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THE EFFECTS OF THE SUSTAINABLE INNOVATION PROCESS ON THE GLOBAL ECONOMY

521.02. World economy; International economic relations

Summary of the PhD thesis in economics

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CONTAINED

CONCEPTUAL RESEARCH MILESTONES

The theoretical topicality and practical importance of the problem addressed. According to international discussions in the 1980s, the debates at the UN Conference on Environment and Development in Rio de Janeiro in 1992, and as a result of research in the literature, the concept of innovation and the notion of sustainable development have undergone a transformation and reformulation, taking the form of *sustainable resource reproduction and well-being.* Sustainable innovation can be defined as the creation of something new that improves performance in the social, environmental and economic dimensions of sustainable development, i.e. the concept of innovation has evolved, complementing the role of innovations.

The literature confirms the positive effect of external and internal market innovations on innovators. In fact, sustainable innovation refers to new concepts such as: commercialisation of technologies; products and services; and entrepreneurship. The study of the world economy comprises conceived within the paradigms: realist, liberal and constructivist, which differ in the place and role of states in the world economy and international economic relations, the conditions of stability of the structure of the international system and the growth of inter-state cooperation, the changing nature of innovation.

However, as there is no single definition for sustainable innovation, a general difficulty arises in defining sustainability concepts. At the same time, the importance of sustainability objectives for innovation policy making is perceived differently because of differences between the criteria of the innovation process and the scientific, social, economic, informational, environmental, etc. effects of innovation. For this reason, in the author's view, it is difficult to assess: the full effect of sustainable innovation, the effects on international markets and the resulting impact on the global economy, therefore it requires more complex investigation and the development of clear conclusions on the researched topic.

Research object: the effects of sustainable innovation on the global economy.

Aim of the research is to analyse the dimensions of the innovation process in dynamics at the level of groups of countries and companies in order to clarify the effects of sustainable innovation on the world economy.

Thesis objectives:

- research into the theoretical foundations of the effects of sustainable innovation on the global economy;
- study methodological approaches to researching the performance of innovation systems in the system of global economic relations;
- the study of the dynamics of the dimensions and role of sustainable innovation in the competitiveness of companies, regions, countries and international markets;
- analysis of the effects of sustainable innovation in models and metrics of world economic development;
- studying the relationship between sustainable innovation, innovation performance and global economic trends;
- Identify new correlations in the analysis of the effects of sustainable innovation by country groupings according to innovation profiles, growth in government spending on technologically advanced products and technological level of sectors;
- assessing the benefits of a sustainable innovation policy and the effects of sustainable innovation performance on international market structure.

Research methodology. The following methods were used in the research process: theoretical analysis, economic statistics, mathematical statistics, economic modelling, survey and systems approach. The theoretical-scientific basis of the study is the current concepts on the nature and effects of the sustainable innovation process, phenomena and trends in the world economy, as well as new developments in the field of competitiveness strategies and innovation policies.

Research hypothesis is the assumption that the effects of sustainable innovation on the global economy, as a driver of competitiveness at the firm, company, region, country level, are determined by new correlations of innovation performance dimensions and differ according to the innovation profile.

Important scientific problem solved is to develop theoretical and practical research on the dynamics of the dimensions of sustainable innovation by groups of countries according to: their innovation profile; the perceived importance of innovation policy objectives; indicators of innovation performance through the relationship between sales growth and R&D expenditure; and the relationship between factors influencing the market structure of organisations in different technology sectors. The scientific research carried out has led to: identification of new correlations and effects between the basic components of innovation performance at the level of companies and groups of countries, as well as the effects of organisations belonging to low-, medium- and high-tech industrial sectors. As a result, we note that a Sustainable Innovation *Roadmap* has been developed based on innovation performance as a competitiveness factor for innovation policy making.

Scientific novelty of the work consists of:

- to argue for an improved methodological approach to researching sustainable innovation performance in dynamics in terms of its effects on global economic phenomena and trends;

- substantiation of the methodology for identifying new correlations between the dimensions of sustainable innovation for extracting the sustainability component in the full effect of innovation and adjusting innovation policies based on the analysis of the perception of the objectives of government innovation policies, the dynamics of the dimensions of sustainable innovation, and the developed map-table of the correlation of innovation indicators for the groups of innovation leader, strong, moderate and emerging innovator countries;

- developing empirical research on the impact of the technological capability factor on the relationship between innovation activity, market structure and organisational size;

- Arguing, on the experimental basis of sustainable innovation policy, that it has multiple effects on competition policy, taking into account the direct interaction between competition and innovation to stimulate innovation, sustainable innovations being those that promote change in the global economy.

The theoretical importance and application value of the work. The research carried out complements the theoretical aspects of the development of the sustainable innovation process. The applied value of the thesis lies in grounding the design of innovation policies based on the identification of new correlations between the dimensions of sustainable innovation, innovation performance indicators at the level of business, company, technology sector, region, country, as well as improved international methodologies for measuring innovation performance and adjusting innovation and market competitiveness models, including data from Spanish companies in low, medium and high technology sectors and companies in the Republic of Moldova, which could contribute to rethinking the dimension of sustainable innovation and its effects in the global economy system. The effectiveness of the results is expressed through the elements of detailed structuring of the components of sustainable innovation, offering new possibilities for using international methodologies for measuring the innovation process in the identification of new dependencies and effects.

Approval of results scientific work was carried out within the International Cooperation Department (ICD) of the Ministry of Economy and Infrastructure (MEI) of the Republic of Moldova, which contributed to the elaboration and implementation of the policy for the development of the innovative potential of the country's economy at regional and global level, as well as within Imobil Capital S.R.L. to increase the competitiveness of innovative products/services at global level.

Summary of the thesis compartments:

The **Introduction** argues the topicality of the research topic of the thesis, formulates: purpose and tasks, research object and methods, theoretical importance and applicative value of the thesis, approval and implementation of scientific results, general conclusions and recommendations.

The **first chapter "Theoretical approaches to the sustainable innovation process in the context of sustainable development of the world economy"** contains three important topics, such as: 1. the study of the sustainable development paradigm of the world economy through the lens of the evolving concept of sustainable innovation, 2. the architectures of strategies for sustainable international business in terms of developing models of the sustainable innovation process, and 3. benchmarks for assessing the impact of sustainable innovation on the world economy. It also provides a synthesis of the literature in the field of the research topic addressed, demonstrating advances in the conceptualisation of sustainability in innovation; the contributions of empirical studies in providing practical solutions; and a better understanding of the benefits of transitioning innovation processes on sustainability at the business, company, sector, region and country level.

The **second chapter "Analysing the dimensions of sustainable innovation in the light of global economic trends"** explains the fragmented, incomplete and sometimes haphazard assessment of innovation to date and the need to improve the understanding of innovation spending and innovation benefits for assessing the impact of regulatory policies on innovation, as well as the need to reassess them. The first sub-chapter includes an analysis of several approaches to estimating the impact of innovation on the world economy by reflecting different global indices, which highlight different aspects of the innovation phenomenon. The second sub-chapter analyses the dynamics of the dimensions of sustainable innovation, including: innovation profiles of companies, regions and economies, and relative performance. The third sub-chapter examines the relationship between sustainable innovation and global economic trends, starting from the idea that this relationship is bi-directional.

In the third chapter "Effects of the dynamics of sustainable innovation indicators on the world economy and the Republic of Moldova" the multidimensionality of innovation activities and the diversity of effects resulting from the implementation of innovations, which are of different but interrelated quality, is explained as the reason why the assessment of the impact of innovation cannot be based on a single indicator, given that the adoption of sustainable innovation practices can affect the performance of organisations and countries in international markets, and the management of sustainable innovation can be an important source of benefits, including competitive ones. The research presented in chapter three is based on material collected from studies carried out by the author as part of the Erasmus mobility programme at the University of Cadiz, Spain, on a panel of Spanish companies, with the aim of developing research on the relationship between the adoption of sustainable innovation practices and the performance of industrial companies in the technology market. In the first sub-chapter, the dynamics of the dimensions of sustainable innovation are analysed in terms of their impact on performance. In the second sub-chapter, new correlations in innovation performance indicators are analysed. The third sub-chapter analyses the benefits of a sustainable innovation policy based on innovation and market indicators for determining the market effects of innovation in low, medium and high technology sectors.

General conclusions and recommendations include the main findings of theoretical and practical research carried out by the author. The recommendations are based on the main research findings and are addressed to different categories of sustainable innovation stakeholders.

Keywords: sustainable innovation, effects on the world economy, innovation performance, sustainable innovation dimension, export innovation intensity, company innovation capacity, sector, region, country, innovation strategies and policies.

SUMMARY OF CHAPTERS

Chapter 1 "Theoretical approaches to the sustainable innovation process in the context of sustainable development of the world economy" contains three topics: the study of the sustainable development paradigm of the world economy through the lens of the evolving concept of sustainable innovation; the architectures of strategies for sustainable international business in terms of developing models of the sustainable innovation process; and benchmarks for assessing the impact of sustainable innovation on the world economy.

In synthesizing the literature in the field of the research topic addressed, the author reports that sustainable innovation emerged as a new concept of innovation, linked to the notion of sustainable development, which, after international discussions in the 1980s and the UN Conference on Environment and Development in Rio de Janeiro in 1992, made sense of the interactions of three complex systems: (i) the world economy, (ii) global society and (iii) the earth's physical environment, introducing the concept and identifying nine planetary boundary processes respectively [45, p.10], of which 3 are outdated. In the contemporary context, the concept is not limited to technology or economic growth, but encompasses services and non-commercial social innovations, innovation being characterised by different competing modes, such as: the way of "producing and using codified scientific and technical knowledge ("science - technology - innovation" (STI)) and the way of "doing, using, interacting" [20, p.22]. At the same time, within the technological paradigm, the question of dominant post-industrial technologies remains controversial.

