THE CORRELATION BETWEEN INNOVATION AND ECONOMIC GROWTH

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Domnița ISAC, PhD Student
Academy of Economic Studies of Moldova
isac.domnita@ase.md

Abstract: *This article analyzes the correlation between innovation and economic growth. This paper aims to analyze and explore how economies can successfully increase their capabilities through innovation policy. Innovation is considered the key factor in technology improvement, the new driver of economic growth, and the crucial strategy for developing the national economy. In order to establish a proper innovation policy is required a deeper analysis of the innovation system, which usually deals with complex interactions between R&D, human capital, and innovation diversification. Due to a virtuous circle that exists between R&D expenses, which can generate new technology and innovations, the result of innovation usually has a direct impact on the increase of productivity and GDP per capita. This thesis emphasizes the importance of structural industrial transformation in determining long-term sustainable economic growth and upgrading the traditional labor-intensive industry to technology. And determining which factors has the greater impact on economic growth and how this can be integrated into innovation policy?*

Key words: *innovation ecosystem, industrial policy, industrial structure transformation, STI system, innovation index, financial infrastructure*

1. Introduction

Better technology offers the potential of better lives for many people, expands human capabilities, better-functioning schools, factories, and applied throughout the economy, greatly increasing efficiency and productivity.

Indeed, we are greatly better off than our ancestors thanks to unprecedented advances in technology, that could give us a much healthier, longer life today than three centuries ago. We are living in an age more optimistic, enjoying much higher living standards.

New technologies, according to journalists, politicians, and scientists, make it possible a heading path towards a better world. Today, we benefit from an incredible tool that is available to us, including magnetic resonance imaging (MRI), mRNA vaccines, industrial robots, the internet, computers, and innovations that we can use to solve problems. The advantage of AI consists in new opportunities provided to scientific and talented entrepreneurs to create and invent solutions to existing problems that the world may face today, which means more capable robots, much human-level artificial intelligence, and perhaps scientific advances that could solve cancer, global warming, and even poverty.

This process of innovation and improvements is also linked to education, skills, competencies, and know-how of the workforce that gives them the ability to create a vision, because how we use knowledge and science determines our capability to turn knowledge into techniques and methods that can be targeted at specific problems.

In addition to that, another key important aspect is the ability of a country to capitalize and to encourage technological innovation, to invest in people, to create a level playing field, and to mobilize the talents and skills of individuals in developing new businesses that can bring new technology to life.

Also, to achieve a better balance by restraining corporate power, strengthening workers' rights, or to increase the availability of finance and technology for the new firms. All of this can improve the quality of life and encourage economic progress. This is actually the reason why societies with better systems of social protection can be more innovative.

2. Basic content

New technology usually increases worker marginal productivity through new machines and production methods, also produce higher wages and create prosperity. This was an example that happened in 1960, period with a large scientific exploration that transformed everything about human existence. During the 1950s-60s, scientists created new goods, including automobiles, refrigerators, televisions, and telephones. Furthermore, industrial countries (America, Germany, or Japan) benefited from higher productivity, all thanks to breakthroughs in technology.

The progress continued with personal computers and digital tools starting to spread rapidly in the 1980s-90s. New digital technology have made a rapid growth and created new jobs, trained as computer scientists, engineers, and financiers. It well known that companies and firms which invest in R&D are more able to increase labor productivity.

This thesis intends to determine the correlation between innovation and economic growth and find the indicator that is weighted the most in measuring the progress of technology-innovation in a country that influence the output.

The awareness of knowledge and human capital as a central role for economic growth led to a significant increase in mass literacy, public education, research and development, and public investment in science and technology. According to Gordo (2013), "the realization that innovation is the key long-term driver of development was itself an innovation". The economic growth model of major economies in the world today has innovation as the key component.

The new era was followed by developing the international enterprise with worldwide recognition, companies such as Google in the U.S. or Silicon Valley.

