GLOBAL ECONOMIC OBSERVER

EDITORIAL BOARD

CONTENTS

The Progress of the EU Labor Market Based on the Green Economy

ALINA LIGIA DUMITRESCU
Institute for World Economy
Calea 13 Septembrie No.13
ROMANIA
alinaligia@gmail.com

Abstract: The article focuses on the analysis of the challenges and opportunities of the labour market in the conditions of the transition to the climate-neutral economy. The research methodology is based on the research of specialized literature in the field about green transition and the comparative analysis of the data on green jobs from International Renewable Energy Agency, International Labour Organisation and Eurostat. The key objective of the research is to identify the main qualifications necessary to increase employment in green economy and means to accelerate the implementation process of transition to a climate-neutral economy in the European Union. In conclusion, in the context of the cohesion policy, the specific challenges of the European Union are to strengthen the economic, social, and territorial cohesion based on the Union's political priorities according to the green and digital transition.

Keywords: labour market, green jobs, renewable energy, skills, challenges, opportunities

JEL Classification : *J2, J24, J48, Q2, Q52*

1. Introduction

The article is based on the author's results of the research carried out as a part of the Research Program PSG2 of the Institute for World Economy, Study PSG 2.7 "The perspectives of the post–COVID-19 development of labor markets in the European Union through the just transition" and aims to present the impact of green transition on labour market worldwide and in the EU.

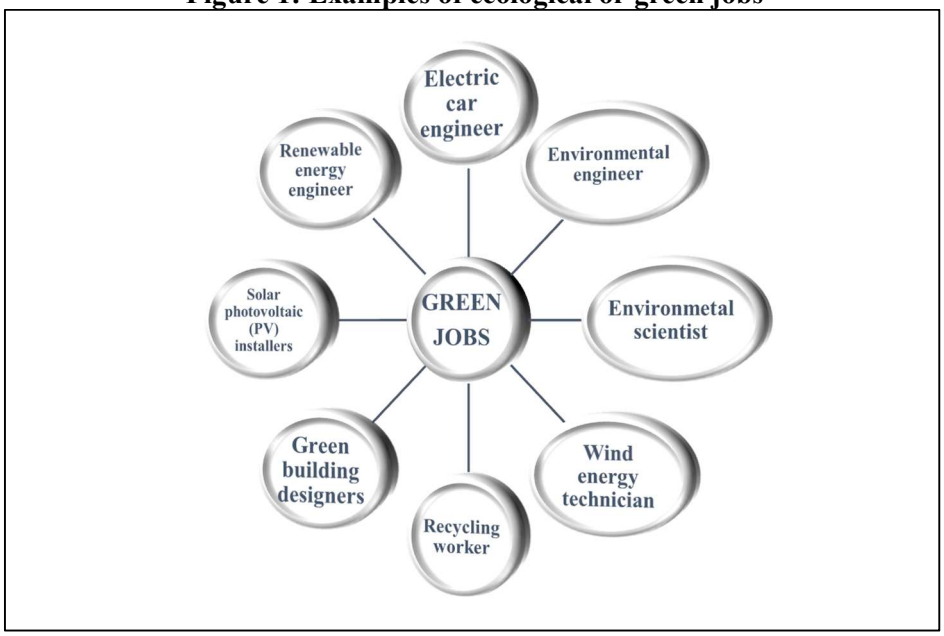
The global economy faces labour challenges. A well-designed transition to a climate-neutral economy can be the answer to these complex issues, because it makes labour markets more resilient to: (1) the potential negative effects generated by the amplification of the process of globalization, (2) the consequences produced by the adoption of new technologies, (3) the deficits of the workforce, and (4) the demographic changes (Czako, 2020). The climate-neutral economy is based on *green jobs* that support the decarbonization of the economy, protect the environment, reduce the energy consumption, and develop the renewable energy production (Figure1).

The green jobs are classified as "jobs in businesses that produce goods or services that benefit the environment or conserve natural resources" or "jobs where workers' tasks involve producing products through green processes or using fewer natural resources" (US Bureau of Labour Statistics, 2013).

In the European Union, the transition to a climate-neutral economy is a component of the EU's cohesion policy, within the European Green Deal. The European Green Deal set the blueprint for reducing emissions by at least 55% by 2030, compared to 1990 levels, and turning the EU into the first climate-neutral continent by 2050. This will create new opportunities for innovation, investments, and jobs. Besides, it is estimated that around 160,000 additional green jobs will be created in the construction sector (European Commission, 2023).

According to the European Commission, the Just Transition Mechanism (JTM) is a specific instrument for European decarbonisation policy, aimed at mobilizing at least EUR 55 billion between 2021 and 2027. It supports a "fair" transition (no one is left behind) to a climate-neutral economy, equivalent to mitigating the socio-economic impact of this multilevel transformation and restructuring process (European Commission, 2021). The JTM provides targeted support based on Territorial Just Transition Plans (TJTP).

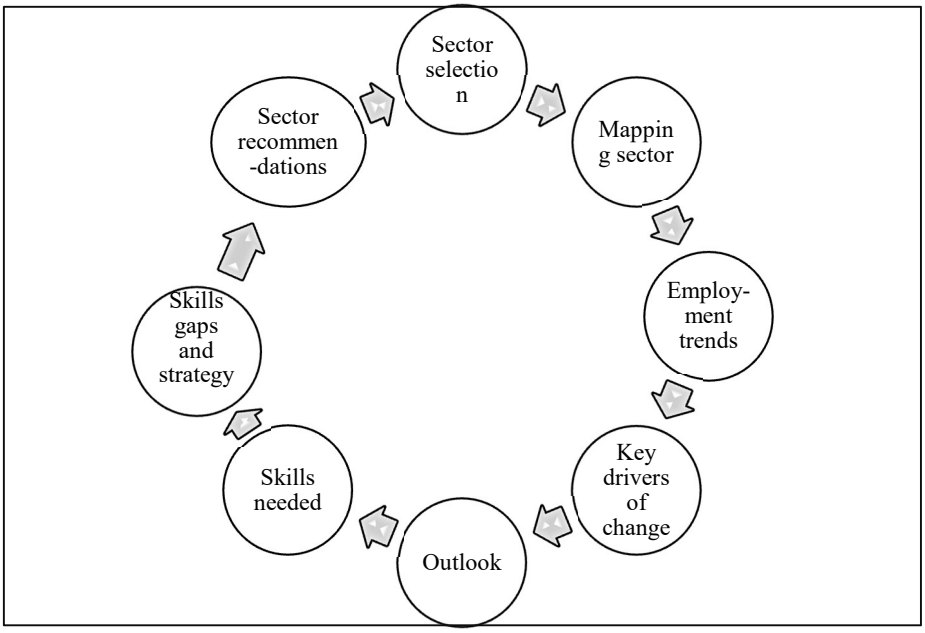
Figure 1: Examples of ecological or green jobs



Source: Author's representation based on literature review.

Experts of the International Labour Organisation (ILO) underline that "transition to the green economy and sustainable development bring about economic restructuring and shifts in employment. New jobs and new job tasks require different skills. The key to inclusive and just transition is to help enterprises to adjust to change and to equip current and potential workforce with relevant skills in order to ensure that job losses are mitigated and those affected receive retraining. Anticipating skill needs therefore becomes critical, but it is a process that takes time" (ILO, 2015). The ILO's experts have provided an overview of the sector analyses process how to approach skills expectations for green jobs at the sector level (Figure 2).

Figure 2: Overview of sector analysis process for green jobs skills



Sources: Author's representation based on ILO (2015).

2. Specialized literature review on the impact of green transition on labour markets

Vandeplas et al. (2022) appreciate that the green transition will have a direct effect on potential labour input, and will affect the structure of labour demand through the obsolescence of some jobs and human capital. This will crucially depend, inter alia, on the ease with which displaced workers can be re-integrated into other sectors

(and/or occupations) of employment, and the ability of employment policies to support people during possible unemployment spells in reskilling and finding new jobs (Vandeplas et al., 2022).

Martinez-Fernandez et al. (2010) present two major channels through which green economy may affect labour markets: (1) impacts from regulations, affecting the supply (enterprises) and the demand (consumers) side, and (2) direct impacts on natural and built environments. The same authors recommend that a third issue to be considered, namely how social conscience influences and drives policies and regulations and labour markets by changing consumer choices of "green" products and services.

Bowen (2012) underlines that skill shortages are reported in industries and occupations likely to benefit from green policies. He shows that the challenges are the high-level skills necessary to manage large-scale green policy interventions and the associated large-scale projects over a long period of time in a way that will build the credibility of green growth aspirations while allowing for learning and policy improvement over time.