The claim that innovation and technology will ensure sustainable development of the economy is questionable, to say the least, because sustainability is development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs [5, p.45]. The search for sustainability impacts can lead to innovations that generate cost savings, new models and competitive advantages, and there is an emerging recognition that sustainable innovation is not just about new concepts, but also about the commercialisation of technologies, products and services and entrepreneurship, which does not explain the applicability and new laws that need to follow.

At the same time, the concept of innovation: *Innovation → Productivity → Growth* (Innovation, Productivity, Growth - IPG), which has a quantitative meaning, is already in need of reformulation. Thus, the following formula is more correct: sustainable reproduction of all resources, with the innovation formula: *Sustainable Innovation → Sustainable Reproduction of Resources → Growth of Well-being* can be condensed into *Innovation → Reproduction → Well-being (IRW).* The IPG formula emphasizes growth through innovation activity, while the IRW formula emphasizes growth through the reproduction of different forms of capital [21]. At the same time, since the research environment is only one part of modern society, the socio-economic performance of each state is formed along the whole chain: education → research → economy, the relationship between the nuanced fields being one of mutual complementarity, transformation, interaction and continuous improvement. The shift to business strategy, oriented towards *sustainable product and service* models (SPS), can provide market opportunities and improved strategic positioning, as well as a potential response to price competition from low-cost economies.

At the same time, sustainable innovation is a multi-level phenomenon that requires three major forces to promote it at the (i) macro level: government policies and actions that overcome the risks involved in radical innovations; (ii) company level: development of new business models; (iii) individual level: changes in cognitive mechanisms, attitudes and behaviours. Such improvements take into account changes in processes, operational practices, business models, thinking and business systems [19, p.236].

There is no precise or standard definition for sustainable innovation, which implies general difficulty in defining the concepts of sustainability and sustainable development [7]. Since 2007 the multiplicity of sustainability is recognised [44], some of the definitions bring more confusion than clarity. At the same time, in the literature, the notion of sustainable innovation reflects the definition of the concepts of sustainability and sustainable development, distinguishing between the terms sustainability-oriented innovation and sustainability innovation. This approach requires a look at how to achieve the transition to a new global paradigm through a more responsible treatment of environmental, social and economic capital. [6, p.505].

Currently, the study of the world economy is conceived within three paradigms: realist, liberal and constructivist [0]. They differ in terms of the place and role of states in the world economy and international economic relations, the conditions for the stability of the structure of the international system and the growth of inter-state cooperation [46]. *Realist* theories comprise three conceptions, according to one of which states instrumentalize policies as rationally as possible in order to maximize their own power or security. However, research by J. Grieco [17] have demonstrated the empirical fragility of this theory, and P. Liberman [30] reports that: domination is increasingly expensive in today's world. *The liberal* conception of international relations is based on the assumption: international economic relations benefit each participant, and the progress of international relations is gradual and irregular, ensured by technological innovations, increasing interdependencies, the general level of education and the evolution of international institutions, due to the achievement of a greater degree of individual freedom through increased international cooperation [0].

A critical issue is understanding the factors that influence social innovation [49]. The increased risk of innovation and the uncertainty of profit stimulate cooperation. The experience of innovation clusters shows that partnerships between large organisations, parent companies and subsidiaries of multinationals, contractors and subcontractors are the main drivers of innovation. According to the new concept, any organisation can innovate through cooperation, changing the traditional focus on research labs and basic research in the innovation process.

Companies in lower-income countries, as a rule, tend to be less inclined towards in-house R&D or the acquisition of external knowledge, focusing more on the adoption of existing technologies. This may be due to a lack of human capital and other factors that limit the ability of companies to conduct their own R&D and achieve productivity gains through a range of other measures, for example by modernising management practices. In higher-income countries, the providers of knowledge are: companies, R&D institutions, universities, while in lower-income countries, technologies are predominantly borrowed from foreign companies, R&D institutions and universities.

Table 1. Effects of sustainable and innovative development

Economic effect	C&D effect	Resource-based effect	Social effect	Environmental effect
- profit-innovation and licensing activities; - increase in sales volume; - increasing production quality - increasing ROI and ROA.	- new types of production; - new equipment; - new technologies; - IT share; - increased levels of automation products; - improving organisational levels of production and workforce.	- increased rates of return on assets; - accelerated turnover of working capital; - increased labour productivity; - reduced production of materials and energy; - reduced complexity of production processes.	- increase income; - job security at work; - working environment; - increasing HR skills; - satisfaction of social values; -reducing human resource turnover.	- reducing air pollution; - reducing waste production; - producing environmentally friendly goods; - improving ergonomic working conditions; - reducing fines for environmental pollution.

Source: Adapted by the author based on [35]

The impact-effect stage is often ignored in innovation research because the innovation is considered ready when it is implemented, plus there is a general assumption that innovations are always useful, valuable and good in nature. These qualities are impossible to verify without considering the impact of the innovation. Innovation might be an economic success, but socially - a disaster because of its impact on social practices [27], through the creation of new practices and, as an effect, on international trade, especially for developing countries, which requires further research. Therefore, it makes sense to make the selection of sustainable innovative activities by reflecting the degree of impact of a given innovative change on indicators of market efficiency and adaptability (Tab.1), building a new logic towards sustainability [3, p.5] and thus changing the structure of the international market.

The effects of innovations can be both positive and negative, but the main aim of sustainable innovations is to reduce environmental burdens. Types of impacts of innovations include: environmental, technological, economic, social, cultural and managerial. In general, there are 4 categories of sustainable innovation impacts: economic, resource, technical and social. However, due to the complexity of innovation as a process and as a system, the number of actors and beneficiaries, discussions on classifying impacts and systematising performance indicators continue, providing several models. The full realisation of the effects of sustainable innovation requires diffusion of innovation, when it spreads to the national economy and then to the global economy.

Chapter 2 "Analysis of the dimensions of sustainable innovation in the light of global economic trends". In this chapter, the author presents the study of scholarly contributions to the idea that sustainable development is a "flexible" concept interpreted in many different ways, i.e. the multiplicity of sustainability is recognised. In this context, the author proposes to complement the definition of innovation, provided by Tim Stock in 2017 [149]. "a process in which sustainability considerations (environmental, social and financial) are integrated into a company's systems, from idea generation through research and development to commercialization", with the words " *as well as incorporating business models for sustainability by radically reducing negative externalities and/or creating significant positive impacts for the natural environment and society."*

The assessment of sustainable innovation, being largely fragmented, incomplete and sometimes haphazard, requires improved approaches, methods and data to assess the effects of sustainable innovation on economies, as well as the impact of regulatory policies on sustainable innovation. The analysis of different approaches to measuring the impact of innovation on the world economy reflects different global indices, which highlight different aspects of the innovation phenomenon.

The main incentive for innovation activities, which relates to gaining market share and higher profits relative to competitors, highlights the importance of analysing the specific market conditions of sustainable innovation, as organisations only decide to spend on innovation when they succeed in capturing innovation rents. Therefore, the World Quotient framework needs to include certain variables, such as contestability of the relevant market. Therefore, sustainable innovation policy, having an important role due to market failure-inducing externalities, which is relevant for the initial phase of innovation, in the later phases must highlight the innovations developed, which have a multiplier effect according to M. Porter's hypothesis [36, p.115]. Thus, the new theory of innovation growth reinforces the argument that in regions characterised by high innovation capacity, positive externalities can attract new innovation actors.

One of the most relevant measurements, Global Innovation Index (GII) [14], uses 84 indicators (Human capital and research; Infrastructure; Market sophistication; Business sophistication; Knowledge and technology outputs; Creative outputs, etc.) to benchmark 142 countries based on their innovation capabilities, grouping countries by income level (high, upper middle, lower middle and low) and performance criterion (above expectations for level of development, in line with level of development and all other economies) [14]. Because it is not a single indicator that would capture the full spectrum of innovation performance from idea inception to impact, the GII relies on a broad set of indicators, in particular, investment in science and innovation, technological progress and socio-economic impact, to assess the innovative performance of economies and to capture key innovation trends. Thus, for the *scientific papers publication* indicator, according to the NISTEP (Japan) report of August 2022 [24], China has achieved absolute dominance in world science, beating the US, Germany and France.

In recent decades, the R*&D investment* indicator has consistently grown faster than economic output, at an exceptionally high rate of 8.5% in 2019, in contrast to overall GDP, which grew by 2.4%. According to recent WB data, gross domestic expenditure on research and development (R&D), expressed as a percentage of GDP, which includes: capital expenditure and current expenditure in the 4 main sectors: business organisation, government, higher education and private non-profit, covering basic research, applied research and experimental development, is unevenly distributed with no explicit trends [22].

The Research and Development Intensity in the World Economy indicator recorded one of the most pronounced increases in 2017-2018, showing one of the highest growth rates in history for industrially developed countries. As a rule, R&D expenditure has a dynamic parallel to GDP [4].

International patent filings, amid falling global output, grew by 3.5% in 2020, fuelled by particularly rapid growth in China (16%), Korea and the US, while Japan and most European economies saw declines [14].

Number of venture capital (VC) transactions grew by 5.8% in 2020, exceeding the 10-year average rate (3.6%) and demonstrating the exceptional resilience of innovation funding. Because it is not possible to fully track the speed of progress in all areas of technology, monitoring progress is useful in a few important areas, such as: the number of transistors in microchips; renewable energy costs; pharmaceutical trade; and advances in bioscience.

Socio-economic effect. So far there is no evidence that diminishing capacity for technological innovation can affect productivity growth and economic growth in the long run. However, there is evidence of a relationship between slow productivity growth and the increasing share of services in global economic output, stagnating levels in education, and the adoption of the newest technologies in the years 2010-2020, with total factor productivity reflecting similar long-term declines, especially in developed economies. At the same time, it demonstrated: continued growth in scientific output, R&D expenditure, international patent filings and venture capital transactions, and the adaptability of innovation spending and regional innovation centres to changing global demand [48].

