entails, as a primary example, the need for European coordinates and the interpretation of EU data at a general level.

At the same time, the data on the correlation of R&D are lower in terms of government investments (0.1779), but higher in terms of private perspective (0.4320). Dependence on private inventions is an observed element that reflects a low government involvement in the R&D sector. As a predominantly capitalist economy, the private sector is encouraged to focus on these areas of development, while the state does not prioritize research inventions.

Japan shows a moderate correlation with a relatively low government contribution. The private sector is the main actor in R&D financing, which corresponds to its economic model based on innovative multinational companies. However, a relatively low correlation indicates that R&D inventions are not the only driver of economic growth.

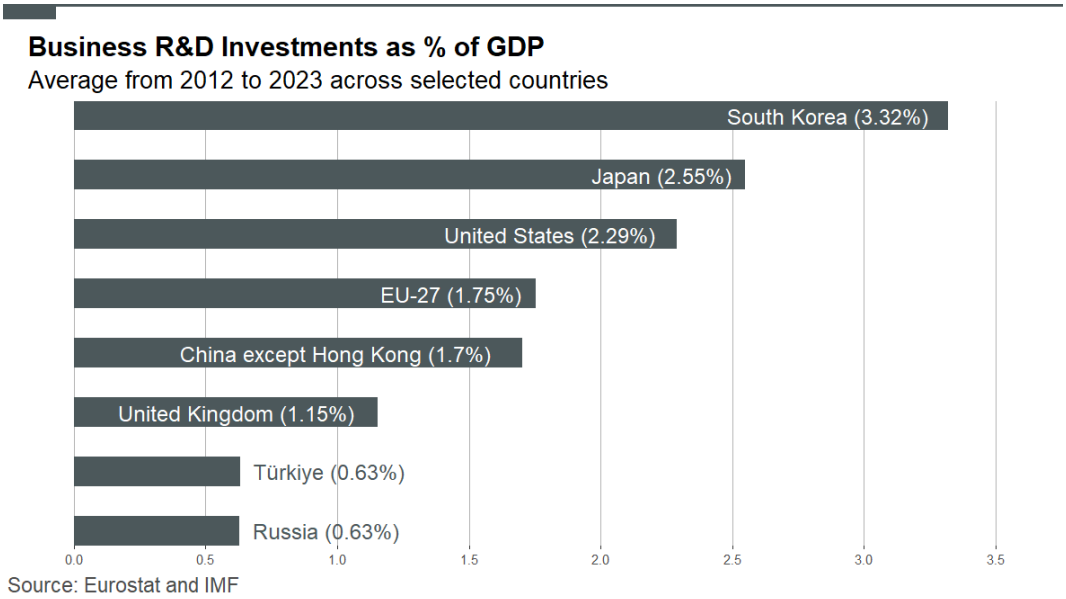
Russia and South Korea have similar values for correlations, but the investment structure is different. In Russia the government contributes to a greater extent, while in South Korea the private sector has a significant involvement. This suggests that while Russia relies on public funding, South Korea has built its economic growth model on private investment, an aspect that explains its success in advanced technological industries.

Turkey and the United Kingdom have the lowest correlation values, indicating a weak link between R&D inventions and economic growth. In the case of Turkey, government inventions are higher, but their impact on the economy seems limited. In the UK, both the private and government sectors have extremely low contributions, suggesting an economic orientation based on services and finance rather than technological innovation.

The fact that some countries are more R&D efficient than others does not mean that the share of the Burt Domestic Product as well as the private percentage of investment are not

directly proportional. Given that countries differ in structure, economic and strategic complexity, it is also necessary to visualize the percentage values extracted from the nominal values of the data.