Janta et al. (2023) identified that greening of the labour market will lead to some groups being particularly affected (both negatively and positively). Gender, age, and skills levels are the factors of potential social inequalities in securing greener employment opportunities. However, dividing the impact of each of these social dimensions is difficult due to the intersectionality of disadvantages (Janta et al., 2023).

International Monetary Fund (2022) experts looked at the relationship between workers' demographic characteristics and the environmental properties of their jobs. They have found that more green-intensive occupations tend to have higher-skilled and more urban workers, while the opposite is true for more pollution-intensive jobs. Targeted and effective training programs to boost the human capital of lower-skilled workers in pollution-intensive or neutral occupations could help by improving these workers' ability to move into more green-intensive jobs (IMF, 2022).

Vona et al. (2021) appreciate that building and reinforcement of a comparative advantage in sectors where demand will grow very rapidly in the near the future is an additional reason to consider skill development for green and low-carbon technologies as a key strategic investment of the European Green Deal. The European regions may differ in the endowment of competences that are required to build or reinforce such green comparative advantage. Beaudry et al. (2010) show that the local endowment of certain skills is one of the main drivers of the diffusion of the low-carbon technologies, that use intensively these skills.

Moretti (2004) has found that spatial and personal inequalities are associated with differences in skill endowments across regions and workers. The key policy question is thus no longer to simply increase the supply of tertiary-educated students, but to precisely identify which types of qualifications, educational and training programs, including on-the-job training, are better suited to provide the skills required in expanding technologies (Vona and Consoli, 2015).

Pociovălișteanu et al. (2015) opine that the number of jobs created in all stages of greening the economy depends on many factors, such as investment size, the extent of demand for organic products, employment elasticity, and the cost of green products and services for consumers. They recommend that: (1) policies aimed at creating green jobs must consider not only the direct creation of such jobs but also indirect jobs that can be created in adjacent industries, (2) employment policies correlate with educational policies needed to create the right skills for the new demands of the green economy.

Pociovălișteanu et al. (2015) conclude that in the European Union the implementation of measures to positively influence green employment are the following: access to European funding, an integrated policy approach to environmental and employment issues, identification and implementation of training needs of the workforce in line with green employer requirements, focus on sectors with potential for creating green jobs by developing customized training programmes and by developing public-private partnerships.

3. The development of renewable energy industries effects on labour markets

The green transition focuses on energy supply by reducing fossil energy sources and increasing renewable energy. Economic sectors based on conventional energy technologies, oil, natural gas, coal, and nuclear represent the sectors with a high share of the labour market. The development of renewable energy industries is much more recent and started to generate significant effects in terms of employment in recent years. Some of these renewables, such as the photovoltaic, wind, and bioenergy sectors, are already mature industries and important employers in the EU and globally. Others, such as geothermal and marine energies, still have a limited impact on the workforce.

Based on the ILO data, approximately 18 million jobs can be created by 2030 worldwide by limiting global warming to 2 °C (ILO, 2018). Global employment in the energy sector reached nearly 58 million in 2017, and

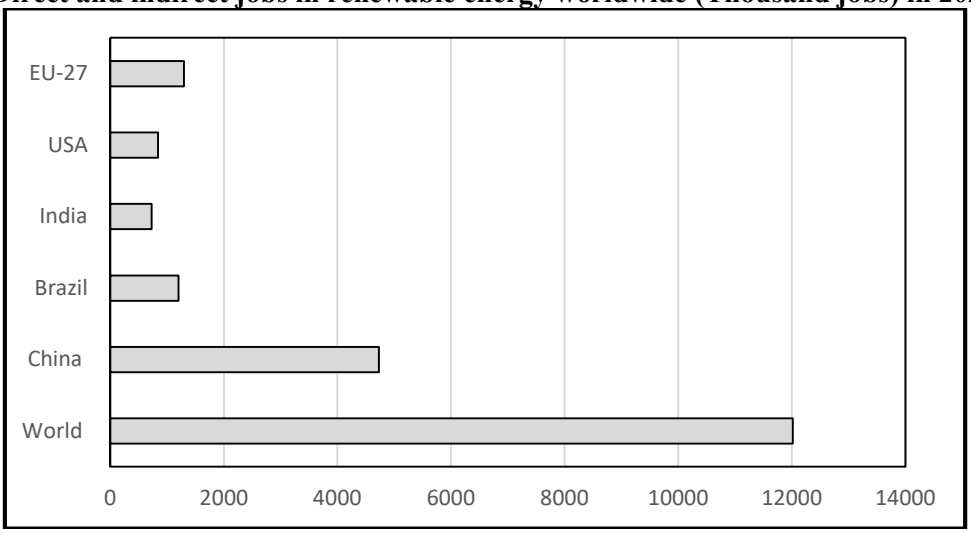
half of these jobs were in fossil fuel industries (IRENA, 2022). According with International Energy Agency, over 65 million people were employed in the energy and related sectors in 2019, accounting for almost 2% of formal employment worldwide. Half of the energy workforce is employed in clean energy technologies (IEA, 2022).

According to the International Renewable Energy Agency's target of limiting global warming to 1.5 °C, approximately 38 million jobs can be created in the renewable energy sector worldwide by 2030 and 43 million jobs by 2050, double forecasts as compared to official policies and commitments. As stated by IRENA (2021), the jobs in the energy sector will increase overall to 122 million in 2050 by limiting global warming to 1.5 °C, as compared to 114 million under current policies and commitments. Solar energy will have the largest share of jobs in renewable energy in 2050, namely 19.9 million jobs, followed by bioenergy 13.7 million jobs, wind energy 5.5 million jobs labour, and hydropower 3.7 million jobs.

In the opinion of the European Commission, in 2016 approximately 87.6 million jobs could be considered green in the EU (including the United Kingdom at that time), representing 40% of employment that year (European Commission, 2019). In the renewable energy sector, more and more jobs can be created than in conventional energy production based on fossil fuels due to the greater size of the labour intensity of green energies (Czako, 2020).

The employment in the renewable energy has registered a steady growth trend over the last decade, both internationally and at the EU level. In the renewable energy sector, employment increased continuously globally, reaching a total of 12 million jobs in 2020, as compared to 11.5 million jobs in 2019 and 7.3 million jobs in 2012, and a third of renewable energy industry jobs worldwide were in the solar photovoltaic sector (IRENA& ILO, 2021) (Chart 1).

Chart 1: Direct and indirect jobs in renewable energy worldwide (Thousand jobs) in 2020



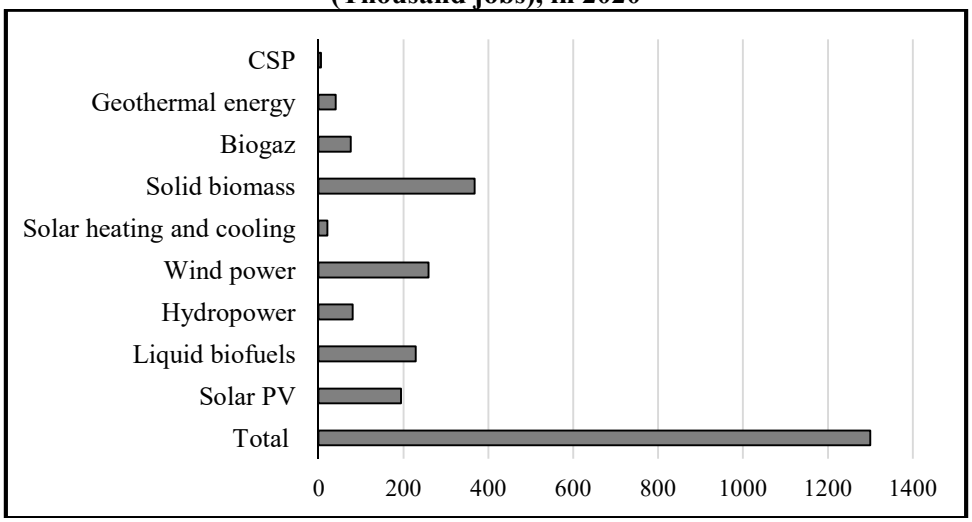
Source: Author's representation, based on data provided by IRENA & ILO (2021).

Data indicate that the EU countries had a total of 1.6 million jobs in renewable energy, of which approximately 1.3 million of these were in the EU-27 member countries (after Brexit) in 2020. The bioenergy sector is the largest employer from renewables sectors in the European area. The solid biomass (for heat and electricity) totals approximately 414,000 jobs (of which 368,000 in the European Union), followed by biofuels with 242,000 jobs (229,000 in the European Union) and biogas with 79,000 jobs (76,000 jobs in the European Union).