A general approach to study the impact of innovation is to apply the IOOI (Input, Output, Outcome and Impact) impact model with the impact chain composed of 4 phases:

1. Input. This phase is when the innovation is introduced into a particular context or system. Entry consists of the initial implementation of the innovation and preparation for the next steps in the impact chain.

2. *Output*. Output is the concrete results of the innovation process, in which the changes achieved due to the application of innovation, including new or improved products, services or processes, are measured and evaluated.

3. *Outcome.* This phase focuses on the effect of using innovation in a specific environment. The outcome refers to how the innovation directly influences performance or processes within the organisation or system.

4. *Impact*. Finally, impact is a deeper and more complex phase of the impact chain, exploring the significance of the innovation and how it can have a long-term impact on the organisation, community or society as a whole. Impact can include cultural, social or economic change and can have significant relevance for the future.

By using the IOOI model with its four distinct phases, researchers and practitioners can take an in-depth look at the innovation process and better understand how innovations contribute to the change and evolution of a system or organisation. This framework provides a comprehensive approach to assessing and understanding the impact of innovation in different contexts. Please note that the European Innovation Scoreboard (EIS) 2021 Regional Innovation Scoreboard Report [13] classifies countries into 4 groups according to relative performance (leaders, strong innovators, moderate innovators and emerging innovators) and distinguishes between 4 main types of activities - framework conditions, investments, innovation activities and impacts, when *impact covers the effects of innovation activities in 3 dimensions of innovation: employment impact, sales impact and environmental sustainability.*

Performance clusters tend to be geographically concentrated, with innovation leaders and most strong innovators located in Northern and Western Europe, and most moderate innovators and emerging innovators - in Southern and Eastern Europe.

Methods for benchmarking innovation performance in EU and non-EU countries can be used *to assess the effects of sustainable innovation* [13] on 7 indicators, including 5 indicators from the framework conditions, *benchmarking against global competitors*, weighted average of innovation system performance, *synthetic innovation index.* In many dimensions of innovation, performance gaps vary considerably between performance groups.

Also relevant is the relationship between environmental quality and human well-being [47], assuming that innovation, as measured by the human development index, especially in developing countries, would be directed more towards sectors that would contribute to human development.

Environmental, economic and social impacts. Sustainability implies the theoretical need to search for a dynamic Pareto-optimum that would take into account the ecological, economic and social components of the utility functions of present and future generations, as well as for indicators capable of describing the interactions between the different dimensions of sustainability. To describe the relationship between environmental and economic impacts, the concept of environmental Kuznets curves can be used as a general indicator for the sustainability of innovations in cases where the impact of innovations can be econometrically separated from other factors [41]. The main problem in describing sustainable innovation is to identify the "subset of environmental innovation". In the case of innovations, linked to end-of-pipe measures or integrated environmental innovations, the environmental or sustainable "part" of the innovation cannot be separated, requiring a completely different set of indicators to measure the sustainability of the innovation [18].

A big problem in assessing the different impacts of sustainable innovations is that evaluating and comparing different indicators is very difficult. Such evaluation problems arise: (i) during the selection and weighting of indicators; (ii) in the interaction between indicators; and (iii) when interpreting the results of the developments described by the indicators.

Connecting sustainable innovation indicators with the overall systems of unidimensional and multidimensional sustainability indicators is possible through the DSD system, the approach includes the relevant driving forces and dimensions (ecological, economic, social and institutional). The availability of adequate data for describing innovation systems is a very important issue. All categories of sustainable innovations can be analysed through surveys and/or case studies, but they are not always suitable for monitoring. One of the problems is that results can be biased by considering only successful innovations or those identified as environmental innovations [26]. Likewise, discrepancies in the data may arise due to the difficulty of separating the sustainable part from the whole innovation system. Thus, it is not considered useful to build a single system of indicators for different sustainable innovations, their heterogeneity only requires a common structure of a system of indicators and specific indicators. Country rankings show that countries can perform differently in certain dimensions [13].

To date, most corporate sustainability has focused on how organisations can reduce their environmental impact and how sustainable development affects competitive advantage, with sustainable entrepreneurship being a crucial component of the global marketplace and, according to one study, there is a correlation between sustainable entrepreneurship and sustainable innovations [32, p.25]. Differences between economic structures are important in terms of the share of manufacturing in GDP and high-tech activities in manufacturing and services. Medium and high technology industries have higher technology intensities. For the EU27, 85% of R&D expenditure in manufacturing is accounted for by medium-high and high-tech industries, as is the share of organisations that have introduced a product/process innovation. Given that the performance and structure of the economy GDP per capita in purchasing power standards is a measure for interpreting real income differences between countries, it is considered that higher income can increase demand for new and innovative goods and services.

Currently, there is no robust indicator measuring the demand for innovation. The WEF survey includes an indicator (buyer sophistication) that provides a measure of individual consumer preferences for innovative products, whether buyers focus more on price or quality of products and services.

The prediction of scale effects is not empirically supported, which casts doubt on the positive relationship between public spending and long-term growth. In the literature, scholars introduce productive public spending and, theoretically, find that in non-scarcity growth models public spending does not influence long-term growth [15, p. 120]. Thus, the non-scarcity growth model proposed by Monteiro S. and Thompson M. [33, p.675], being based on increasing the proportion of output spent on productive public expenditure with a positive effect on economic growth rates in the short (entry-level effect), medium (transition dynamics) and long term (steady state), captures the beneficial aspects of cooperation, collaboration and the development of synergies between innovation participants.

In the author's proposed simplified adaptation of the method for quantifying *the socio-economic effect of sustainable innovation*, following M. Coccia's model [9, p.280] and K. Knight [28, p.120], magnitude of innovation impact (MACT) is:

$$10 \text{ MACT: Log } f(a) \, \mathrm{d}a \text{ MACT.} \tag{1}$$

$$\xi\alpha = \int \in \Re+, \tag{2}$$

and the social benefits of innovation (positive externalities) are defined as:

$$U^{+} := \mathrm{Log}_{10} \left| \int_{\alpha}^{\xi} f(a) \, \mathrm{d}a \right| \qquad U^{+} \in \Re^{+} \tag{3}$$

So that *zu* = *f(a)* and *zu′* = *g(a)* are the impact functions of technological innovation; ℜ → ℜ *and zu':* ℜ → ℜ continuously in [α, ξ], bounded region, where α = the number of subjects who are users of the innovation (individuals, organizations, institutions, etc.) at time t and ξ = number of adopters at time *t + n; u (externalities, external effects)* = externalities of the users; *zu = f(a)* represents the positive effects of the innovation and zu′ = g(a) - its negative effects (externalities).

Therefore, we note that the given model of calculating the socio-economic effect of innovation, based on a real function of a real variable of the impact of innovation, is a simplification, in the author's view more correct would be the impact function ℜn → ℜn, when the impact of innovation depends on a number of factors.

Study data [4] on the recognition of business opportunities shows the significant difference in terms of innovation bias, risk and proactivity. In terms of the correlation between motivation to develop innovative products and processes, the Rico study shows that most innovations are based on market requirements. However, it is difficult to generalize the influence of sustainable innovation implementation factors on the implementation of innovations, as local and global market conditions vary [4].

Analyses show a weaker correlation between innovation and productivity than the actual effect of innovation on productivity. In medium-tech manufacturing, the introduction of new products is reflected in a 126% improvement in productivity, while in high- and medium-high-tech industries - by 91% [31, p.150]. To assess such issues, the analysis of the relationship between innovation and productivity using the Knowledge Discovery Metamodel (KDM) is used. [12], linking R&D, innovation and productivity, with productivity indicators varying significantly by region and company [42].

The highest potential returns to innovation are in those types of organisations with the lowest propensity to innovate [2]. Some innovations in low-tech manufacturing industries may be driven by the transfer of production from China to Eastern Europe. Organisations in high-tech manufacturing industries are more likely to introduce new products and compete in domestic or global markets.

In general, in economically developed countries there is a direct correlation between the size/age of the organisation and its tendency to offer new products or processes over a 3-year period [40]. Respectively, larger organisations have a greater capacity to absorb new technologies, which could be one of the reasons why smaller organisations are less likely to engage in R&D, although they tend to spend a higher proportion of their annual turnover on in-house R&D, plus larger organisations are able to undertake more innovative projects.

Regression analysis results show that exporters are more likely to engage in R&D [10]. R&D investment has the greatest impact on the probability of launching new products in high-tech manufacturing industries, where R&D increases the probability of launching an innovative product, while in less R&D-intensive service sectors R&D has almost no impact. While in high-tech manufacturing industries, R&D is closely related to the emergence of innovative products, in low-tech manufacturing industries, R&D has a significant impact on process innovation compared to high-tech manufacturing industries [11, p.390].

Inter-countries analysis [40, p.65] shows that there is a correlation between more efficient institutions, increased patenting and increased export innovativeness, with the effect being statistically more significant in countries where institutions are relatively weak. The innovation intensity of exports depends to a large extent on both market size (measured by population size and GDP per capita) and economic openness (measured by the ratio of exports to imports in GDP). An increase in trade openness by a total of 30 pp of GDP (e.g. from Ukrainian to Latvian level) is correlated with an increase in export innovation intensity by 9-15% [34].

At the same time, no significant correlation is found between the number of patents issued and the openness of the economy or its size. In addition, there is a direct but weaker correlation between highly innovative exports and the financial openness of the economy (as measured by the Chinn-Ito index) [8, p.166]. These results are seen as evidence of a general correlation between innovation and country characteristics.

There is also an inverse correlation between natural resources and innovation activities. Research shows that resource-dependent countries' exports tend to be significantly less innovative than those of other countries. At the same time, the availability of rents from natural resources can allow for research funding, which offsets any negative impact that natural resources may have on the number of patents granted, but without necessarily increasing the incentives for commercialising innovation [40, p.47].