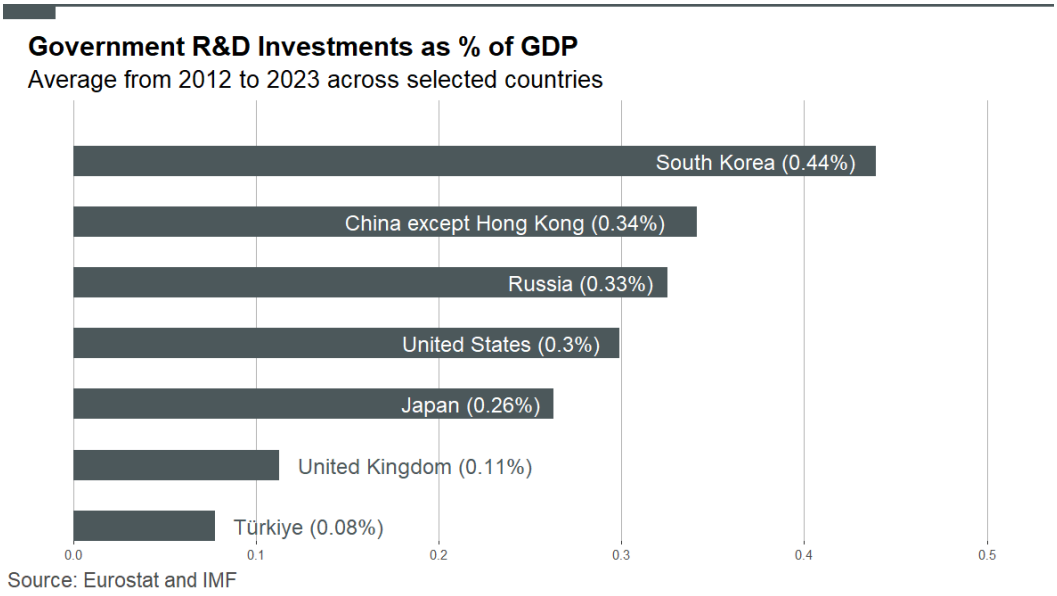
Figure 1. *Business R&D Investment as % of GDP*



Source: author's own process of data using RStudio.

Figure 1 shows that South Korea has the highest share of R&D investment in relation to GDP, both from the private sector and from the government (the values can be seen in Figure 2). The national innovation model combines public support with a significant involvement of private companies, thus strengthening the technological and industrial advantage. Massive investments in the research sector did not arise spontaneously, but are the result of more than two decades of innovation-oriented policies. Since the 2000s, the South Korean government has implemented successive reforms to boost research and development, laying the foundation for a national innovation system. Under Roh Moo-hyun's administration, strategies aimed at transforming the science and technology-based economy. In the following period, the transfer of responsibility to the private sector was emphasized, promoting a more active involvement of companies. Government programs have advocated increasing international completeness, and initiatives such as '557' have set clear targets, such as allocating 5% of GDP to R&D and the development of new strategic technologies. The stimulus policies have led to the consolidation of South Korea's position in leading industries such as electronics, automobiles or biotechnology (Kim et al., 2020).

Figure 2. *Government R&D Investment as % of GDP*



Source: author's own process of data using RStudio.

In all the economies analysed, private sector investment in research and development is considered higher than that made by governments. This trend highlights the fact that innovation is mainly driven by private companies, which direct their capital towards the development of new technologies and products with a direct economic impact.

The US clearly illustrates this phenomenon, with an allocation of about 2.29% of GDP for R%D in the private sector, compared to 0.30% of GDP through government funding. This difference underscores the U.S. economy's reliance on corporate investment in technology and innovation.

Europe follows a similar mode, where public research grants have been used mainly as a mechanism to stimulate private investment. Studies show that government subsidies have a complementary effect on private investment rather than a substitution effect, meaning that firms that receive public support also tend to increase their own inventions in R&D (Bronzini et al., 2009).

The European Union adopts a balanced model in terms of research and development funding, combining public and private inventions to ensure the long-term sustainability of innovations. Unlike economies such as the US and South Korea, where private inventions dominate the R&D sector, Europe maintains a more balanced ratio between the two sources of funding. Government research inventions account for about 0.25% of GDP in most Member States, contributing significantly to scientific infrastructure and innovation projects with social impact. This strategy makes it possible to support fundamental

research, universities and public laboratories, while ensuring that the private sector benefits from a stable framework for technological development.