IRENA& ILO (2021) estimates the number of jobs in the wind energy at 333,200 in Europe, of which 259,500 jobs were in EU member states in 2020 (Chart 2). The European continent's cumulative wind generation capacity remains at 208 GW, with around 14.3 GW added in 2019, while in 2020 the capacity additions stood at 11.4 GW. Germany, Spain, and the United Kingdom are the leaders in wind installations in Europe, but in all three countries, the pace slowed considerably in 2020 (IRENA & ILO, 2021). The European offshore wind industry continues to expand, and it is estimated that almost 100,000 jobs have been created in this segment alone. In addition to domestic markets, energy exports have been an important source of wind jobs in Germany, Spain, and Denmark. Thus, export of wind equipment has remained constant over the last decade, at approximately EUR 8 billion annually, even though wind capacity has expanded worldwide. Both Europe as a whole and EU member state added record amounts of solar PV in 2019 and 2020, more than double the volume of 2018, contrary to

estimates that COVID-19 could reduce the market (IRENA & ILO, 2021). EU member states accounted for the majority of 90% of the continent's photovoltaic capacity growth, representing a significant increase from a 79% share in 2019 (IRENA & ILO, 2021).

Chart 2: Direct and indirect jobs in renewable energy in the European Union, by sectors, (Thousand jobs), in 2020



Note: CSP=concentrated solar power, PV=photovoltaic.
Source: Author's representation, based on data provided by IRENA & ILO (2021).

4. Challenges of labour markets in the context of green transition

4.1. Global challenges: misalignments between the demand and supply of skills

The transformation of the energy sector based on the just transition is a multilevel process. In addition to the industrial restructuring, the implementation process includes the reform of the university curriculum and professional training systems, active employment strategies, and effective social protection networking. These actions can help local economies innovate and overcome the potential labour market imbalances between job losses (redundancies, restructuring) and new job creation. Labour market policies accompanying the just transition are also essential to help generate better-paid jobs for employees.

According to the analysis of IRENA & ILO (2021), the energy transition to the energy industry of the future will encounter frictions and mismatches between several components, such as temporal, spatial, educational, and economic, as a result of misalignments between the demand and supply of skills (Table 1).

Table 1: Types of misalignments between the demand and supply of skills

TYPES OF MISALIGNMENTS	DESCRIPTION
Temporal misalignments	- It happens when job losses precede large-scale job creation. An example is the closure of mining activities that do not necessarily coincide with the development of new activities in the renewable energy or energy efficiency sectors.
Spatial misalignments	- It occurs when new jobs become available in other communities or regions. It is a challenge to move for people who have lost their jobs and may have the right qualifications and skills, but have financial, family or property connections in the region where they live.
Educational misalignments	- It takes place when the skill levels required for the occupations in the energy transition have not been developed by education and training systems. The solution required is careful planning and anticipation of future skill requirements.

TYPES OF MISALIGNMENTS	DESCRIPTION
Sectorial misalignment	- It is the case of changing the value and supply chains based on the energy transition. If the new industries are located domestically, we see a shift from one industry to another, and from one job to another. If the new value chain is highly dependent on imports, the impact on domestic jobs is negative, creating jobs outside the country.

Source: Author's representation, based on data provided by IRENA & ILO (2021).

4.2 The development of the qualifications necessary to increase employment in green economy

The energy transition produces significant employment opportunities in various fields of activity, but education and continuous training for new skills are needed to support industrial restructuring. Despite positive trends and recent developments, skills gaps and shortages are widespread in several Member States, except those where proactive employment measures are consistently taken. In high-income countries, skills anticipation systems are linked to technical education systems, many of the most significant shifts in skills and occupations in the green economy are taking place at higher skill levels, requiring university education or highly qualified technical training.

However, renewable energy sectors employ people with various qualifications and levels of education. For example, IRENA & ILO (2021) show that in the onshore wind energy sectors over 60% of the workforce requires a minimum of basic training, and people with degrees in fields such as science, technology, engineering, and mathematics are required in smaller numbers (about 30%). Professionals such as lawyers, logistics experts, marketing specialists, or regulatory and standardization experts account for approximately 5%, while administrative staff accounts for 14%. In the marine (offshore) wind energy sectors, the proportion of those with a basic level of training also represents the largest share of jobs, at 47% (IRENA & ILO, 2021).

The rapid innovation processes taking place in the energy sector bring with them the need for a set of new skills. Therefore, the efforts are directed to respond to emerging skills requirements in areas such as electric vehicles, energy storage sectors, bioenergy, solar heating and cooling and digitization of energy networks. Additionally, innovation and entrepreneurship skills can be vital for developing not only new technologies but also viable business models (IRENA & ILO, 2021).

Ensuring the necessary skills can be achieved in a variety of ways. Depending on the context of each state, multiple pathways may be available for the same type of qualification, for example, either through an apprenticeship scheme, continuing vocational training or through direct on-the-job training. The same analysis shows that there are 35 key occupations in the field of wind energy, however only 16 of these jobs require a university degree, the rest of the skills can be developed either through on-the-job training or continuing vocational training and/or apprenticeship.

According to the same source, within the higher education system, experiential learning methods are encouraged whereby students are encouraged to develop knowledge through direct practice in the new energy sectors. Complementarily, the shift to online and digital learning, which has been accelerated by the COVID-19 pandemic, has drawn attention to the potential role of information and communications in improving the training methods used to develop the necessary skills.

4.3 EU's specific challenges related to the impact of green transition on labour market

In the context of the cohesion policy, the specific challenges of the European Union are to strengthen the economic, social, and territorial cohesion, based on the Union's political priorities as the green and digital transition. Increasing employment and value-added in environmental economy[1] are essential for achieving the green transition in European Union.

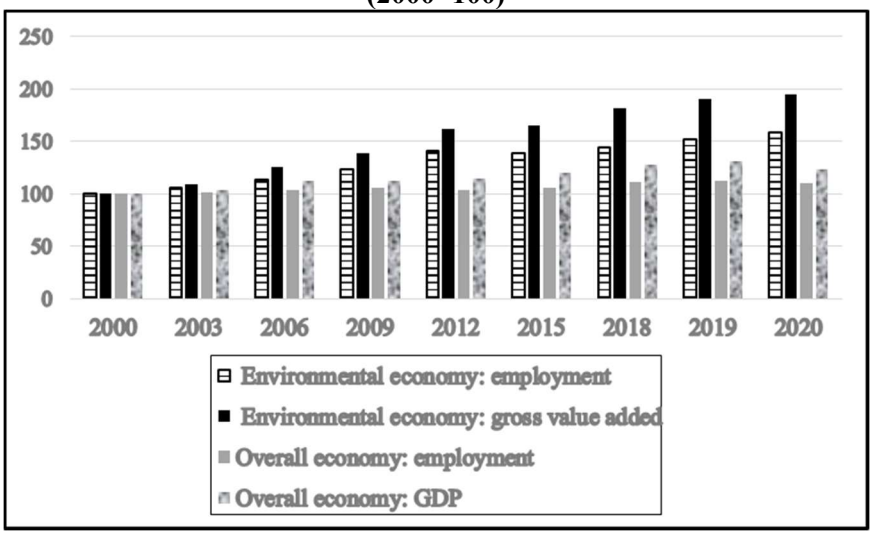
4.3.1 The evolution of the key indicators for the environmental economy

According to Eurostat (2023), the employment in the EU environmental economy increased from 3.2 million full-time equivalents in 2000 to 5.1 million full-time equivalents in 2020. The environmental economy

[1] According with Eurostat, the environmental economy encompasses activities and products that serve either of two purposes: 'environmental protection' — that is, preventing, reducing, and eliminating pollution or any other degradation of the environment, or 'resource management' — that is, preserving natural resources and safeguarding them against depletion.

generated EUR 828 billion output and EUR 341 billion gross value added in 2020. Between 2000 and 2020, employment and gross value added grew faster in the environmental economy than in the overall economy (Chart 3).