Sustainable innovation is strongly marked by several trends in the global innovation market: the tilt towards emerging markets, the simplification of eco-industrial systems, convergence between technologies and a much deeper understanding of the relationship between technology and users, differences between resident and non-resident patenting, non-price competitiveness, smaller and newer organisations and towards foreign ownership, as well as the relationship between the type of market structure and innovation activity, radical changes in global value chains and the level of penetration of funding streams. And, conversely, developments in the global economy are contributing to changes in sustainable innovation policies and the emergence of new dependencies.

Chapter 3 "Effects of the dynamics of sustainable innovation indicators on the world economy and the Republic of Moldova". In search of new explanations for the effects of innovation in the context of the global trend towards sustainability and the dynamics of the dimensions of the innovation process, we calculated and analysed the correlations between innovation performance indicators by innovation profiles based on the European Innovation Scoreboard (EIS) 2021 data for the period 2014-2021 for European countries, as well as 10 countries in the world that showed growth in government spending on technologically advanced products close to the EU average. Seventeen indicators expressed in percentages were chosen as performance indicators, including: number of innovative organisations per product, number of innovative organisations per process, number of innovative organisations, volume of exports of advanced and medium technology goods, volume of exports of scientointensive services, volume of sales of innovative products, level of sales impact, public sector R&D expenditure, venture capital expenditure, volume of government support for R&D in the business sector, finance and support, expenditure on R&D in the business sector, volume of expenditure on non-research and development innovation, volume of expenditure on innovation per employee, volume of investment by organisations, volume of overall income per capita and volume of expenditure by organisations on R&D per 10 million inhabitants. Countries were grouped into 4 categories of innovation profiles, including: innovation leaders, strong innovators, moderate innovators and emerging innovators.

Below we present the results of determining correlation coefficients for pairs of GII (Global Innovation Index) indicators for the years 2014-2021 based on innovation performance indicators by groups of countries by innovation profile and 10 countries with government spending growth on technologically advanced products close to the EU average.

The results of the author's correlational analysis of performance indicators in the innovation leaders group are presented in Table 2. The innovation leaders group comprises 5 countries: Belgium, Denmark, Finland, Sweden and Switzerland. Sweden had the highest growth in the number of innovative organisations per product, Belgium - innovative organisations per process, Sweden - innovative organisations, Sweden - volume of exports of advanced and medium technology goods, Sweden, Finland and Denmark - volume of exports of science-intensive services, Belgium - volume of sales of innovative products, Sweden - level of sales impact, Denmark - public sector R&D expenditure, Finland - venture capital expenditure, Belgium - volume of government support for business R&D, Belgium - finance and support, Sweden - expenditure on business R&D, Belgium - volume of expenditure on non-research and development innovations, Sweden and Belgium - volume of expenditure on innovations per employee, Sweden - volume of investment by organisations, Switzerland - volume of overall income per capita and Denmark and Sweden - volume of expenditure by organisations on R&D per 10 million inhabitants.

Table 2. EIS 2021. Correlation coefficients of innovation performance indicators of countries in the innovation leaders group, 2014-2021

	Product innovators (SMEs)	Business process innovators (SMEs)	Innovators	Exports of medium and high-tech goods	Exports of knowledge-intensive services	Sales of innovative products	Sales impact	R&D expenditure in the public sector	Risk capital expenditure	Government support for research and development in organisations	Finance and support	R&D expenditure in the organisations sector	Expenditure on innovation other than research and development	Innovation expenditure per employee	The organisation's investments	GDP per capita (PPS) (EU 30 800)	Top organisations spending the most on R&D per 10 million inhabitants (EU 16.2)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1	-0,58	0,77	0,45	0,58	0,18	0,41	0,15	0,25	-0,29	-0,02	0,44	-0,14	0,26	0,40	-0,13	0,54
2		1	0,08	0,06	-0,66	0,54	0,42	-0,54	-0,40	0,68	0,03	-0,13	0,12	0,19	0,15	0,16	-0,84
3			1	0,59	0,18	0,64	0,83	-0,23	-0,01	0,18	-0,01	0,44	-0,07	0,46	0,59	-0,02	-0,00
4				1	-0,20	-0,05	0,16	-0,21	-0,49	0,03	-0,35	0,18	-0,33	-0,11	0,16	0,46	0,05
5					1	-0,15	-0,00	0,83	0,08	0,05	0,68	0,75	0,59	0,60	0,59	-0,82	0,87
6						1	0,96	-0,56	0,29	0,33	0,02	0,04	-0,01	0,44	0,37	-0,06	-0,58
7							1	-0,45	0,18	0,34	0,07	0,24	0,03	0,54	0,54	-0,11	-0,39
8								1	-0,31	0,20	0,76	0,71	0,73	0,46	0,45	-0,77	0,87
9									1	-0,70	-0,38	-0,49	-0,47	-0,29	-0,43	0,13	-0,07
10										1	0,70	0,61	0,77	0,76	0,74	-0,52	-0,19
11											1	0,82	0,99	0,87	0,78	-0,96	0,42
12												1	0,79	0,87	0,94	-0,79	0,60
13													1	0,84	0,76	-0,92	0,35
14														1	0,96	-0,85	0,23
15															1	-0,74	0,30
16																1	-0,52
17																	1

Source: Elaborated by the author

The group of strong innovators comprises 11 countries: Germany, Estonia, Ireland, France, Luxembourg, the Netherlands, Austria, Iceland, Israel, Norway and the United Kingdom. Estonia had the highest growth in number of innovative organisations per product, Germany - number of innovative organisations per process, Estonia and Norway - number of innovative organisations, Germany - volume of exports of high and medium technology goods, Luxembourg - volume of exports of science-intensive services, UK - volume of sales of innovative products, Israel and Germany - level of sales impact, Iceland - expenditure on public sector R&D, Luxembourg and UK - expenditure on venture capital, France and UK - volume of government support for business R&D, Iceland and UK - finance and support, Israel - expenditure on business R&D, Estonia - volume of expenditure on non-research and development innovations, Germany - volume of expenditure on innovations per employee, Israel - volume of investment by organisations, Luxembourg - volume of overall income per capita and Israel and Luxembourg - volume of expenditure by organisations on R&D per 10 million inhabitants. The results of the author's correlational analysis of performance indicators in the group of strong innovators are presented in Table 3.

Table 3. EIS 2021. Correlation of innovation performance indicators of countries in the strong innovators group, 2014 -2021

	Product innovators (SMEs)	Business process innovators (SMEs)	Innovators	Exports of medium and high-tech goods	Exports of knowledge-intensive services	Sales of innovative products	Sales impact	R&D expenditure in the public sector	Risk capital expenditure	Government support for research and development in organisations	Finance and support	R&D expenditure in the organisations sector	Expenditure on innovation other than research and development	Innovation expenditure per employee	The organisation's investments	GDP per capita (PPS) (EU 30,800)	Top organisations spending the most on R&D per 10 million inhabitants (EU 16.2)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1	0,86	0,95	-0,32	-0,17	0,57	-0,40	0,43	0,24	-0,10	0,10	-0,35	0,73	0,63	-0,31	0,03	-0,70
2		1	0,97	-0,11	-0,33	0,40	-0,42	0,48	-0,07	-0,20	-0,08	-0,18	0,58	0,58	-0,19	0,11	-0,52
3			1	-0,21	-0,35	0,58	-0,33	0,42	0,16	-0,23	-0,00	-0,23	0,71	0,68	-0,22	0,05	-0,61
4				1	0,11	-0,03	0,79	0,10	-0,60	0,20	-0,16	0,59	-0,24	0,22	0,63	-0,08	0,14
5					1	-0,13	0,47	-0,61	0,46	-0,24	-0,33	-0,39	-0,32	0,21	-0,23	0,63	0,27
6						1	0,23	0,24	0,36	0,12	0,15	0,08	0,55	0,69	-0,02	-0,20	-0,67
7							1	-0,52	0,27	-0,27	-0,50	0,37	-0,16	0,23	0,54	0,01	0,38
8								1	-0,42	0,27	0,48	0,42	0,29	-0,02	0,06	-0,36	-0,43
9									1	-0,10	0,12	-0,48	0,16	0,40	-0,45	0,24	-0,19
10										1	0,79	0,18	-0,38	-0,02	-0,23	-0,26	-0,44
11											1	0,01	-0,08	-0,06	-0,44	-0,25	-0,54
12												1	-0,19	-0,21	0,77	-0,58	0,18
13													1	0,44	0,10	-0,31	-0,51
14														1	-0,13	0,15	-0,61
15															1	-0,57	0,35
16																1	0,32
17																	1

Source: Elaborated by the author

The group of moderate innovators comprises 9 countries: the Czech Republic, Greece, Spain, Italy, Cyprus, Lithuania, Malta, Portugal and Slovenia. Greece had the highest growth in number of innovative organisations per product, Greece - number of innovative organisations per process, Cyprus and Greece - number of innovative organisations, Czech Republic - volume of exports of high and medium technology goods, Cyprus - volume of exports of science-intensive services, Greece - volume of sales of innovative products, Cyprus - level of sales impact, Czech Republic - public sector R&D expenditure, Cyprus - venture capital expenditure, Italy - volume of government support for business R&D, Portugal - finance and support, Slovenia - expenditure on business R&D, Lithuania - volume of expenditure on non-research and development innovations, Italy - volume of expenditure on innovations per employee, Italy, Czech Republic and Lithuania - volume of investment by organisations, Malta - volume of overall income per capita and Malta - volume of expenditure by organisations on R&D per 10 million inhabitants. The results of the author's correlational analysis of performance indicators in the group of moderate innovators are presented in Table 4.