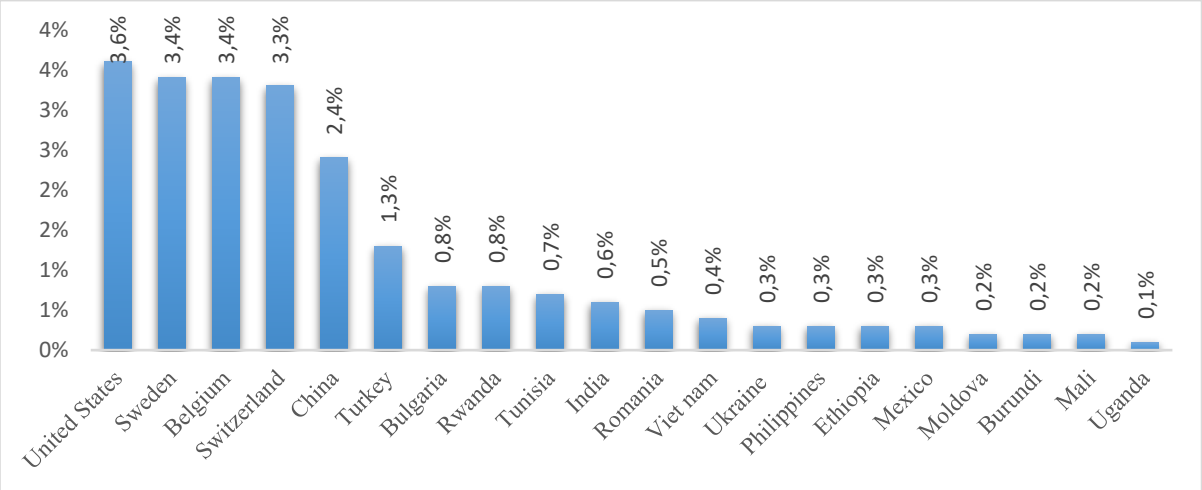

Figure 1. Gross expenditure on R&D, %GDP (2024)

Source: developed by the author based on World Intellectual Property Organization (WIPO) data

In the Republic of Moldova case, the total expenditure for R&D represents only 0,2% form GDP or MDL 699,1 million and the total workforce engaged in this activity is composed by 3,3 working people. Funding for the development and maintenance of research infrastructure is also low, so far it only covers personnel costs and indirect costs related to research activity. Therefore, the need to stimulate innovation through effective and impactful policies to ensure digital transformation is highlighted. An approach in this regard is designed through the medium-term public policies developed by the Moldovan government in the context of EU accession. These policies serve as support for the implementation of the Growth Plan for Moldova and the general objectives of the National Development Strategy. In order to achieve digital transformation, the SND provides a specific objective of developing opportunities for innovation and entrepreneurship, with a priority focus on investments in industrial infrastructure. Another objective considered a priority in this regard is ensuring an attractive business environment, favorable to attracting foreign investment and international collaboration.

However, it must be acknowledged that the design of innovation policies is not an easy task. It may require more analysis of the innovation system of a given country, region, or city. To achieve the industrial structure transformation in the national economy, which is considered the new economic growth driver, each country must focus on scientific, technological, and production capabilities. Nevertheless, the output of each dimension is difficult to estimate. Economic literature typically uses the scientific publication in internationally recognized academic journals to measure scientific advancement. Patent applications are used to reflect the availability of new technology, where each country is assigned to one of 14 technological domains according to the International Patent Classification (IPC). Exports are used as an indicator to show a country's ability to provide competitive goods and services.

The innovation system is a complex and long-term path that requires a wide range of preconditions and policies that are essential for industrial development. The entities' incentive to engage in innovative activities depends on a complex framework that includes macroeconomic stability, a functioning legal system, an effective educational system, and a financial system that can turn savings into investments.