In many European countries, R&D incentive policies aim to encourage the private sector by providing subsidies, tax breaks and public-private partnership schemes. These measures encourage companies to increase their investments in research, generating a multiplier effect on the economy. The data suggest that this blended finance model helps to create a more stable innovation ecosystem that is less vulnerable to market fluctuations (Reinstaller & Unterlass, 2012).

Japan maintains a high level of private investment in research and development, allocating 2.55% of GDP to R&D in the business sector. In contrast, the government contributes only 0.26% of GDP, which indicates a significant dependence on private initiatives for technological advancement. A distinctive feature of the Japanese model is geared towards compensating for demographic decline through innovation. Japan is experiencing a rapidly aging population and a declining workforce, which has led to increased investment in technologies that replace labor-intensive processes. This mode has been reflected in the expansion of the digital sector, automation and digitalization (Sylwester, 2001).

Although private inventions generate sustained economic growth, they have not been able to completely reverse the effect of the decline in the working population. Recent studies suggest that innovation contributes to job creation, especially in the manufacturing sector, but with mixed effects on other industries (Becker, 2015).

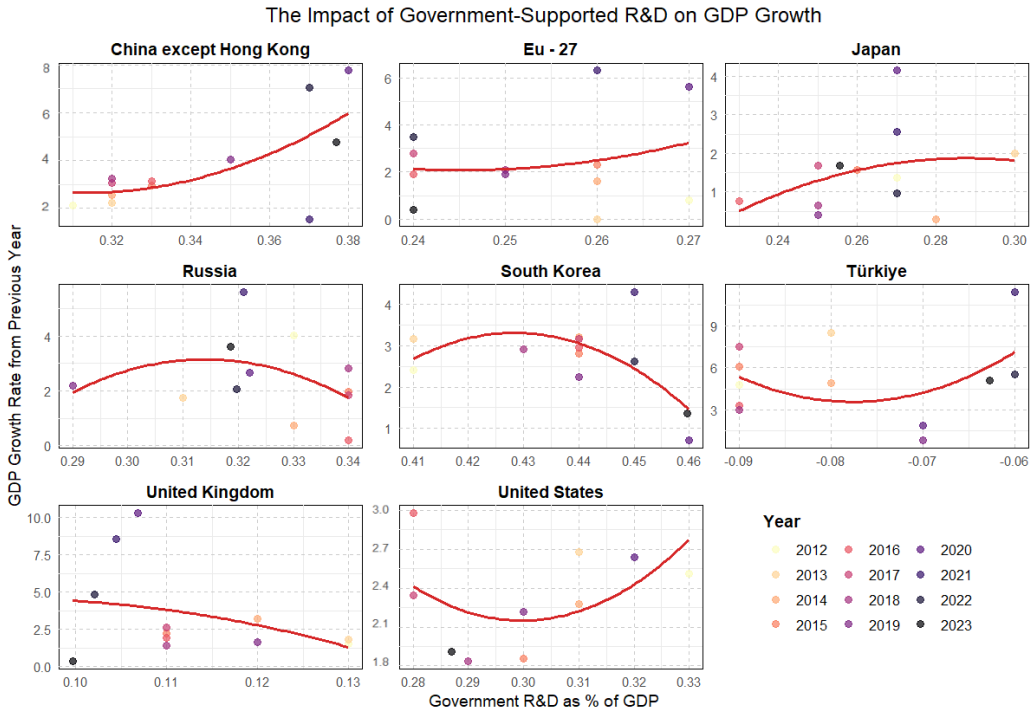
The United Kingdom has one of the lowest levels of investment in research and development among advanced economies, with 1.15% of GDP from the private sector and only 0.11% of GDP allocated by the government. These values confirm a long-standing trend of stagnation in innovation allocation. Unlike other developed countries, the Mars UK has failed to significantly increase its spending on research in the last two decades, which has led to a loss of completeness compared to countries such as Germany, Japan or South Korea. Despite this trend. The UK excels in certain areas, such as academic research and patent production. The number of scientific articles published in relation to GDP is among the highest in the world, which indicates a strong research system but with less economic applicability (Xu & sim, 2018).