The group of emerging innovators comprises 13 countries: Bulgaria, Croatia, Latvia, Hungary, Poland, Romania, Slovakia, Bosnia and Herzegovina, North Macedonia, Montenegro, Serbia, Turkey and Ukraine. Serbia had the highest growth in number of innovative organisations per product, Croatia - number of innovative organisations per process, Serbia, Montenegro and Croatia - number of innovative organisations, Hungary and Slovakia - volume of exports of advanced and medium technology goods, Latvia, Hungary and Serbia - volume of exports of science-intensive services, Serbia, Croatia and Slovakia - sales of innovative products, Hungary and Slovakia - level of sales impact, Croatia - public sector R&D expenditure, Hungary, Romania and Croatia - expenditure on venture capital, Hungary - volume of government support for R&D in the business sector, Hungary - finance and support, Hungary - expenditure on R&D in the business sector, Serbia - volume of expenditure on non-research and development innovations, Serbia - volume of expenditure on innovations per employee, Serbia - volume of investment by organisations, Hungary, Poland and Slovakia - volume of overall income per capita and Hungary - volume of expenditure by organisations on R&D per 10 million inhabitants. The results of the author's correlational analysis of performance indicators in the group of emerging innovators are presented in Table 9.

Table 4. EIS 2021. Correlation of innovation performance indicators of countries in the moderate innovator group, 2014-2021

	Product innovators (SMEs)	Business process innovators (SMEs)	Innovators	Exports of medium and high-tech goods	Exports of knowledge-intensive services	Sales of innovative products	Sales impact	R&D expenditure in the public sector	Risk capital expenditure	Government support for research and development in organisations	Finance and support	R&D expenditure in the organisations sector	Expenditure on innovation other than research and development	Innovation expenditure per employee	The organisation's investments	GDP per capita (PPS) (EU 30,800)	Top organisations spending the most on R&D per 10 million inhabitants (EU 16.2)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1	0,89	0,97	-0,14	0,62	0,20	0,38	-0,24	0,07	-0,17	-0,18	-0,17	0,18	0,11	0,23	-0,30	0,17
2		1	0,97	-0,16	0,65	0,30	0,44	-0,16	0,14	-0,24	-0,14	-0,30	0,55	0,38	0,22	-0,18	-0,04
3			1	-0,15	0,65	0,26	0,43	-0,21	0,11	-0,21	-0,16	-0,25	0,38	0,26	0,13	-0,24	0,06
4				1	0,15	-0,53	0,40	-0,19	-0,14	0,27	-0,01	0,49	-0,20	-0,04	0,07	0,73	0,19
5					1	0,34	0,86	-0,16	0,38	-0,13	0,14	-0,16	0,16	0,16	-0,24	-0,03	-0,54
6						1	0,44	0,46	-0,16	0,06	0,14	0,09	0,05	0,02	0,25	-0,52	-0,55
7							1	0,06	0,04	0,13	0,15	0,27	-0,00	0,41	0,06	0,14	-0,53
8								1	-0,24	0,37	0,56	0,51	-0,03	0,24	0,58	-0,57	-0,94
9									1	-0,42	0,39	-0,58	0,32	-0,23	-0,46	-0,04	-0,45
10										1	0,56	0,73	-0,57	0,32	0,41	0,15	-0,07
11											1	0,30	-0,16	0,16	0,20	-0,20	-0,64
12												1	-0,59	0,29	0,53	0,08	-0,16
13													1	0,27	0,27	-0,00	-0,32
14														1	0,71	0,14	-0,23
15															1	-0,05	-0,38
16																1	0,51
17																	1

Source: Elaborated by the author

Based on the synthesis of the results of the study of new correlations between the innovation performance indicators of countries classified by innovation clusters according to the EIS 2021 and the pairs of strongly and highly correlated innovation indicators identified by the study, the author developed the Innovation Roadmap (Table 5), which is used to adjust innovation policies by comparing government innovation policy objectives and innovation performance indicators.

Based on the synthesis of the results of the study of new correlations between performance indicators innovation performance indicators of countries classified by innovation groups according to EIS 2021 and the pairs of innovation indicators in strong correlation (correlation coefficient value is between 0.71 and 0.9) and very strong correlation

(correlation coefficient value is between 0.91 and 1.0), identified by the study, the author developed an innovation map-table. Thus, the knowledge of pairs of indicators in the development of country innovation policies allows taking into account positive effects (pairs with direct correlation, when higher values of one characteristic correspond to higher values of another, and lower values of one characteristic correspond to lower values of another, Tab.6) or negative effects (pairs with inverse correlation, when higher values of one characteristic correspond to lower values of another, and lower values of one characteristic correspond to higher values of another, Tab.7) in the innovation process and is useful for extracting the sustainability component in the full effect of innovation.

Table 5. EIS 2021. Correlation of innovation performance indicators of countries in the emerging innovators group, 2014 -2021

	Product innovators (SMEs)	Business process innovators (SMEs)	Innovators	Exports of medium and high-tech goods	Exports of knowledge-intensive services	Sales of innovative products	Sales impact	R&D expenditure in the public sector	Risk capital expenditure	Government support for research and development in organisations	Finance and support	R&D expenditure in the organisations sector	Expenditure on innovation other than research and development	Innovation expenditure per employee	The organisation's investments	GDP per capita (PPS) (EU 30,800)	Top organisations spending the most on R&D per 10 million inhabitants (EU 16.2)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1	0,90	0,98	-0,45	-0,60	0,49	-0,43	0,30	-0,22	-0,27	-0,14	-0,21	0,16	0,40	0,13	-0,23	-0,31
2		1	0,97	-0,32	-0,66	0,39	-0,38	0,39	-0,28	-0,39	-0,17	-0,34	0,33	0,35	0,17	-0,24	-0,45
3			1	-0,41	-0,64	0,45	-0,42	0,35	-0,25	-0,33	-0,15	-0,27	0,24	0,39	0,15	-0,24	-0,38
4				1	0,33	0,18	0,91	0,14	0,38	0,48	0,49	0,46	0,28	0,28	0,35	0,49	0,39
5					1	-0,09	0,60	0,12	0,23	0,37	0,32	0,34	0,29	0,26	0,41	0,21	0,36
6						1	0,37	0,56	0,20	0,08	0,35	0,21	0,20	0,56	0,36	0,48	-0,14
7							1	0,31	0,42	0,52	0,58	0,53	0,37	0,46	0,52	0,58	0,38
8								1	0,18	0,15	0,51	0,38	0,62	0,64	0,71	0,50	0,20
9									1	0,35	0,58	0,52	-0,06	-0,07	0,07	0,49	0,44
10										1	0,87	0,86	-0,03	0,25	0,44	0,43	0,87
11											1	0,89	0,13	0,37	0,58	0,65	0,76
12												1	0,08	0,32	0,53	0,60	0,83
13													1	0,73	0,84	-0,15	-0,01
14														1	0,86	0,15	0,17
15															1	0,14	0,35
16																1	0,49
17																	1

Source: Elaborated by the author

According to generalized data, very strong positive correlation exists for:

- the group of innovation leaders, the pairs: Innovative product sales -Impact of sales (6 - 7); Finance and support - Innovation expenditure other than R&D (11-13); Business sector R&D expenditure - Firm investment (12-15); Innovation expenditure per employee - Firm investment (14-15);

- Strong innovators group, pairs: Innovators - Product innovators and Business process innovators (SMEs) (3 - 1, 2);

- Moderate innovators group, pairs: Product Innovators (SMEs) and Innovators (1-3); Business Process Innovators and Medium and High-Tech Goods Exports (2 - 4); Business Process Innovators (SMEs) - Knowledge-intensive Service Exports (2-5);

- Emerging innovators group, pairs: Innovators - Product innovators (SMEs) and Business process innovators (SMEs) (3 - 1, 2); Exports of medium and high-tech goods and Sales impact (4 - 7).

Table 6. Innovation roadmap. Very strong and strong positive (direct) correlation

	Product innovators (SMEs);	Business process innovators (SMEs)	Innovators	Exports of medium and high-tech goods	Exports of knowledge-intensive services	Sales of innovative products	Sales impact	R&D expenditure in the public sector	Risk capital expenditure	Government support for research and development in organisations	Finance and support	R&D expenditure in the organisations sector	Expenditure on innovation other than research and development	Innovation expenditure per employee	The organisation's investments	GDP per capita (PPS)	Top organisations spending the most on R&D per 10 million inhabitants
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		•blue •green •black	•red ●blue ●green ●black										•blue				
2			●blue ●green ●black		●green												
3							•red						•blue				
4							•blue ●black									•green	
5							•green	•red				•red					•red
6							●red										
7																	
8											•red	•red	•red		•black		•red
9																	
10											•red •green •black	•black •green	•red	•red	•red		•black
11												•red •black	●red	•red	•red		•black
12													•red	•red	●red •blue		•black
13														•red •black	•red •black		
14															●red •black •green		
15																	
16																	
17																	

Note. Colours signify strong direct and inverse correlation for innovation groups as follows: red - Innovation leaders; blue - Strong innovators; green - Moderate innovators; black - Emerging innovators. High bubble size means very strong correlation and low - strong correlation.
Source: Elaborated by the author

Strong positive correlation exists for:

- the group of innovation leaders, the pairs: Innovators - Product Innovators (SMEs) and Sales Impact (1-3); Innovators - Sales Impact (3-7); Knowledge-intensive Services Exports - Public Sector R&D Expenditure, Business Sector R&D Expenditure and Most R&D Expenditure per 10 million inhabitants above EU average (5 - 8, 12, 17); Public Sector R&D Expenditure - GDP per capita (PPS) and Finance and Support; R&D expenditure in the business sector; Expenditure on innovation other than R&D; Top R&D spending enterprises per 10 million inhabitants (EU 16.2) (8 - 11,12,13,17); Government support for R&D in enterprises - Finance and support, Expenditure on innovation other than R&D, Innovation expenditure per employee and Firm investment (10 - 11, 13, 14, 15); Finance and support - Business enterprise R&D expenditure, Innovation expenditure per employee and Firm investment (11 - 12, 14, 15); Business enterprise R&D expenditure - Innovation expenditure other than R&D and Innovation expenditure per employee (12 - 13, 14); Innovation expenditure other than R&D - Innovation expenditure per employee and Firm investment (13 - 14, 15);

- Strong innovators group, pairs: Product innovators (SMEs) - Business process innovators (SMEs) (1-2); Product innovators (SMEs) - Expenditure on innovation other than R&D (1-13); Exports of medium and high-tech goods - Sales impact (4-7); Government support for business R&D - Finance and support (10-11); Business R&D expenditure - Firm investment (12-15);

- the group of moderate innovators, the pairs: Product innovators (SMEs) - Business process innovators (SMEs) (1 - 2); Exports of medium and high-tech goods - GDP per capita (PPS) (4 - 16); Exports of knowledge-intensive services - Sales impact (5 - 7); Government support for business R&D - Finance and support and Business R&D expenditure (10 - 11, 12); Innovation expenditure per employee - Firm investment (14 - 15);

- group of emerging innovators, the pairs: Product innovators (SMEs) - Business process innovators (SMEs) (1 - 2); Public sector R&D expenditure - Firm investment (8 - 15); Government support for business R&D - Finance and support, Business sector R&D expenditure and R&D expenditure per 10 mil population above EU average (10 - 11, 12, 17); Finance and support - R&D expenditure in the business sector and Top R&D spending enterprises per 10 million inhabitants (11 - 12, 17); R&D expenditure in the business sector - Top R&D spending enterprises per 10 million inhabitants (12 - 17); Innovation expenditure other than R&D - Innovation expenditure per employee and Firm investment (13 - 14, 15); Innovation expenditure per employee - Firm investment (14 - 15).