Economic research has shown that a series of policy instruments (traditionally so-called *industrial policy*) employed by the government aiming to promote high-technology industry development had a massive impact on industrial diversification over the past half-century. These policy measures include import tariffs, subsidies, and subsidized loans and import-substitution-industrialization (ISI), aimed at improving the competitiveness and capabilities of domestic firms and promoting structural transformation. Starting in the 1950s, industrial policy has been an important strategy for many developing economies in East Asia before becoming globally competitive.

However, many economists claimed that despite East Asia have been the only country that used this specific growth model and had indeed a substantial increase of value added in manufacturing, which was reflected in real GDP. The industrial policy nowadays, compared to the 1950s, is more directed towards the service sector rather than manufacturing, where most factories have embedded robotic machinery in their repetitive and straightforward tasks.

Regarding the service sector, focused more on human knowledge complexity, the policy emphasizes the importance of science, technology, and innovation (STI) and the primary goal is to enhance this pillars that bring new opportunities, create dissemination of knowledge in other important sectors (public health) that improve the daily living society. Additionally, the STI can be incentivized by the government funds and public policy that are able to connect different institutions, such as universities, training centers, research organizations, and regulatory institutions, that can easily create a framework for transferring technology developed in the academic lab to companies.

In advanced economies, the expenditure on education as a percentage of GDP is much higher than in developing countries; for instance, the ratio represents 6,7% in Sweden and 4,6% in India, compared with Uganda, expenditure is even more reduced, 2,6% of GDP. In the Republic of Moldova total expenditure on education as a percentage of GDP represents 6,1%.

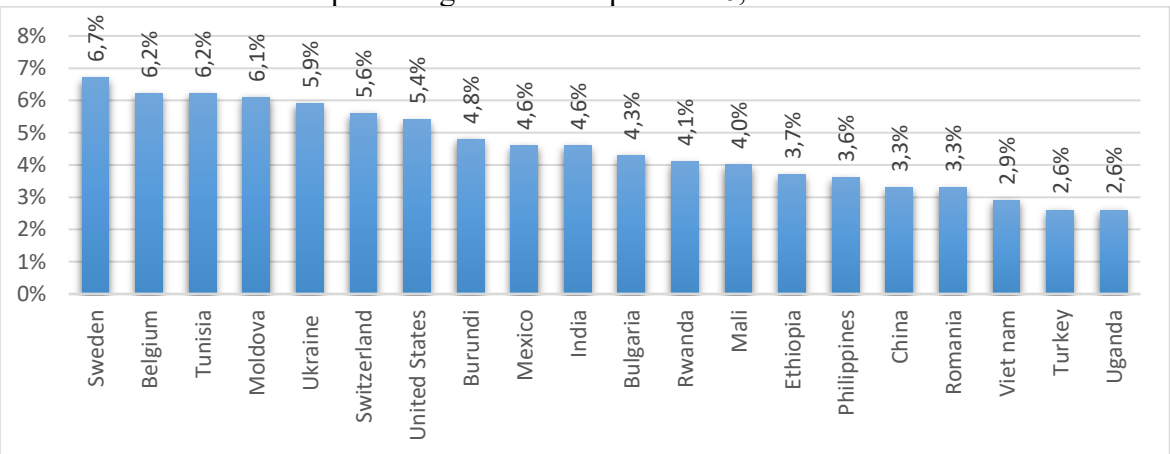

Figure 2. Expenditure on education, %GDP (2024)

Source: developed by the author based on World Intellectual Property Organization (WIPO) data

The linkage between innovation and education has been considered the most important element for technological transformation by many countries. Additionally, a lot of studies have revealed a positive correlation between innovation and education, and the necessity to connect the academic and the business world. The importance of education came from many empirical analyses, which have shown that, even if the government would allocate sufficient funds towards research and development (R&D), the lack of qualified skills would not bring the expected results.

Education gives the possibility for upgrading the supply of labor from low or middle-level skills to sophisticated skills workers essential for high-technology industry development. Advanced countries have already made the process of investing in human resources to create a high labor-qualification in order to develop their own enterprise or to absorb much easier foreign technology. For example, the European Union (EU) is adopting industrial policy, – called smart specialization, designed to encourage innovative skill education and scientific training to increase the competitiveness of the Union's industry. The US had successfully integrated universities and other institutions into its innovative system through technology policy. Japan was another example of cultivating talents by reforming the public education system and funding studies of advanced technology overseas.