Chart 3: The evolution of the key indicators for the environmental economy and overall economy in the European Union, between 2000-2020 (%) (2000=100)

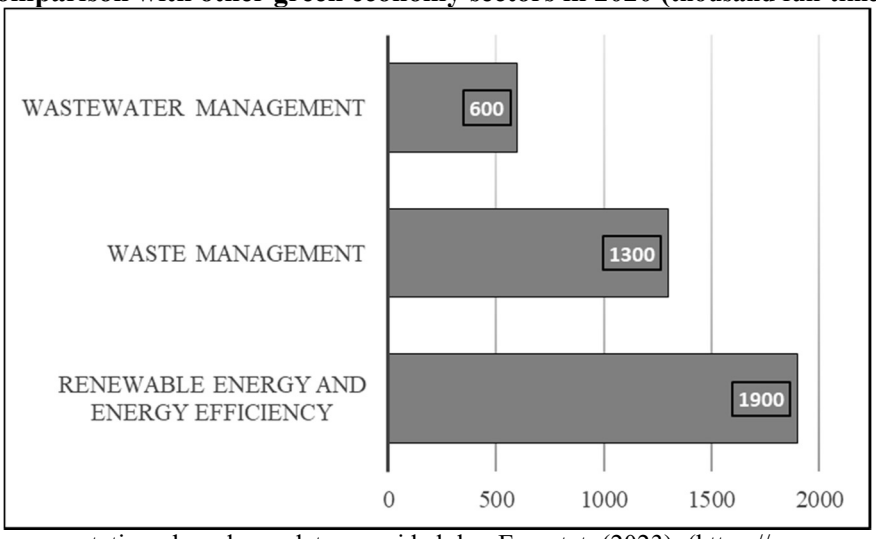


Source: Author's representation, based on data provided by Eurostat (2023) (https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Environmental_economy_%E2%80%93_statistics_on_employment_and_growth#Development_of_key_indicators_for_the_environmental_economy).

4.3.2 The development of the employment in renewable energy sectors by comparation with some of the environmental economy sectors

Eurostat (2023), data show that also as a result of renewable and energy-efficiency measures more than a million full-time equivalent jobs have been created in the EU between 2000 and 2020 (1.9 million full-time jobs equivalents in 2020) (Chart 4). The second largest contribution to environmental employment in 2020 came from waste management, with the number of jobs increasing from 0.9 million full-time equivalents in 2000 to 1.3 million full-time equivalents in 2020 (overall increase of 49 %). By contrast, employment related to wastewater management decreased in the same period by 14% from 0.7 million to 0.6 million full-time equivalents (Chart 4).

Chart 4: The employment in renewable energy sector in comparison with other green economy sectors in 2020 (thousand full-time jobs)



Source: Author's representation, based on data provided by Eurostat (2023) (https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Employment_in_the_environmental_economy,_by_domain,_EU,_2000%E2%80%932020_(thousand_full-time_equivalents).

5. Conclusion

The green economic transition is an ongoing process in the context of political efforts to act against climate change. As part of this process, the energy sector is also undergoing a significant ecological transition, with the renewable energy component sectors expanding as key elements. Fossil fuel sectors have seen job losses in some parts of the world, including the EU. On the other hand, the significant demand to increase the efficiency of buildings means that the construction industry has a high potential to create energy efficient jobs. The opportunities from the perspective of the just transition are closely related to the establishment of matches between the demand and the supply of the necessary skills.

The process of transition to a green economy is complex and includes, in addition to the technological components and measures of education and professional training, measures of active employment on the labour market, as well as social and regional protection. These tools are essential to help local economies innovate, overcome potential labour market imbalances, and manage both job losses (staff reductions, restructuring) and job creation. Labour market policies accompanying the just transition are also essential to help generate decent jobs for employees.

Green economy offers significant opportunities to create jobs, but also leads to some challenges, especially in certain areas and for certain workers. The European Union sees green growth as both a challenge and an opportunity for the labour market and skills that are key factors for enabling green growth. The main challenges for restructuring the global labour market are the misalignments between the demand and supply of skills and the anticipating and establishing adequate skills policies to support workers in coping with structural change. In the European Union, the weaknesses concerning the green transition's implementation and its negative impact on the labour market comes from the gaps between member states concerning the economic and social development and different level of development of the national institutional structures. The EU strength comes from the EU cohesion policy instruments, including the Just Transition Mechanism to reduce the economic and social gaps between member states.

In this context, governmental measures are necessary for macro-economic and fiscal policies to price pollution, incentivise employment in renewable energy sectors, and channel funds from carbon-rich consumers to the energy poor through a Just Transition Fund. The success of this Just Transition process depends on the implementation of measures that include, on the one hand, the responsible restructuring of the traditional core of the local economy and, on the other hand, the construction of new competitive advantages thanks to investment, employment, transport, and waste management and wastewater management.

References:

[1] Czako, V. (2020). *Employment in the Energy Sector Status Report 2020*, EUR 30186 EN. Luxembourg: Publications Office of the European Union. ISBN 978-92-76-18206-1. https://ec.europa.eu/jrc/en/science-update/employment-energy-sector.

[2] Beaudry, P., Doms, M. and Lewis, E. (2010). Should the personal computer be considered a technological revolution? Evidence from US metropolitan areas. Journal of Political Economy, 118(5), pp.988-1036.

[3] Bowen, A. (2012). 'Green'Growth,'Green'Jobs and Labor Markets, World Bank Policy Research Working Paper No. 5990, Available at SSRN: https://ssrn.com/abstract=2018164.

[4] European Commission (2023). Delivering the European Green Deal. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en.

[5] European Commission (2021). The Just Transition Mechanism: Making sure no one is left behind. Brussels. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_ro

[6] European Commission. (2019). *Sustainable growth for all: choices for the future of Social Europe, Employment and Social Developments in Europe 2019*. Brussels: European Commission. https://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=8219.

[7] Eurostat (2023). Environmental economy - employment and growth. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Environmental_economy_%E2%80%93_statistics_on_employment_and_growth#Development_of_key_indicators_for_the_environmental_economy

[8] International Monetary Fund (2022). The World Economic Outlook (WEO). War Sets Back the Global Recovery. Washington, DC, April.

[9] International Labour Organisation (ILO, 2018). *World Employment Social Outlook 2018: Greening with jobs*. https://www.ilo.org/global/publications/books/WCMS_628654/lang--en/index.htm%0Ahttp://www.ilo.org/wesodata/?chart=Z2VuZGVyPVsiRmVtYWxlIiwiTWFsZSJdJnVuaXQ9Ik51bWJlciIsImc2VjdG9yPVsiQWdyaWN1bHR1cmUiXSZ5ZWFyRnJvbT0yMDEwJmluY29tZT1bXSZpbmRpY2F0b3I9WyJlbXBsb3ltZ.

[10] International Labour Organisation (ILO, 2015). *Anticipating skill needs for green jobs. A practical guide.* https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_564692.pdf.
[11] International Energy Agency (IEA, 2022). *World Energy Employment*, Revised version, August, https://iea.blob.core.windows.net/assets/a0432c97-14af-4fc7-b3bf-c409fb7e4ab8/WorldEnergyEmployment.pdf.
[12] International Renewable Energy Agency & International Labour Organisation (IRENA & ILO, 2021). *Renewable Energy and Jobs – Annual Review 2021*. Abu Dhabi: International Renewable Energy Agency. Geneva: International Labour Organization. https://www.irena.org//media/Files/IRENA/Agency/Publication/2021/Oct/IRENA_RE_Jobs_2021.pdf.
[13] IRENA. (2020). *Measuring the socio-economics of transition: Focus on jobs.* Preluat de pe: https://www.irena.org/publications/2020/Feb/Measuring-the-socioeconomics-of-transition-Focus-onjobs
[14] Janta, B., Kritikos, E. and Clack, T. (2023). 'The green transition in the labour market: how to ensure equal access to green skills across education and training systems', EENEE Analytical report. doi: 10.2766/563345. https://eenee.eu/wp-content/uploads/2023/01/EENEE_AR02_Green-skills_Final-report-without-identifiers.pdf.
[15] Martinez-Fernandez, C., C. Hinojosa and G. Miranda (2010). "Greening Jobs and Skills: Labour Market Implications of Addressing Climate Change", *OECD Local Economic and Employment Development (LEED) Papers*, No. 2010/02, OECD Publishing, Paris, https://doi.org/10.1787/5kmbjgl8sd0r-en.
[16] Moretti, E. (2004). Human capital externalities in cities. In Handbook of regional and urban economics, Vol. 4, pp. 2243-2291. Elsevier.
[17] Pociovălișteanu DM, Novo-Corti I, Aceleanu MI, Șerban AC, Grecu E. (2015). Employment Policies for a Green Economy at the European Union Level. *Sustainability*; 7(7):9231-9250. https://doi.org/10.3390/su7079231, https://www.mdpi.com/2071-1050/7/7/9231.
[18] Vandeplas, A., Vanyolos, I., Vigani, M., & Vogel, L. (2022). *The Possible Implications of the Green Transition for the EU Labour Market* (No. 176). Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.https://economy-finance.ec.europa.eu/system/files/2022-12/dp176_en_green%20transition%20labour.pdf.
[19] Vona, F. (2021) *Labour markets and the green transition – A practitioner's guide to the task-based approach*, Biagi, F. (editor), Bitat, A. (editor), Publications Office of the European Union. https://data.europa.eu/doi/10.2760/65924.
[20] Vona, F. and Consoli, D. (2015). Innovation and skill dynamics: a life-cycle approach. Industrial and Corporate Change, 24 (6), 1393-1415.
[21] US Bureau of Labour Statistics (BLS, 2013). *The BLS Green Jobs Definition.* https://www.bls.gov/green/green_definition.htm.