Very strong inverse correlation was identified for the following pairs of indicators:

- Innovation leaders group: Finance and support and GDP per capita (PPS) (11-16); Innovation expenditure other than R&D and GDP per capita (PPS) (13-16);

- Strong innovators group: Product innovators (SMEs) and Innovators (1-3); Business process innovators (SMEs) and Innovators (2-3);

- the group of moderate innovators: Public sector R&D expenditure and Top R&D spending companies per 10 million inhabitants (8-17);

Strong inverse correlation was identified for the following pairs of indicators:

- group of innovation leaders: Business Process Innovators (SMEs) and Top Businesses Spending Most on R&D per 10 Million Inhabitants (2-17); R&D Spending in the Public Sector and Finance and Support; R&D Spending in the Business Sector; Innovation Spending Other than R&D (8- 11,12,13); Venture capital expenditure and Government support for R&D in business (9-10); GDP per capita (PPS) and Knowledge-intensive services exports; R&D expenditure in the public sector; R&D expenditure in the business sector; Innovation expenditure per employee; Business investment (16 - 5, 8, 12, 14, 15);

- group of strong innovators: Product innovators (SMEs) and Business process innovators (SMEs); Innovation expenditure per employee (1 - 2, 14); Innovators - Innovation expenditure per employee (3 - 14); Exports of medium and high-tech goods - Sales impact (4 - 7); Government support for business R&D - Business R&D expenditure (10 - 12).

Table 7. Innovation roadmap. Negative (inverse) correlation

	Product innovators (SMEs);	Business process innovators (SMEs)	Innovators	Exports of medium and high-tech goods	Exports of knowledge-intensive services	Sales of innovative products	Sales impact	R&D expenditure in the public sector	Risk capital expenditure	Government support for research and development in organisations	Finance and support	R&D expenditure in the organisations sector	Expenditure on innovation other than research and development	Innovation expenditure per employee	The organisation's investments	GDP per capita (PPS)	Top organisations spending the most on R&D per 10 million inhabitants
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		● (blue, small)	● (blue, large)											● (blue, small)			
2			● (blue, large)														● (red, small)
3														● (blue, small)			
4							● (blue, small)										
5																● (red, small)	
6																	
7																	
8											● (red, small)	● (red, small)	● (red, small)			● (red, small)	● (green, large)
9										● (red, small)							
10												● (blue, small)					
11																● (red, large)	
12																● (red, small)	
13																● (red, large)	
14																● (red, small)	
15																● (red, small)	
16																	
17																	

Note. Colours signify strong direct and inverse correlation for innovation groups as follows: red- Innovation leaders; blue - Strong innovators; green- Moderate innovators; black - Emerging innovators. High bubble size means very strong correlation and low - strong correlation.
Source: Elaborated by the author

Table 8. EIS 2021. Correlation of 10 countries' innovation performance indicators with growth in government spending on technologically advanced products close to the EU average, 2014 -2021

	PhD graduates	Expenditure on R&D in the public sector	Government funding of research and development in organisations	R&D expenditure in the organisations sector	Product/process innovators	Marketing/ organisational innovators	Innovation cooperation	PCT patent applications	Exports of medium and high-tech products	Exports of knowledge-intensive services	Manufacturing - share in total value added (EU 15.0)	Top organisations spending the most on R&D per million inhabitants (EU 16.2)	Average R&D expenditure, million euro (EU 246.0)	Public procurement of advanced technological products (EU 3.50)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	-0,30	-0,40	-0,16	0,22	0,19	0,42	0,40	-0,58	-0,21	-0,03	0,12	0,64	0,04
2		1	0,03	0,70	-0,27	0,20	-0,42	0,37	0,00	0,52	0,68	0,10	-0,09	-0,11
3			1	-0,40	-0,42	-0,55	0,45	0,01	0,02	-0,27	0,07	0,02	-0,21	0,04
4				1	0,02	0,05	-0,58	0,49	0,06	0,32	0,65	0,18	0,28	0,19
5					1	-0,05	0,12	0,26	-0,44	-0,33	0,04	0,60	0,73	0,60
6						1	-0,73	0,02	0,28	0,43	0,04	-0,29	0,04	-0,38
7							1	0,305	-0,67	-0,65	0,01	0,34	0,26	0,33
8								1	-0,70	-0,33	0,87	0,67	0,66	0,58
9									1	0,35	-0,45	-0,71	-0,59	-0,42
10										1	-0,13	-0,39	-0,34	-0,66
11											1	0,60	0,33	0,48
12												1	0,68	0,83
13													1	0,67
14														1

Source: Elaborated by the author

The data in Table 8 show the correlation determined by the author for increases in 14 performance indicators in the years 2014-2021 for the group of 10 countries in the world (Australia, Brazil, Canada, Japan, India, Russia, South Africa, South Korea and the US) with increases in government spending on technologically advanced products close to the EU average.

According to the analysis, there is a strong direct correlation for pairs of indicators: PCT-11 patenting Manufacturing - share in total value added, (12) Top organisations spending most on R&D per million inhabitants - (14) Public procurement of advanced technological products, (5) Product/process innovators - (13) Average R&D expenditure, million euro (EU 246.0) and (2) Public sector R&D expenditure - (4) Organisation sector R&D expenditure, the others being of medium strength.

Table 9. Pairs of innovation indicators in correlation, correlation coefficient value for the panel of 10 countries with increasing government spending on technologically advanced products close to the EU average, by innovation groups

Direct correlation		Inverse correlation			Direct correlation		Inverse correlation	
Leaders in innovation					*Moderate innovators*			
8-11	0,86	6-7	0,73				6-12	0,29
12-14	0,83	9-12	0,71				2-5	0,27
5-13	0,73	8-9	0,70				5-8	0,26
2-4	0,70				*Emerging innovators*			
Strong innovators							10-14	0,66
2-11	0,68	2-7	0,42				7-9	0,67
12-13	0,68	3-5	0,42				7-10	0,65
8-12	0,67	1-3	0,40				1-9	0,58
8-13	0,66	3-4	0,40				4-7	0,58
13-14	0,66	6-14	0,38				3-6	0,55
4-11	0,65	10-12	0,38				9-11	0,45
1-13	0,64	10-13	0,33				5-9	0,44
5-12	0,60						9-14	0,42
5-14	0,60							
11-12	0,60							
8-14	0,57							
4-8	0,49							
11-14	0,48							
3-7	0,45							
6-10	0,43							
9-10	0,35							
7-14	0,33							
7-12	0,33							
11-13	0,33							
7-8	0,30							

Source: Elaborated by the author

Strong negative (inverse) correlation is observed for three pairs of indicators: (6) Marketing/organizational innovators - (7) Innovation cooperation, (9) Exports of medium and high-tech products - (12) Largest firms spending on R&D per million inhabitants and (8) PCT patent applications - (9) Exports of medium and high-tech products (Table 9).

To study the perception of the importance of innovation policy objectives, the author conducted a comparative study for a panel of innovative organizations in Spain, *considered a moderate innovator*, and in the Republic of Moldova, *considered an economy in transition*. The study was carried out in the framework of the Erasmus doctoral programme to research the effects of sustainable innovation performance on the world economy. For this purpose, a comprehensive 8-question survey was carried out on a panel of 15 innovative organisations in Spain, including eco-innovation, of which: 5 from the high-tech, 5 - medium-tech and 5 - low-tech sectors and 15 Moldovan organisations. The questionnaire included questions, which covered the following issues: (1) ensuring that knowledge is properly valued and disseminated through networks and market channels; (2) better commercialisation of research; (3) strengthening the innovation capacity of organisations; (4) providing opportunities for educated people to use their knowledge and skills effectively; (5) financial support for innovation; (6) supporting R&D; (7) improving the business environment for innovation; and (8) increasing the contribution of public research organisations to innovation processes.