Russia allocates 0.33% of GDP to research and development in the government sector, one of the largest public contributions among the countries analyzed. However, private inventions are extremely low, standing at just 0.63%, i.e. a low involvement of companies in innovation. The model reflects the Russian economy's high dependence on state funding and a less dynamic private sector in advanced technological development. On the other hand, public inventions are concentrated in strategic industries, such as defense and energy, which limits the impact of innovation on the overall economy (Doraszelski & Jaumandreu, 2008).

Turkey has the lowest levels of R&D investment among the economies analyzed, with 0.63% of GDP from the private sector and only 0.08% of GDP from the government. This situation indicates a limited involvement of the state and companies in innovation, which affects the competitiveness of the Turkish economy in the long term. In the absence of policies to stimulate R&D, many Turkish companies prefer to import technologies from advanced economies instead of investing in their own innovation capacities. This approach contributes to economic growth based on low labor costs, but without a competitive advantage supported by technology. The Turkish strategy can be understood as one focused on low labor costs rather than on the development of industries based on innovation. Studies show that R&D inventions have not had a significant impact on Turkey's economic growth, suggesting that the economy remains dependent on technology imports and low-value-added industries (Alam et al, 2019).

Almost no relationship is linear in economics, and the R&D sector is no exception to this principle. In Figure 3 and Figure 4 you can see the trend over time of the two indicators. Even if the trend is a downward one, the relationship remains positive for all elements, an aspect to be taken into account for interpretation (Siliverstovs, 2001).

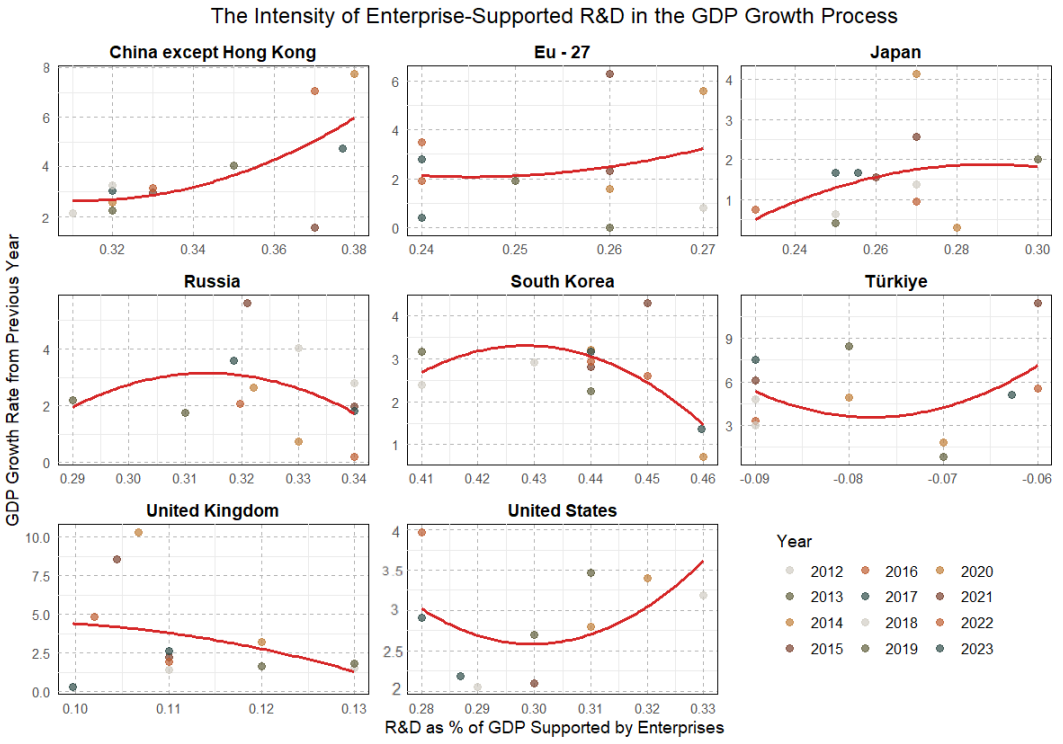
Figure 3. *The Impact of Government – Supported R&D on GDP Growth*



Source: author's own process of data using RStudio.