Assessing the Energy State of the EU under Green Deal Objectives

PAUL CALANTER
Project Writing Department, Institute for World Economy
Romanian Academy
ROMANIA
paul.calanter@yahoo.com

Abstract: EU energy policies focus on energy security, the integration of Member States' energy markets and the transition to a carbon-free energy system. This article aims to analyse the energy state of the European Union, considering the Green Deal objectives. Therefore, in the first part of the article, the general objectives of the Green Deal will be exposed while in the second part of the article we will analyse the energy mix of the European Union, the energy production, the energy imports dependence, the energy consumption, the electricity production and prices. In the last part of the article, we will examine the elements regarding the energy-climate relationship, namely greenhouse gases emissions, energy efficiency and renewable energy.

Keywords: Green Deal, greenhouse gases emissions, policies, energy efficiency

JEL Classification: Q21, Q42, Q43, Q48

1. Introduction

The Green Deal is a long-term strategy adopted by EU since 2019 aiming to ensure that the carbon neutrality in Europe is achieved by 2050. The European Green Deal has the potential to transform the EU into a modern, competitive and resource-efficient economy (Iglińskiet al., 2022). In 2019, the European Commission estimated that meeting the Green Deal objectives would require significant investments. Thus, at that time, it was estimated that achieving the 2030 climate and energy targets will require 260 EUR billion of additional annual investment, representing around 1.5% of 2018 GDP at EU level (EC, 2019).

The EU has introduced the Just Transition Mechanism to provide financial and technical support to the regions that are most affected by the shift to a low-carbon economy. This mechanism will help mobilise at least 65-75 EUR billion over the period 2021-2027 to support people and communities, businesses, Member States and regions. With a total budget of EUR 17.5 billion, the Just Transition Fund is the first pillar of the mechanism, and on June 7th, 2021, the Council adopted the regulation establishing this fund. The Fund provides tailored support to reduce the social and economic costs of the green transition for fossil fuel-dependent regions and high-emission industries.

Green Deal represents a true roadmap to ensure the sustainability of the EU economy by turning climate and environmental challenges into opportunities in all policy areas and by guaranteeing a transition that is fair and inclusive to all. The measures proposed by the Green Deal are intended to encourage resource efficiency by shifting the core EU policies to the objective of the clean circular economy and to limit climate change, to reverse biodiversity loss and to reduce pollution (Hainsch et al., 2022).

Green Deal presents the necessary investments and the available financing instruments and explains how a just and inclusive transition will be ensured (Hafner et al., 2020). The European Green Deal covers all sectors of the economy, with actions focusing on areas such as transport, energy, agriculture, environment and oceans, climate, industry, research and innovation (Tutak et al., 2021).

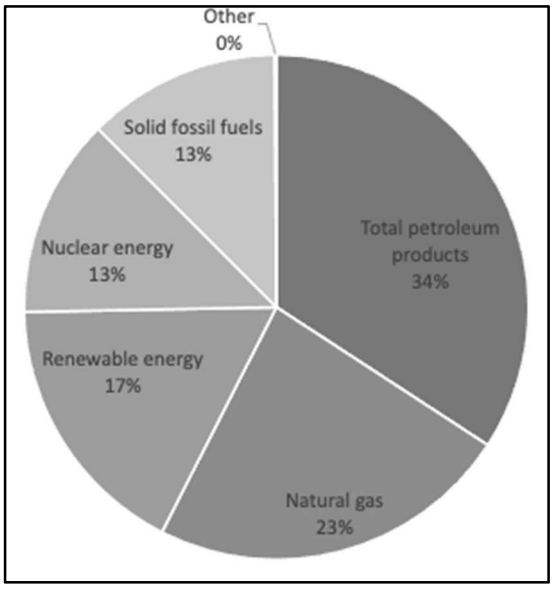
2. Energy situation of the EU

2.1. Energy mix

The energy available in the European Union comes from energy produced in the EU and from energy imported from third countries. Therefore, to get a good overview of the total energy available in the EU, energy production should always be correlated with imports. In 2021 (latest available data), the European Union produced approximately 44 percent of its own energy, while 56 percent was imported (Eurostat, 2023). In 2021,

the European Union's energy mix (the range of available energy sources) consisted mainly of five sources (Figure 1): solid fossil fuels (12%), nuclear energy (13%), renewable energy (17%), natural gas (23%), and crude oil and petroleum products (34%).

Figure 1: Share of energy products in total energy available, 2021 (%)



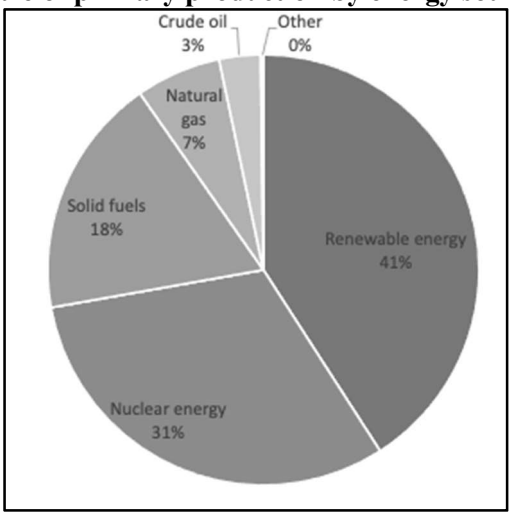
Source: Author according to the Eurostat database, 2023.

The share of different energy sources in the available energy mix varies significantly between Member States. In 2021, the share of petroleum products in available energy is highest in Cyprus (86%), Malta (85%) and Luxembourg (61%), while natural gas is an important source of energy in Italy (40%), the Netherlands (35 %) and Hungary (34%). Renewable energy sources have the largest share in Sweden (48%) and Denmark (41%), while nuclear energy accounts for 41% of available energy in France and 25% in Sweden. The share of solid fossil fuels is highest in Estonia (56%) and Poland (43%).

2.2. Energy production in EU

Energy production in the EU is distributed across several different energy sources: solid fuels, natural gas, crude oil, nuclear and renewable energy (hydro, wind and solar). According to Figure 2, renewable energy sources (41% of total EU energy supply) were the largest contributor to EU energy supply in 2021 (latest available data). On the second place we find the nuclear energy (31%) followed by solid fuels (18%), natural gas (6%) and oil (3%).

Figure 2: Share of primary production by energy source, 2021 (%)



Source: Author according to the Eurostat database, 2023.

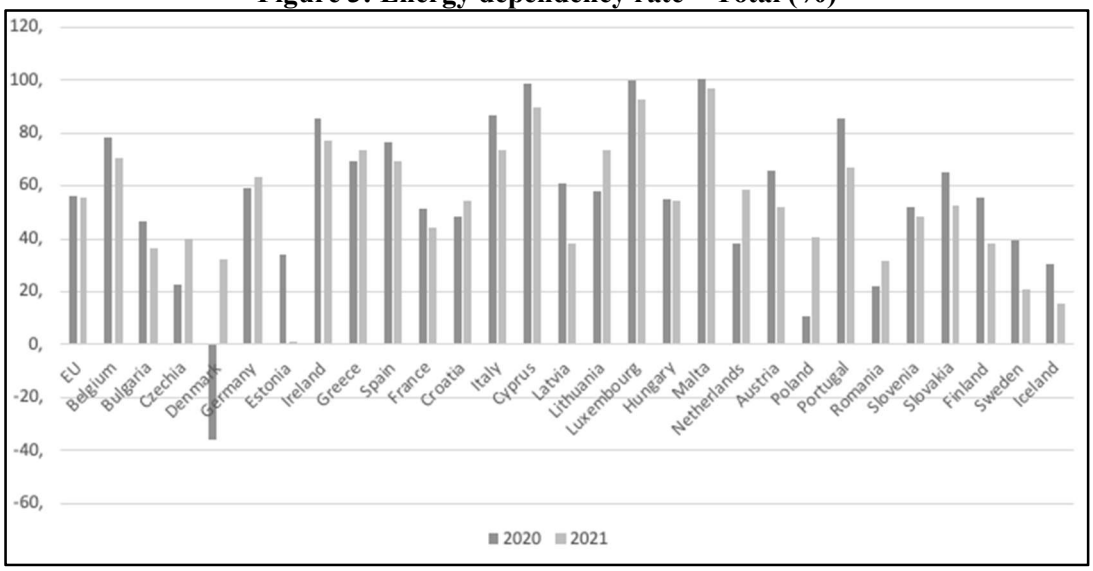
The energy production is different from one country to another. In 2021, renewable energy was Malta's primary basis for primary production (in other words, Malta did not produce another type of energy) and was the main source in other countries. The shares of Latvia, Portugal and Cyprus were more than 95%. The efficiency of nuclear energy was high in France (76% of total national energy resources), Belgium (70%) and Slovakia (60%). In Poland (72%), Estonia (56%) and the Czech Republic (45%) the solid fuels were the main sources of energy. The Netherlands (58%) and Ireland (42%) have the highest share, while the share of oil was the highest in Denmark (35%).