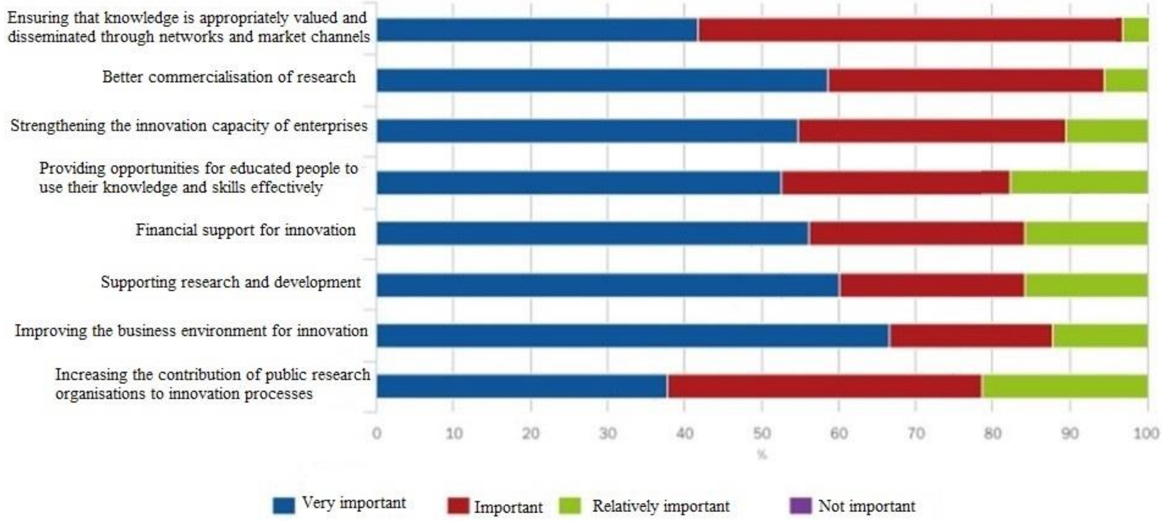

Figure 1. Perception of the importance of innovation policy objectives in Spain (moderate innovator)
Source: Elaborated by the author

The strategic innovation policy objectives identified by the survey have been ranked on the chart (Figures 1 and 2) in descending order of importance, defined as the percentage of organisations rating a particular objective as "very important" or "important" according to the EBRD Innovation Policy Survey methodology [40, p.50].

The survey results (Figures 1 and 2) show some differences in perception, the most essential being the presence in the Moldovan panel of 3 "does not matter" segments on ensuring that knowledge is properly valued and disseminated through networks and market channels, providing opportunities for educated people to use their knowledge and skills effectively, and financial support for innovation, which are missing in the Spanish responses.

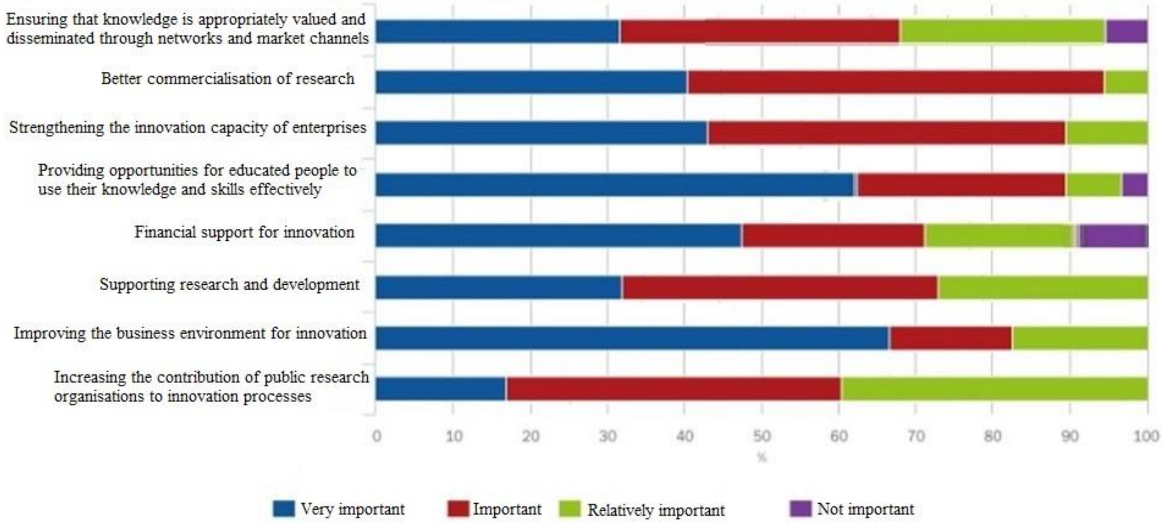

Figure 2. Perception of the importance of innovation policy objectives in Moldova (economy in transition) Source: Elaborated by the author

Thus, under the indicator *Ensuring that knowledge is properly valued and disseminated through networks and market channels* - prevailing perception Important; At *Better commercialisation of research* perception prevails Very important; *Strengthening the innovation capacity of organisations* – perception Very important, but at *increase* - perception Relatively important; answers to *Providing opportunities for educated people to use their knowledge and skills effectively, Financial support for innovation, Supporting research and development, Improving the business environment for innovation* are virtually identical. At *Increasing the contribution of public research organisations to innovation processes* - perceptions are equal to each other.

The studies carried out in the **Republic of Moldova** in the years 2010-2020 have allowed us to find that, in the researchers' opinion, the 2017 R&D reform has worsened or not changed the situation in the field [38, p.21] in terms of organisation and funding of scientific research, state attitude towards research and innovation, motivation of scientific staff, opportunities for professional growth and access to various research programmes, exchange of experience, quality of scientific research, implementation/use of scientific results, collaboration with relevant institutions in the country and abroad. During this period, generally characterised by a strong migration of the population and intellectual exodus, the share of researchers in the natural sciences, engineering, technology and humanities has decreased, while the number of researchers in the agricultural, social and medical sciences has slightly increased [23]. According to the AȘM report [39, p.42], in the years 2010-2020, expenditure on research and development in the Republic of Moldova amounted to 0.23% of GDP, of which 14.2% - for technological development, and of these: for natural sciences - 8.0%, engineering and technological - 52%, medical - 3.5%, agricultural - 0.1%. At the same time, the number of registered patents has seen a very sharp decrease of 2.3 times, only in 2021 there was an increase in the number of patents granted abroad.

Strengthening the international dimension ensures a better exploitation of the national scientific potential as well as of the modern research-innovation infrastructure. Thus, opening up access to Romanian research infrastructure through joint research projects has meant connecting to the pan-European network for the national research and education network RENAM. In 2020, 5 scientific journals from **Republic of Moldova** were indexed in the database of journals that have approved open access policies - Directory of Open Access Journals, thus about 60% of the scientific journals evaluated and classified at national level meet the international requirements of ensuring open access to publications taken up [39, p.197]. Related to this, the increased demands for publications and the increased availability of publications in electronic format explain the reduction in the number of publications in indexed scientific journals, including with co-authors from other countries. Negative trends in the higher education sector according to the international Webometrics ranking [37] and academic research according to Scimago's general ranking of science academies [39, p.209].

However, the **Republic of Moldova** is included in the category of countries with a positive relationship between innovation and development. From 2022, the Republic of Moldova is part of the group of innovation achievers with the highest average income (*upper middle-income*) [16, p.48], Along with Ukraine and Bulgaria, the analysis of the innovation sector in Republic of Moldova requires a much more significant presence of scientific results in the international circuit.

Thus, the analysis of the survey results, conducted by the author for the Republic of Moldova, confirms the literature data that countries in transition, with a few exceptions, tend to pursue innovation policies of the same type as those in developed countries based on the analysis of strengths, comparative advantages and specific characteristics. At the same time, the systemic approach to innovation policy, while seen as effective in ensuring above regional average levels of GDP growth and targeting of state support, tends to be more about strengthening the relationship between industry and science and less about helping organisations to absorb foreign technology. The experience of several economies shows that state efforts to strengthen responsible institutions have not always been directly linked to promoting innovation as a policy objective.

In the study of the relationship between sales growth and R&D expenditure, carried out by the author as part of the Erasmus PhD programme to research the effects of sustainable innovation performance on global market structure, data on 15 innovative organisations in Spain were used, grouped according to the field of innovation, of which: 5 - high-tech, 5 - medium-tech and 5 - low-tech (Table 10).

The results in Table 10 show that innovation intensity is highest in high tech (14.1%), 5.68 percentage points above the overall average (8.42%), 9.85 percentage points above medium tech (4.25%) and 12.95 percentage points above low tech (1.15%). During 2016-2018, R&D expenditure increased by 10.24% in high tech (twice as much as in other sectors), 5.7% in medium tech and 4.35% in low tech. Sales increased by 10.58% in high-tech (three and four times more than in the other sectors), by 2.42% in medium-tech and by 3.12% in low-tech. Only in high-tech is the difference between the relative growth in sales and R&D expenditure positive, indicating uniform growth in the other sectors. On average, the high-tech sector is the most profitable (13.35%), 4.35 percentage points more than medium-tech and 2.45 percentage points more than low-tech. Thus, the high profitability in high tech is due to high investment in R&D, advanced infrastructure and skilled human capital.

Tabel 10. Results of the study of the relationship between sales growth and R&D expenditure for 15 organisations in Spain

Indicators	Total	Low-tech sector	Medium technology sector	High-tech sector
	Average	Average	Average	Average
R&D expenditure, € million	329	210	355	423
Sales volume, million euro	20 042	43974	10575	5576
Innovation intensity, %	8,42	1,15	4,25	14,10
R&D expenditure growth, 3 years, %.	7,14	4,35	5,70	10,24
Sales growth in 3 years, %	5,12	3,12	2,42	10,58
Sales growth minus R&D expenditure growth, %	-2,02	-1,35	-3,28	0,34
Profitability, %	10,16	10,90	9,00	13,35

Source: Elaborated by the author

The effect of belonging to a high-tech industrial group is quite significant, with a 1% increase in profitability associated with a 0.25% increase in sales, and a 1% increase in R&D expenditure efficiency, but a 0.31% increase in sales.

In order to determine the effects of innovation performance on market structure, in the framework of the Erasmus PhD program for researching the effects of sustainable innovation performance on global market structure, the author conducted the analysis of the relationship between factors influencing market structure and their contribution for 3 sectoral models and 1 general model.

In this study (Table 11), profitability and the difference between the 3-year trend in sales and R&D expenditure were used as independent variables (innovation performance parameters), but also the following innovation activity variables: (i) the natural logarithm of R&D expenditure and innovation intensity, (ii) the percentage difference between the 3-year trend in sales and R&D expenditure, and (iii) sales profitability as a share of profit in sales. The 3-year sales trend indicator was used for the market structure variable and the industry-specific conditions were used for the market structure variable: (1) dummy variable for the high-tech industry group, HI dummy - high R&D expenditure intensity (above 5% of sales); (2) dummy variable for the medium-tech industry group, MI dummy - medium R&D expenditure intensity (2-5% of sales); (3) dummy variable for the low-tech industry group, LI dummy - low R&D expenditure intensity (below 2% of sales).