However, according to Yifei G. (2022), the education improvement in lower-income countries is faster than the higher-income countries, and this gives the opportunity to contribute to more profound research.

Yet STI policy faces tough decisions in determining which fields of scientific research should receive support, which consequently reflect on which industrial activities will offer long-term benefits.

First, because studies based on surveys find that not all goods and services developed through advanced technology capability are successfully commercialized in the market, sometimes advanced innovations are created from basic exploring science. For instance, discoveries of penicillin and semiconductors that boosted the health and electronics industry. Second, the scientific research can be very theoretical and not easily applicable to organizational practices, which leads to barriers in establishing science-industry linkages.

Usually, many industrial policies are built to support the country's or region's strengths to achieve a higher level of productivity and innovation. And this is the reason why countries do not produce the same outcome and instead are specialized in a specific scientific, technological, or production field using comparative advantage. Studies show that among the 11 important scientific domains, the chemistry domain accounts for the largest output; subsequently, among the 14 technological domains, the information and communication technology (ICTs) and biopharma have the most international patents; and lastly, among the 15 production domains the machinery and transport equipment accounts all exports. For instance, the European Union has launched a five-year plan called the European Skills Agenda to ensure that people have the right skills for jobs. The European Union also pointed out the importance of girls and women in the information and communications technology (ICT) sector, which today represents only 19,5% of employees.

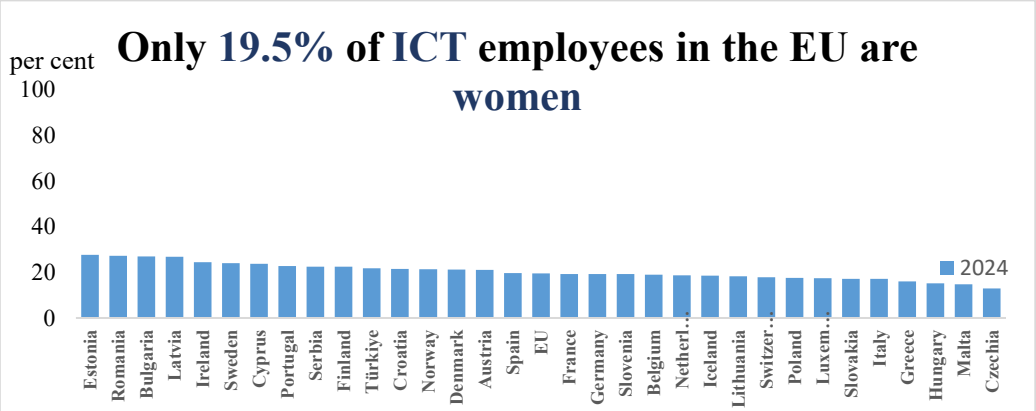

Figure 3. Women ICT employees in EU

Source: EURSTAT, European Parliament (www.europarl.europa.eu)

The same aspect we could find when the R&D sector was analyzed for the Republic of Moldova, technology and innovation have a lower number of women researchers (26,6%) from all science domains. For instance, the Government of Rwanda has established a funding instrument, "Women in Science Research and Innovation Grant (WIS)" to help women scientists develop research proposals that will enable them to create jobs and become entrepreneurs.