2.3. Energy imports and dependence

For self-consumption, the European Union needs also the energy that is imported from third countries. In 2021 the main energy product that was imported was the petroleum products (including crude oil, which is the main component) which accounted for almost two-thirds of EU energy imports (64 %), followed by natural gas (25 %) and solid fuels (6 %).

By 2021, more than half of the extra-EU oil imports came from five countries, with Russia (28 %), US and Norway (9 % each) being the top three providers. The comparative analysis shows that almost three-quarters of the EU's natural gas imports come from Russia (44 %), Norway (16 %) and Algeria (12 %), while more than half of the EU's fossil fuel imports (mainly coal) come from Russia (52 %), followed by Australia (17%) and the US (15%). Starting with 2022 the sanctions imposed as a consequence of the Russian aggression against Ukraine, triggered a significant change in EU's energy trade.

Figure 3: Energy dependency rate – Total (%)



Source: Author according to the Eurostat database, 2023.

The energy dependence rate indicates the extent to which the economy relies on imports to meet its energy needs. It is measured as net imports (imports minus exports) of gross domestic energy consumed (i.e. energy produced plus net imports). According to figure 3, in 2021, the level of import dependency in the EU was 56%, meaning that half of the energy needed by the EU was satisfied by net imports. However, the dependency had levels in Europe. In Malta, Luxembourg and Cyprus were 90% or more and in Estonia around 1%.

2.4. Energy consumption

About two-thirds of the total energy available in the EU is consumed by final consumers (final energy consumption) for example, EU citizens, industry, transport. The difference, about a third is lost mainly in the production and distribution of electricity, which is used to support energy processes or for non-energy uses (e.g. asphalt). In 2021 (latest available data), in the European Union the petroleum products (e.g. heating oil which represented 35% in the final consumption), were the most consumed. Electricity and gas ranked on the second place with 23% each, followed by solar heating, geothermal or biogas for space heating or hot water production) (12 %), heat (5%) and solid fossil fuels (mainly coal) (3%). The real consumption of renewable energy is bigger that 12 % because of the hydropower, wind power and or photovoltaic solariums, which are included in the electricity sector.

The pattern of final energy consumption varies significantly across EU member states. In 2021, petroleum products accounted for more than 55% of final energy consumption in Luxembourg and Cyprus. In Malta and Sweden, the electricity was more than 30%, and in the Netherlands, Hungary, Belgium and Italy gas was more than 30%. Renewable energy sources account for more than 25 % of final energy consumption in Finland, Sweden and Latvia.

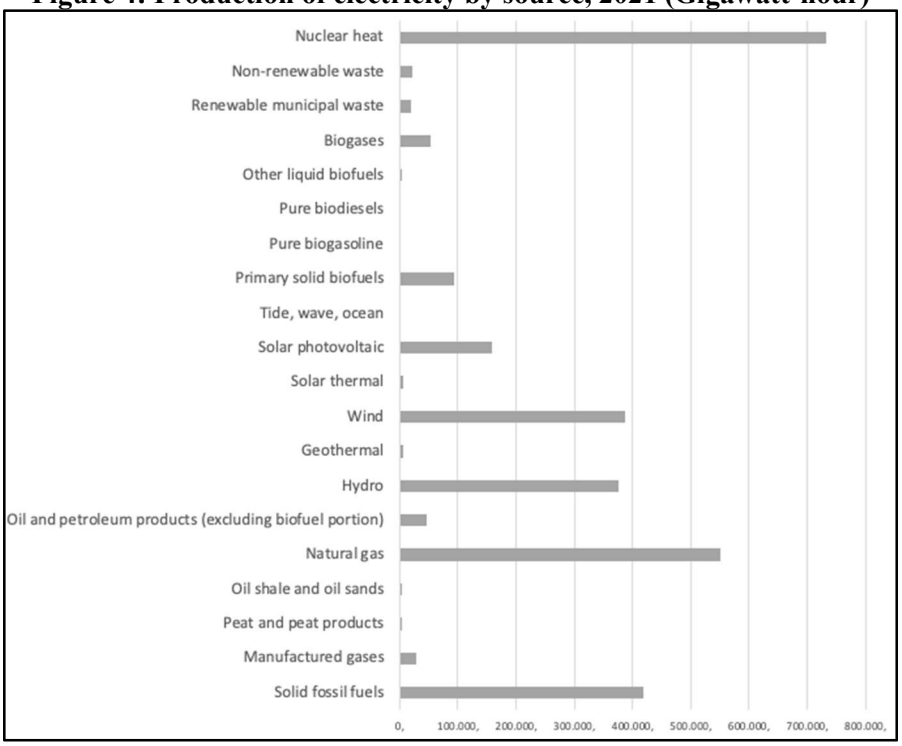
Energy is consumed in different sectors of the economy: household (energy consumed in citizens' homes), transport (rail, road, domestic aviation or domestic transport), industry, services (including trade and public services), agriculture and forestry. Looking at which sectors consume the most energy in the EU, the transport industry (29% of final energy consumption) consumed the most energy in 2021. It is followed by households (28 %), industry (26 %), services (14 %), agriculture and forestry (3 %).

To properly understand energy statistics, it is necessary to distinguish between primary and secondary energy products. A primary energy product is extracted or captured directly from natural resources, such as crude oil, firewood, natural gas or coal. This process is called primary production. Secondary energy products (such as electricity or motor gasoline) are obtained because of a transformation process, either from a primary or from a different secondary energy product. Final consumers can use primary (for example natural gas for heating) or secondary energy products (such as motor gasoline to fill up the car tank).

2.5. Electricity production

About 24% of the final energy is represented by electricity and comes from different sources. In 2021, renewables were the main source of electricity generation in the European Union (38 percent), ahead of fossil fuels (36 percent) and nuclear (25 percent). Most of the renewable energy comes from wind and hydro (both 13%), biofuels and solar (both 6%).

Figure 4: Production of electricity by source, 2021 (Gigawatt-hour)



Source: Author according to the Eurostat database, 2023.

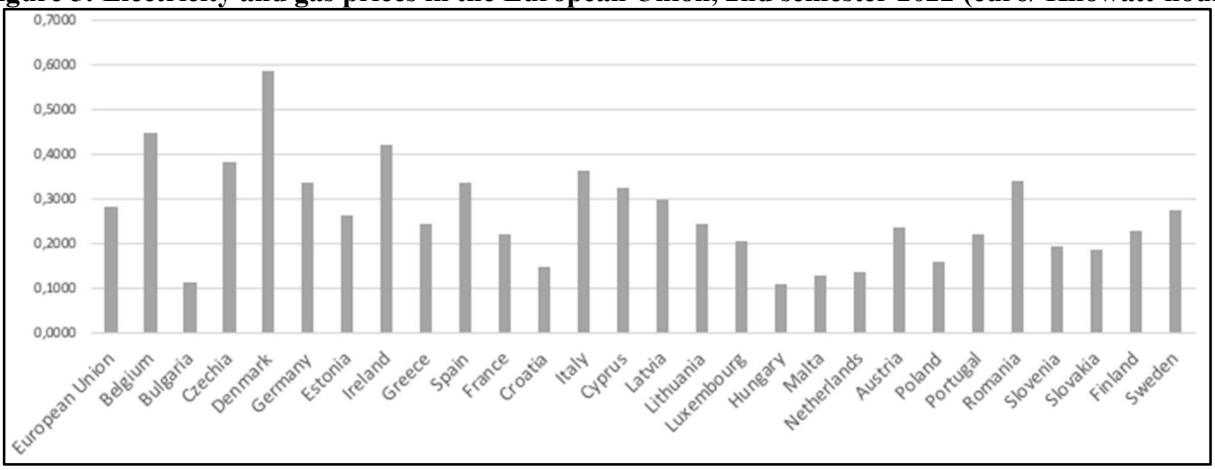
Electricity sources vary between the member countries. According to Figure 4, in 2021 (latest available data), around half (49 %) of Denmark's electricity generation came from wind. In Austria, 60% of electricity production comes from hydro. In Poland, Cyprus and Malta more than 80% of electricity generation comes from fossil fuels. However, in France almost 70% of electricity comes from nuclear while in Slovakia and Belgium around 50% came also from nuclear power plants.