The United States of America is a good example of a distinct model in terms of the relationship between government investment in research and development and economic growth characterized by a non-linear trend. The graph highlights the fact that the reported levels of public funding in R&D do not generate a significant impact on GDP, but once government investments reach a certain threshold, the effects on economic growth become visible and accelerated. The report suggests that initial public inventions are not enough to boost innovation and productivity, but once a critical level has been exceeded, the accumulation of knowledge and research infrastructure allows for a more efficient use of the capital invested. The explanation of this phenomenon can be found in two fundamental economic mechanisms. The first is the "Standing on shoulders" effect, according to which at higher levels of public funding, companies benefit from previous research and discoveries, accelerating the innovation process. This effect becomes visible only after sufficient expertise and research infrastructure have been accumulated to enable sustained technological progress. The second mechanism is the "fishing out" effect, according to which initial inventions are used for easy-to-implement discoveries with limited economic impact. Only after these stages are overcome, research advances to more complex innovations that have a transformative effect on the economy (Siliverstovs, 2001).

Figure 4. *The Intensity of Enterprise – Supported R&D in the GDP Growth Process*



Source: author's own process of data using RStudio.

Compared to other developed economies, the U.S. exhibits a variable elasticity of public investment in R&D to economic growth. Unlike the European Union, where government funding has a relatively constant pact, in the UAE the effects are more dependent on the private sector's ability to capitalize on these investments. The American innovation system relies heavily on private companies, which play a critical role in converting public research into commercial processes and technologies. Thus, government funding in R&D has a limited impact if it is not supported by a public sector and policies favorable to technology transfer. The non-linear relationship in question has important implications for U.S. R&D policies. Government investment in R&D must be maintained in the long term to ensure sustainable economic effects, as the benefits only become visible after a long period of knowledge accumulation. At the same time, the effectiveness of these investments depends on the existence of a private ecosystem capable of integrating and commercializing research results. In the absence of clear mechanisms for collaboration between the public and private sectors, government inventions risk being left without a significant economic impact. At the same time, tax regulations and incentives play a crucial role in optimizing this process, facilitating companies' access to financing and promoting a crucial role in optimizing this process, facilitating companies' access to establishment and promoting partnerships between research institutions and the business environment.

Private investment in R&D has a clearer and more positive effect on GDP growth, as it is geared towards the rapid development of products and technologies that bring a competitive advantage to the market. Companies invest in R&D with the aim of creating products and improving production processes, which leads to increased productivity and consistent measurable economic growth. For example, Sylwester's analysis shows that in large encomitants such as those that are part of the G7 group, private investment in R&D is directly associated with economic growth (IDEEA 9). In economies such as China and South Korea, private inventions have facilitated rapid adoption of new technologies. The study by Xu and SIM highlights that specific financial factors such as cash reserves and debt maturity contribute positively to R&D intensity in companies, which is subsequently reflected in significant economic growth. Government-funded R&D focuses on fundamental research and long-term projects, with benefits that materialise gradually and have asocial added value, but which do not immediately translate into GDP growth. On the other hand, private investment is directed towards applied innovations, with rapid effects on productivity and competitiveness, which explains the upward regression line observed in the graphs in Figure 4 – Enterprise Supported R&D.

In Russia, data show that private investment in R&D has an initial positive impact on GDP growth, but subsequently the decline in such investment correlates with a reduction in the stimulus effect on the economy. In addition, government investment in R&D in Russia forms a bell-like curve indicating the existence of an optimal threshold. Allocations below or above the threshold do not bring additional benefits, signaling a limited effectiveness of public policies to support innovation (Shah, 2024).