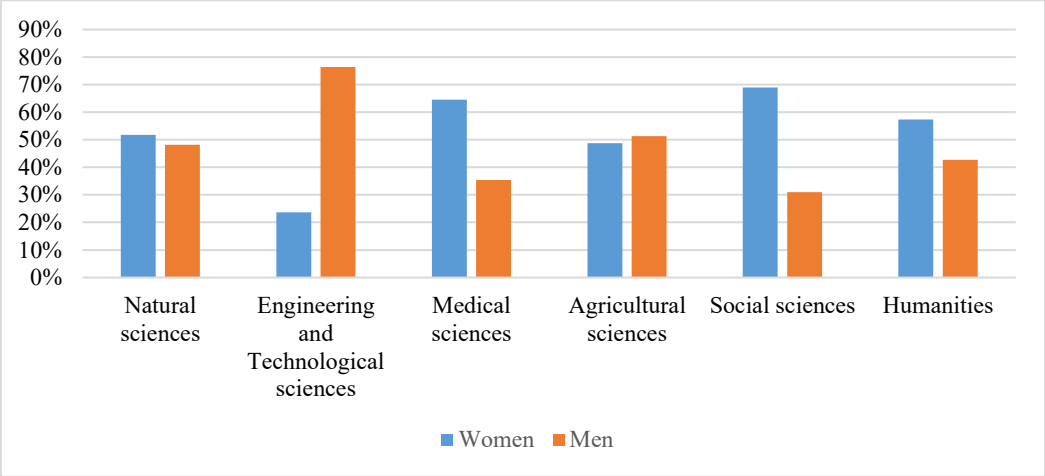

Figure 4. Women in science research and innovation in the Republic of Moldova
Source: NBS

Specialization has its benefits as well as drawbacks. For instance, it can boost the economy's growth and efficiency, develop expertise, and produce higher-quality output; however, it can also be vulnerable to global supply chain disruption, external shocks, or international market volatility.
The majority of high-income economies managed to specialize and accumulate a considerable diversity of capabilities, making them part of the global innovation area. Over the past 20 years, these top countries are namely United States, Japan, China, Germany, and the Republic of Korea, whose economies have highly concentrated innovative outcomes.
Therefore, these top countries already have a high-functioning innovation ecosystem that can transform ideas into science and technology for the future and avoid vulnerabilities as much as possible. Understanding the specialization and diversification is essential for less developed regions in designing innovation policies, along with the concept of smart specialization, more recently developed by Western countries.
Therefore, studying the relation between innovation effort (meaning the performance of the high-technology industry and massive input in the research and development, R&D section) and economic output can also help to better compose the policy agenda for the recovery of the economy. Literature review reveals that the innovation index positively correlates with education level, and there is a positive correlation between innovation and R&D expenditure. However, even if the R&D investment takes a long time to have a visible impact on the economy, it nevertheless has a stronger correlation with GDP growth or income per capita. From the graph below, we can see that developing and underdeveloped countries are still struggling with low income per capita (PPP USD$), despite their higher expenditure on education.