2.6. Electricity and gas prices

In the second half of 2022, household electricity prices, including taxes and tariffs, were highest in Denmark, Belgium and Ireland while the lowest prices were recorded in the Bulgaria and Hungary (Figure 5).

Denmark had the highest share of taxes and levies in electricity prices (48 %) followed by Germany (42 %). The Netherlands had the lowest taxes and levies, the value being negative (-4 %). The next places were occupied by Latvia and Greece. Natural gas prices for household consumers, including taxes, are highest in Sweden and Denmark, and lowest in Hungary and Croatia.

Figure 5: Electricity and gas prices in the European Union, 2nd semester 2022 (euro/ Kilowatt-hour)



Source: Author according to the Eurostat database, 2023.

The share of taxes and levies in natural gas prices was the highest in the Netherlands (51%), and the lowest in Bulgaria, Greece and Latvia, being in this case negative.

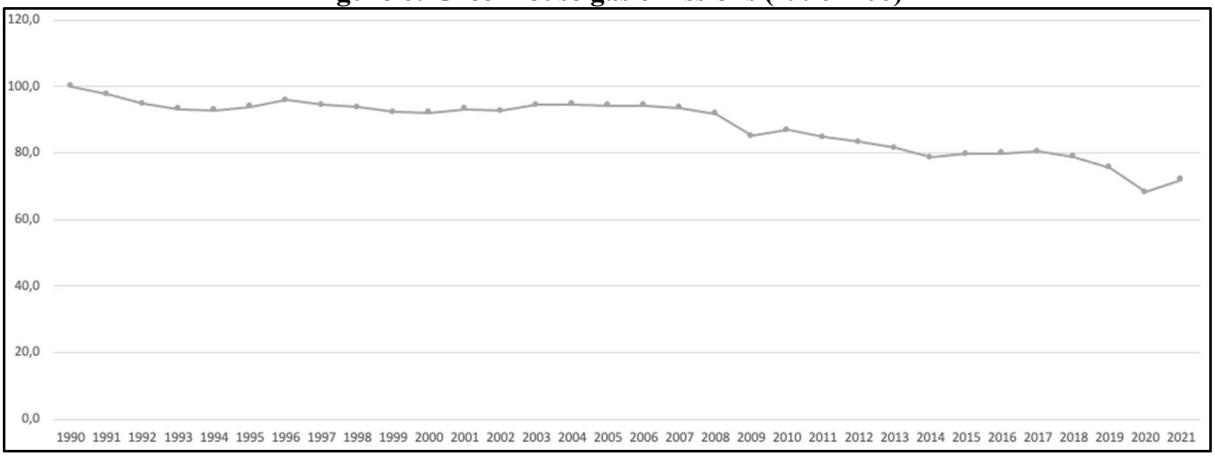
3. Energy and the environment

3.1. Greenhouse gas emissions

Climate change is a threat to sustainable development. After years of extensive research, the scientific community agrees that human-made greenhouse gas (GHG) emissions are the main cause of the rise in Earth's average temperature over the past 250 years. Agriculture and waste are also sources of manufacturing GHG emissions. According to Figure 6, the European Union greenhouse gas emissions fell from 2010 to 2014, rose from 2015 to 2017 and fell again in 2018-2020. In 2020 (latest available data), GHG emissions fell more than 10% in comparison to 2019. This is the strongest decline since 1990.

In 2020, the volume of greenhouse gas emissions in the EU was more than 1.5 billion tonnes of CO2 equivalent compared to 1990. This corresponds to a reduction of 32% in comparison to 1990 levels. The new objective is to reduce greenhouse gas emissions by 55% compared to 1990. Greenhouse gas emissions were below 1990 levels in 25 of the EU countries. The largest reductions were recorded in Estonia, Latvia, Lithuania and Romania.

Figure 6: Greenhouse gas emissions (1990=100)

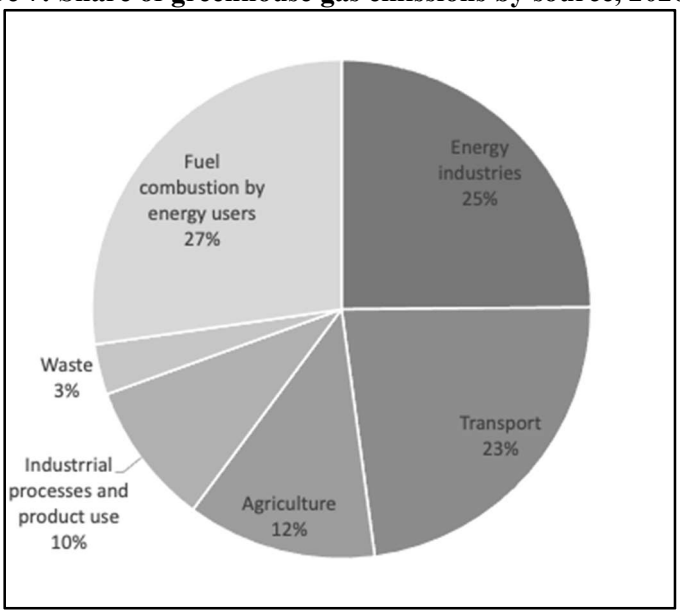


Source: Author according to the Eurostat database, 2023.

According to Figure 7, by 2020, fuel combustion accounted for the largest share of total consumer greenhouse gas emissions (28 %), surpassed only by the energy industry (25 %). Compared to 1990, the share

fell for all sectors except transportation. Here, it rose from 15% in 1990 to 23% in 2020. Also, it has been a slight increase in agriculture from 10% to 11%.

Figure 7: Share of greenhouse gas emissions by source, 2020 (%)



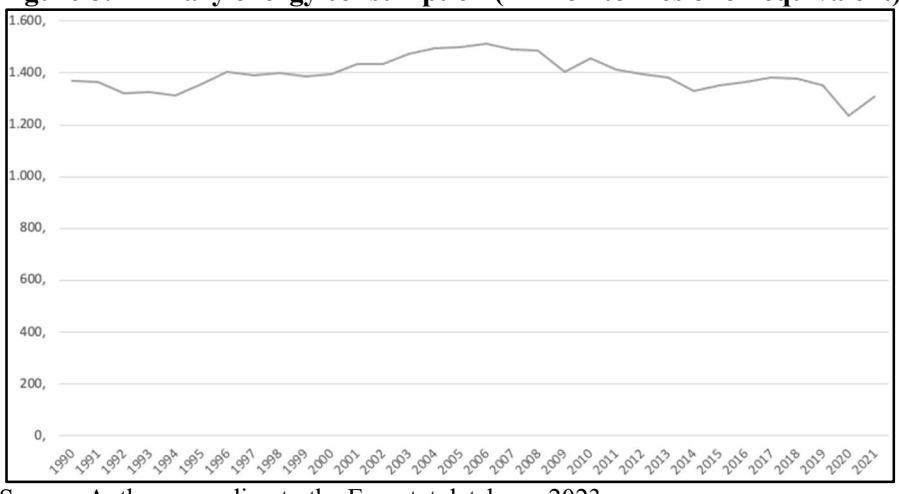
Source: Author according to the Eurostat database, 2023.

3.2. Energy efficiency

One of the priorities of the Energy Union strategy is to improve energy efficiency, mainly by reducing the total energy consumption in the EU and reducing the costs of energy management. Improving energy efficiency contributes to protecting the environment, mitigating climate change and reducing the EU's dependence on foreign oil and gas suppliers.

According to figure 8, in 2021, the primary energy consumption reached 1,309 million tons of oil equivalent (mtoe). This is an increase of 5.9% compared to 2020. At the time, consumption was at its lowest level due to the impact of the pandemic, but it is still the second lowest level since 1990 (the first year for which data is available). The level from 2021 is 16.1% lower than the EU 2030 target.