On the other hand, in Turkey, institutional factors play a decisive role in how investment in R&D influences economic growth. Studies in emerging markets highlight that the institutional environment, through aspects such as political stability, government efficiency and corruption, can shape the relationship between R&D and GDP growth, leading to a different dynamic than in Russia (Kim et al., 2020).

Thus, while Russia faces a variable efficiency of R&D depending on the source of financing, Turkey presents a model in which the institutional context significantly influences the relationship between R&D investment and economic growth. These findings suggest that for effective innovation policies it is essential to adapt funding strategies to the specificities of each institutional environment.

For China and South Korea, private investment in R&D has a significant impact on GDP growth. Studies so much so that, as private companies allocate more and more resources to innovation and technological development, a multiplier effect on economic productivity is generated. Thus, the regression line obtained from empirical analyses is tangentially ascending, sometimes with small deviations depending on the strategy and financial conditions at that time. The positive effects are due to the fact that, in both economies, companies use innovation as the main source of competitive advantage, which leads to the rapid adoption of new technologies and the improvement of production processes. For example, the study conducted by Xu and Sim (2018) highlights that in the manufacturing industry of China and South Korea, private investment in R&D drives notable increases in firms' performance, which subsequently translates into accelerated GDP growth. Thus, for China and South Korea a clearly positive correlation can be observed, where the expansion of private investment in technology and innovation stimulates economic growth by increasing productivity and improving competitiveness in the market.

In Japan, there is a close relationship between R&D expenditure and GDP growth, suggesting that, despite significant investment, the marginal effect of this expenditure on economic growth is small. Studies show that at very high levels of R&D spending, the additional effect of investments becomes smaller and smaller, due to diminishing marginal returns. In Japan, where spending on innovation is already very high, it does not bring a proportionate increase in GDP (IDEA 5). Japan is facing a steep aging population and a shrinking workforce, which can reduce the ability to turn technological innovation into economic growth. These demographic factors limit the rapid adoption of new technologies and affect productivity in the long term, offsetting the positive effects of investment in R&D (IDEA 9). The Japanese economy, characterized by an advanced technological level and a well-developed industrial infrastructure, has reached a ceiling of additional benefits from investments in innovation. Thus, although R&D is continuous, its impact on GDP growth becomes insignificant, compared to emerging economies that can benefit from higher growth through the adoption of new technologies.

In summary, the near-flat curve observed in the graphs of the impact of R&D on GDP in Japan indicates that, beyond a certain level of investment, additional spending on

innovation does not automatically translate into significant economic growth. This is likely the result of a combination of saturation of investment effects, demographic challenges and a mature economic structure, which together mitigate the marginal effects of R&D.

5. Conclusion

Investment in research and development is undeniably essential for economic growth, but its impact varies considerably depending on the source of funding and the context of each economy. In both the private and government sectors, they play a crucial role, but their effectiveness is influenced by factors such as the intentional structure, the level of economic development and the policies supporting innovation.

First, the private sector is the main driver of innovation in developed and emerging economies. Companies invest in R&D to remain competitive, introduce new technologies and increase productivity, Data shows that countries such as China and South Korea benefit significantly from private investment, with a strongly positive correlation between private R&D and GDP. This can be explained by investment saturation, demographic challenges and a mature economic structure, which reduce marginal returns on innovation. However, public investment is vital for the development of strategic sectors such as health, infrastructure and emerging technologies, providing a stable framework for long-term innovation.

Another important aspect is the difference between the way R&D is financed in different economies. For example, Russia relies more on government investment, which limits the positive impact on economic growth because the private sector does not contribute enough to innovation. Instead, South Korea has built a hybrid mode, combining government support with a strong involvement of private companies, which has allowed the development of cutting-edge industries, such as technology and biotechnology.