Tabel 11. Results of regression analysis of the relationship between factors influencing market structure and their contribution

	Model 1 General sample		Model 2 Low-tech sector		Model 3 Medium technology sector		Model 4 High-tech sector	
Profitability,%	0,29	10,48			0,29	7,90	0,25	6,93
Sales growth minus R&D expenditure growth, %	0,37	15,87					0,29	10,56
HI dummy			10,58	15,66	4,91	5,94	5,32	6,85
MI dummy			2,42	3,54	-0,89	-1,86	0,58	-1,15
LI dummy			3,12	1,98	-0,78	-0,55	0,27	-0,31
Number of observations	15		15		15		15	
R-squared	0,24		0,17		0,21		0,29	
F-stat	199,45		66,96		71,82		91,73	

Source: Elaborated by the author

The results of the regression analysis (Table 11) show that innovation performance in the high-tech sector more obviously affects the market structure than in the medium- and low-tech sectors. Model 1 (for the overall sample) is statistically significant, with both innovation performance parameters explaining 24% of the variation in market structure as measured by the 3-year sales trend. Model 2 tests the hypothesis on the effect of the organisation's sector affiliation on market structure. An affiliation to the high-tech sector leads to an increase in sales of 10.58%, which is statistically significant and 4 times the value for the medium-tech sector and 3 times the value for the low-tech sector. Models 3 and 4, variables in both categories are included in the regression model, in which to estimate the relative importance of innovation performance and intensity and their impact on market structure. The effect of organisations belonging to medium and low technology sectors is either downward on market structure (3 years of sales growth - model 3) or economically insignificant positive (model 4), but both regression coefficient values are statistically negligible, suggesting a lack of relationship between sectors in the lower innovation echelon and market structure. The high coefficient of multiple determination (29%) indicates that model 4 is statistically significant and best describes changes in market structure.

Therefore, the study shows that innovation policy would have multiple effects on competition policy, given the direct interaction between competition and innovation to stimulate innovation, especially for cases where innovation is interpreted broadly, such as any new business approaches, because sustainable innovations are those that promote change in the global economy.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

The results of the theoretical and practical studies carried out by the author have allowed the formulation of the following general conclusions:

1. The study of the theoretical aspects of sustainable innovation in the context of trends in the global economy provided a wide variation of definitions, representations, approaches, models of sustainable innovation and assessments of the global economy, in particular, the global framework of indicators for the Sustainable Development Goals (SDG Indicators) and the goals of the 2017 Agenda for Sustainable Development 2030, which includes 231 unique indicators (SDG Indicators). At the same time, the most popular definition of the world economy or global economy as the economy that refers to the global economic system includes all economic activities carried out between nations, including: production, consumption, economic management, labour in general, exchange of financial values and trade in goods and services, with an emphasis on the types of subjects of the world economy and groups of subjects of the innovation process.

2. The effects of sustainable innovation can be both positive and negative, but the main aim of sustainable innovation is to reduce the environmental burden of entrepreneurial activity, and the new attitude towards innovation emphasises the role of economic profitability and security of supply, broadens the understanding of these effects to include environmental, technological, economic, social, cultural and managerial ones. The full realisation of the effects of sustainable innovation requires the diffusion of innovation, when it spreads to the national economy, benefiting companies of different sectors and sizes equally, and subsequently the global economy. In general, 4 categories of sustainable innovation impacts can be distinguished: economic, resource, technical and social. However, due to the complexity of innovation as a process and as a system, the number of actors and beneficiaries, discussions on classifying impacts and systematising performance indicators continue, providing several models.

3. The study of the dimensions of sustainable innovation from the perspective of global economic trends confirmed the current state of the discussion and methodological principles for measuring the impact of sustainable innovation on countries' economies and the world economy in general. The assessment of innovation, including sustainable innovation, being largely fragmented, incomplete and sometimes haphazard, requires improved approaches, methods and data for assessing the effects of sustainable innovation on economies as well as the impact of regulatory policies on sustainable innovation.

4. The analysis of different approaches to assessing the impact of innovation on the world economy reflects various global indices, which highlight different aspects of the innovation phenomenon. Some studies show that eco-innovation is not always linked to increased profits and others find no improvement in innovators' performance. However, while the potential for sustainable innovation to improve performance is clear, this effect can only occur over the long term and under the right conditions.

5. Sustainable innovation can influence the performance of organisations and countries in international markets and is affected by trends in the global economy. Developments in the global economy can lead to changes in policies on sustainable innovation and to new dependencies, such as the innovation intensity of global exports. Sustainable innovation is also influenced by trends in the global innovation market, including the simplification of eco-industrial systems, convergence of technologies, differences

in patenting and international migration. This recent evolution in innovation activity has led to a shift from advanced economies to emerging markets and from country to organisation assessment.

The results obtained and the need to solve the scientific problem enabled the author to formulate the following ***recommendations*** to develop the theoretical and practical aspects of sustainable innovation, taking into account the effects, including new ones, identified as a result of the author's research on the world economy:

1. According to the study of the theoretical part of the theme, which suggests that sustainable innovation management can be an important source of benefits, empirical results are not yet conclusive and studies that attempt to verify the relationships between the adoption of sustainable innovation practices, the performance of companies, industries and countries are still in their infancy. The topic of the effects of sustainable innovation and extracting the sustainability part of innovation is still topical and recommended to all stakeholders, who are part of the innovation infrastructure of the global economy, to further develop research in the given field.

2. Drawing from the research results on the effects of innovation under the global trend towards sustainability and the dynamics of the dimensions of the innovation process, identifying as a result pairs of indicators with strong direct correlation and strong reverse correlation, governments would gain new opportunities for a better understanding of the current state of sustainable innovation in the world and a possible rethinking of efforts to promote sustainable innovation in order to better harness the innovation potential of countries. This would be due to the identification of new dependencies by rationalising spending on the procurement of technologically advanced products and organisations' R&D spending, increasing the added value of industries by increasing patenting activity, increasing R&D spending in the public and business sector or optimising spending on marketing innovations through cooperation, increasing exports of technologically advanced and medium products to optimise organisations' conventional R&D and patenting spending.

3. According to the results of the author's study on the relationship between sales growth and R&D expenditure, innovation performance affects market structure more obviously than in the case of medium and low technology sectors, which implies that innovation policy would have multiple effects on competition policy, given the direct interaction between competition and innovation, especially for cases where innovation is interpreted broadly, as any new commercial approaches, because sustainable innovations are those that promote changes in the global economy.

The development of the sustainable innovation process, the grounding of innovation policy making on the basis of new correlations between the dimensions of sustainable innovation, innovation performance indicators at company, technology sector, region, country level, as well as improved international methodologies for estimating innovation performance and adjusting innovation and market competitiveness models, including data on Spanish organizations in low, medium and high technology sectors, being used in the conditions of Republic of Moldova could *contribute to the rescaling of sustainable innovation in the world economy system.*

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elaborated by *Gribincea Alexandru*, for the PhD thesis entitled *„Effects of the sustainable innovation process on the world economy*", in the specialty *521.02 World Economy; International Economic Relations,* scientific supervisor *Castraveț Lucia, PhD, prof. univ.*

2. Articles in scientific journals

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ANNOTATION

Gribincea Alexandru
The effects of the sustainable innovation process on the world economy.
PhD thesis in economics, Chisinau, 2022

Thesis structure: introduction, three chapters, general conclusions and recommendations, bibliography of 350 titles, 8 appendices, 135 pages of basic text (up to Bibliography), 6 figures and 13 tables. The results are published in 27 scientific papers.

Keywords: sustainable innovation, impacts, global economy, innovation performance, sustainable innovation dimension, export innovation intensity.

Field of study: Economics.

The aim of the research is to analyse the dimensions of the innovation process in dynamics at the level of groups of countries and companies in order to clarify the effects of sustainable innovation on the world economy.

Research objectives: research theories on the effects of sustainable innovation on the world economy; study methodological approaches to researching the performance of innovation systems in the system of global economic relations; study the dynamics of the dimensions and role of sustainable innovation in the competitiveness of companies, regions, countries, international markets, etc.

The novelty and scientific originality of the thesis improves the methodological approach to dynamic research on sustainable innovation and its impact on the global economy. It also proposes a methodology for identifying new correlations in the dimensions of sustainable innovation, with a focus on sustainability in the total effect of innovation.

The results obtained contributing to the solution of a scientific problem: Theoretical studies and practical research on sustainable innovation and its impact on the global economy have identified key drivers of innovative performance at company, technology sector, region and country level. These findings have been used to develop related indicators and create a map of sustainable innovation for different technology sectors. The competitiveness model has also been adapted, with innovation at its core, to guide effective innovation policies.

The theoretical significance of the research lies in the assumption that the development of sustainable innovation has effects on international market and global economy phenomena as a factor of competitiveness.

The applied value of the paper focuses on the theoretical development of sustainable innovation and the grounding of innovation policies. It identifies novel correlations between dimensions of innovation, innovation performance at company, sector, regional and country levels. It improves international methodologies for measuring innovation performance and adjusts innovation and competitiveness models based on data from Spanish and Moldovan firms, covering low, medium and high technologies.

Implementation of scientific results. The implementation of the scientific results was carried out within the DCI of the MEI of the Republic of Moldova contributing to the elaboration and implementation of the policy to develop the innovative potential of the country's economy at regional and global level, as well as within the "Imobil Capital" S.R.L. to increase the competitiveness of innovative products/services at global level.

GRIBINCEA ALEXANDRU

THE EFFECTS OF THE SUSTAINABLE INNOVATION PROCESS ON THE GLOBAL ECONOMY

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