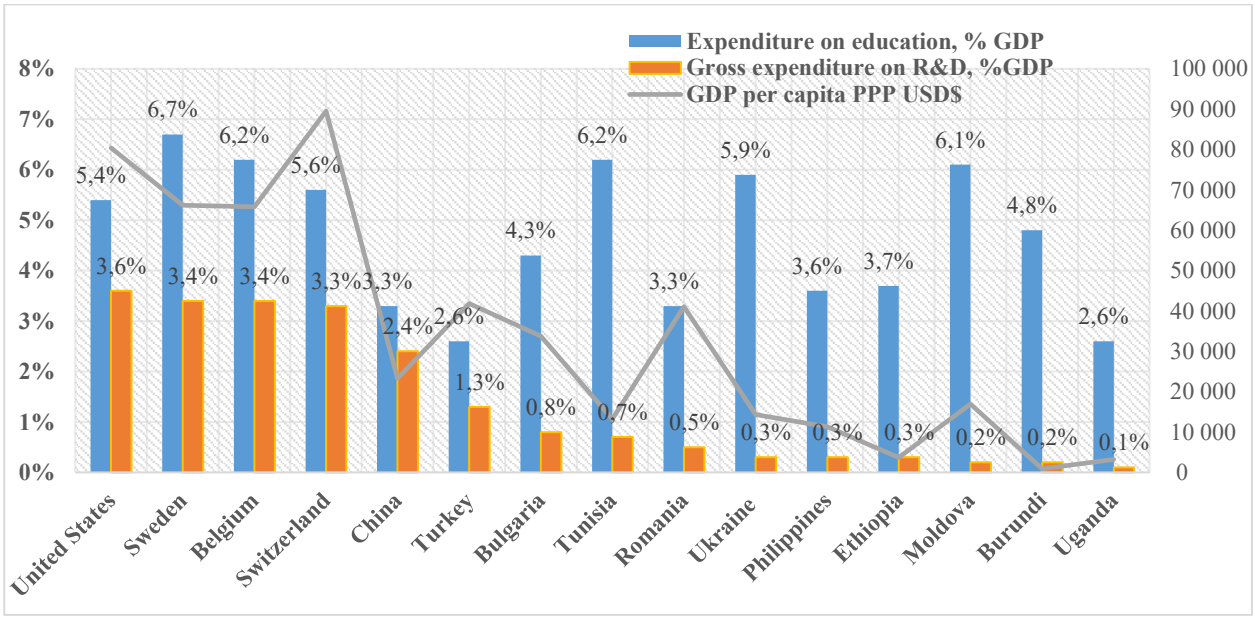

Figure 4. Expenditure on education (%GDP), expenditure on R&D (%GDP), and GDP per capita, 2024

Source: developed by the author based on World Intellectual Property Organization (WIPO) data

Along with these indicators and many others compose the Global Innovation Index Ranking gives an overview of a country's relationship with innovation progress and comparison with other economies. In the long term, it is expected that the Republic of Moldova will be a European country producing technology and innovations (relative to its size and economic capacity) and not just importing the existing technology. For this, the preparation of the PNCI also includes and follows the indicators with a significant impact, such as share of research expenditures to GDP and the improvement of Global Innovation Index.

Moreover, another important key element when designing the innovation policy is the relationship between digital payments integration and economic growth. In the last few years, digital payment has been a broader regional economic strategy with public sector support.

Implementation of FPS represents a major step towards digitalization and contribution to the innovation ecosystem to help and ensure a more efficient and accessible financial system, which can bring a variety of benefits for the government, individuals, and businesses. In the Republic of Moldova instant payment (MIA) has launched in 2024 by National Bank of Moldova, the willingness involvement of central bank in enhancing the payment infrastructure come along with the responsibility, as overseers, to ensure trust in money for all stakeholder participant in financial

market, both the public and private sector. Consequently, the central bank has consolidated the efforts in ensuring proper governance and risk management to guarantee that FPS is safe, secure, resilient, and efficient.

Instant payment has the potential to drive financial inclusion, reduce the cost of financial transactions, and make more affordable and accessible payment options for individuals and businesses; additionally, it can be associated with greater productivity and economic development.

Integration of fast payment has increased across many jurisdictions; economic literature has shown that digital payments can accelerate economic growth, for instance, through e-commerce, due to cheaper and faster transactions, which can facilitate online purchases. Literature also provides evidence that once an individual builds up a track record of formal payment, afterwards can access financial services beyond payment, resulting in higher levels of access to credit from financial institutions.

3. Conclusions

This study investigation examines the determination of which is more important from a policy analysis perspective: the expenditure on education or the expenditure on R&D. And why are some countries more advanced and others are left behind. As we can see from the last chart, there is a stronger correlation between expenditure on R&D, rather than expenditure on education. Even if the government allocates sufficient financial resources to develop the education system, to this must be added other factors in order to increase the economic competitiveness and standard of living. Investing in infrastructure, regulation, and other aspects aims to establish an innovative-friendly environment, it is also important. Another important aspect that should consider in a country's plan of growth is the prioritization of industrial policy and STI system that can shape industrial development. Additionally, it should give importance to R&D efforts in the pursue of GDP growth, based on results, innovation efforts would have better performance in the high-technology industry. As we can see, among countries income group, the expenditure on R&D from total GDP is almost two times that of upper-middle-income countries.

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