Turkey and the United Kingdom show weaker correlations between R&D and GDP, suggesting that investment is not sufficiently targeted or that innovation is not the main driver of economic growth. In Turkey, for example, public investment is higher than private investment, but the impact on the economy remains limited, indicating problems in the effectiveness of innovation policies. In the United Kingdom, both the private and public sectors have low levels of investment in R&D, reflecting an economic orientation based on services and financing rather than technological innovation.

The United States of America is a special case in the analysis of the impact of investments in research and development on economic growth. The American model is based on the dominance of the private sector, where companies are primarily responsible for innovation. The data shows that the US has one of the highest correlations between private investment in R&D and GDP, confirming that innovation is a key driver of economic competitiveness. Unlike other economies, where government plays a more active role, in the U.S. public

investment is lower and the private sector is encouraged to take the lead. A distinctive aspect of the American economy is its ability to turn research into viable commercial solutions. The US has a well-developed ecosystem of partnerships between universities, research institutes and the private sector, which accelerates the innovation process. This interaction is supported by a favorable tax policy, incentivized for companies and a competitive business environment. However, the US is not without its challenges. Unlike in the European Union, where government funding in R&D is relatively constant and distribution strategically, in the US the effects are more dependent on the ability of the private sector to capitalize on these investments. This model can lead to fluctuations in innovation, as companies are oriented towards short-term profit, and areas that require long-term investment, such as public health or fundamental research, may receive less attention from the private sector.

In conclusion, the impact of R&D on economic growth depends on the balance between public and private financing, the institutional framework and the capacity of each economy to capitalize on innovation. Countries that have managed to create an ecosystem conducive to research and development, such as South Korea and China, have achieved remarkable results. On the other hand, economies that do not have a coherent strategy to support R&D risk not reaping the full benefits of innovation. This analysis suggests that a balanced approach tailored to the national context is key to making research investment a sustained engine of economic growth.

References

Alam, A., Uddin, M., and Yazdifar, H. (2019). Institutional determinants of R&D investment: Evidence from emerging markets. *Technological Forecasting and Social Change*, 138: pp. 34-44.

Becker, B. (2015). Public R&D policies and private R&D investment: A survey of the empirical evidence. *Journal of economic surveys*, 29.5: pp. 917-942.

Bronzini, R., and Piselli, P. (2009). Determinants of long-run regional productivity with geographical spillovers: The role of R&D, human capital and public infrastructure. *Regional science and urban economics*, 39.2: pp. 187-199.

Doraszelski, U., and Jaumandreu, J. (2008), *R&D and productivity: Estimating production functions when productivity is endogenous*. Harvard Institute of Economic Research Discussion Paper, 2147.

Kacprzyk, A., and Doryń, W. (2017). Innovation and economic growth in old and new member states of the European Union. *Economic research-Ekonomska istraživanja*, 30.1: pp. 1724-1742.

Kim, E.S., Bae, K.J., and Byun, J. (2020). The history and evolution: a big data analysis of the national innovation systems in South Korea. *Sustainability*, 12.3: p. 1266.

Reinstaller, A., and Unterlass, F. (2012). Comparing business R&D across countries over time: a decomposition exercise using data for the EU 27. *Applied Economics Letters*, 19.12: pp. 1143-1148.

Shah, I.H. (2024). Does R&D investment drive employment growth? Empirical evidence at industry level from Japan. *International Journal of Finance & Economics*, 29.1: pp. 102-118.

Siliverstovs, B. (2016). R&D and non-linear productivity growth. *Research policy*, 45.3: pp. 634-646.

Sylwester, K. (2001). R&D and economic growth. Knowledge, *Technology & Policy*, 13.4: pp. 71-84.

Xu, J., and Sim, J.W. (2018). Characteristics of corporate R&D investment in emerging markets: Evidence from manufacturing industry in China and South Korea. *Sustainability*, 10.9: p. 3002.

Yu, H. (2021). An analysis of the paradox in R&D. Insight from a new spatial heterogeneity model. *Technological Forecasting and Social Change*, 165: p. 120471.