Figure 8: Primary energy consumption (Million tonnes of oil equivalent)



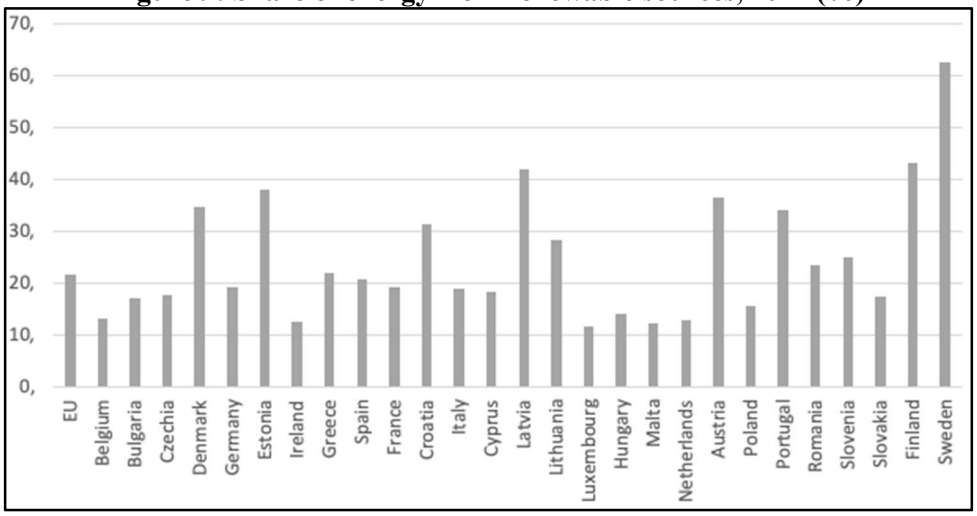
Source: Author according to the Eurostat database, 2023.

Final energy consumption increased sharply in 2021 (up to 968 Mtoe, +6.8 percent in comparison to 2020), but it was with 1,8% lower in comparison to 2019. The level in 2021 is 14.4 %, higher compared with the 2030 target.

3.3. Renewable energy

The share of renewable energy consumption in 2021 reached 21.8 % (Figure 9). This is a slight decrease compared with 2020 and the first decrease ever recorded.

Figure 9: Share of energy from renewable sources, 2021 (%)



Source: Author according to the Eurostat database, 2023.

In 2021, Sweden had the highest share of renewables (62.6 %), followed by Finland (43.1 %) and Latvia (42.1 %): the lowest level of renewables were recorded in Luxembourg (11.7 %), Malta (12.2 %), Netherlands (12.3%) and Ireland (12.5%). The difference is recorded due to the variations in the endowment of natural resources, especially in the potential for the construction of hydroelectric plants and the availability of biomass.

4. Conclusion

The energy policy is a shared competence between the EU and its Member States. Under the Treaties, the EU has a responsibility to ensure security of supply, while the Member States are responsible for establishing the structure of their energy supply and the choice of energy sources. EU legislation on the energy sector is linked to strengthening a single energy market, improving energy efficiency and promoting renewables to decarbonise the economy and meet the objectives of the Paris Agreement (Papież, et al., 2021).

The EU will retain a key role in monitoring security of supply during the energy transition from the old, centralised generation system, where fossil fuels predominate in national markets, to a new system characterised by a high share of renewable energy, more localised production and cross-border markets (Giampietro, et al., 2022). The Energy Union Strategy has placed an important focus on the proper functioning of the Single Market, as well as on the promotion of renewable energy and energy efficiency systems, which increase energy security by reducing dependence on imported fossil fuels (EC, 2015).

Our main finding is that ensuring a well-functioning energy system requires a continuous effort on the part of the EU and its Member States, involving increased vigilance as regards the reliability of suppliers in third countries, assessing how new supply routes (or closing old ones) could affect energy security, and determining whether energy agreements with third countries are in line with EU objectives.

References:

[1] European Commission, 2019, Communication From The Commission To The European Parliament, The European Council, The Council, The European Economic And Social Committee And The Committee Of The Regions: The European Green Deal. Available at: https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF

[2] European Commission, 2015, Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee, The Committee Of The Regions And The European Investment Bank A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2015:80:FIN

[3] Eurostat, 2023, Shedding light on energy - 2023 edition. Available at: https://ec.europa.eu/eurostat/web/interactive-publications/energy-2023#expandable-example-content

[4] Giampietro, M., & Bukkens, S. G. (2022). Knowledge claims in European Union energy policies: Unknown knowns and uncomfortable awareness. Energy Research & Social Science, 91, 102739.

[5] Hainsch, K., Löffler, K., Burandt, T., Auer, H., del Granado, P. C., Pisciella, P., & Zwickl-Bernhard, S., 2022, Energy transition scenarios: What policies, societal attitudes, and technology developments will realize the EU Green Deal?. Energy, 239, 122067.

[6] Hafner, M., & Raimondi, P. P., 2020,. Priorities and challenges of the EU energy transition: From the European Green Package to the new Green Deal. Russian Journal of Economics, 6(4), 374-389.
[7] Igliński, B., Pietrzak, M. B., Kiełkowska, U., Skrzatek, M., Gajdos, A., Zyadin, A., & Natarajan, K., 2022, How to Meet the Green Deal Objectives—Is It Possible to Obtain 100% RES at the Regional Level in the EU?. Energies, 15(6), 2296.
[8] Papież, M., Śmiech, S., & Frodyma, K., 2021, The role of energy policy on the decoupling processes in the European Union countries. Journal of Cleaner Production, 318, 128484.
[9] Tutak, M., Brodny, J., & Bindzár, P., 2021, Assessing the Level of Energy and Climate Sustainability in the European Union Countries in the Context of the European Green Deal Strategy and Agenda 2030. Energies, 14(6), 1767.

Quo Vadis the Common Agricultural Policy amid Tomorrow's Challenges?

ANDREEA - EMANUELA DRĂGOI, PhD.
Institute for World Economy, Romanian Academy
13 September Street, No. 13th, Bucharest
ROMANIA
andreeadragoi@iem.ro, https://iem.ro/

Abstract: Under the current economic environment, shaped by the widespread consequences of the war in Ukraine, the European Union's agricultural sector and its rural development policy are facing numerous challenges with significant impact on agricultural production, food security and the welfare of the European farmers. This research paper aims to investigate the Common Agricultural Policy's (CAP) response to those challenges in the current financial framework (2023-2027) using a comparative analysis based on the published CAP Strategic Plans (CSP) of the Member States. To this purpose our methodological approach will use a series of indicators selected for highlighting the measures proposed in various Member States to increase food security, to boost sustainable agricultural production and to protect the farmers' income. Our main objective is to illustrate the future of CAP funding using as case study Romania's approved CSP, while presenting the specific measures proposed in this country to support its agricultural sector among the challenges brought for its farmers by the current economic international context.

Keywords: Common Agricultural Policy, European Union, CAP Strategic Plan, food security, the war in Ukraine

JEL Classification: Q1, Q10, Q13, Q15, Q19

1. Introduction – the war in Ukraine and its consequences for the Common Agricultural Policy

The war in Ukraine became not only a disruptive factor for the international geopolitical stability through the numerous sanctions imposed on the aggressor state (the Russian Federation), but also a major game changer for the evolution of the global value chains. For the purpose of this research, our analysis is limited to highlighting its impact on a specific sector - the European Union (EU)'s agricultural sector through a mixed research design. On the one hand, we will present a comparative analysis of the CSP approved in the EU (between September 2022 and April 2023), and, on the other hand, we will highlight through a case study the challenges that Romania intends to address through its own CSP for protecting its famers and its agricultural sector in the current international economic turmoil generated by the war in Ukraine.

Presently, there are numerous studies underlying the consequences of the war in Ukraine for the international economic environment (Guenette et al., 2022; Orhan, 2022; Kammer et al., 2022). While many of these studies are related to the sanctions impacts (imposed to Russian Federation) on energy and financial sectors (Żuk & Żuk, 2022; Benton, 2022; Girardone, 2022; Khudaykulova et al., 2022), there are some (Glauben et al, 2022; Chepeliev et al, 2023) depicting the consequences of war for the international trade and for specific economic sectors (such as service, agricultural and even IT).

The war in Ukraine has generated a geopolitical volatile world, were the EU must find the optimum approach to protect its interests while remaining faithful to the preservation of principle of international law (in this case the respect for the sovereignty and territorial integrity of the Ukraine). The war in Ukraine's impact for EU's agricultural sector is presently flowing through many channels: higher commodity prices for energy (with impact on agricultural production), disrupted trade and supply chains (for essential inputs such fertilizers) and higher investor uncertainty preventing some farmers to access loans or grants for developing their farms.

As a major game changer the war has shaped also the core interests of EU's largest and most powerful common policy, namely the Common Agricultural Policy (CAP). For the EU's agricultural sector the war has brought significant changes that the CAP must now address as many recent studies in the literature have underlined (Détang-Dessendre, 2023; Rabbi et al, 2023; Galanakis, 2023).

It should be noted that while the current financial framework of CAP (2023-2027) must also address the post-pandemic induced vulnerabilities of the EU's rural areas *we believe that there are three major challenges brought by the war that will significantly shape the future CAP.*

Firstly, the war has created a supply shock for agricultural markets. Many agricultural business must now find alternative energy sources if they relied previously on Russian energy imports and hence agricultural and farms production has significantly decreased.

Secondly, the calculation of the shock magnitude and effect on upstream production shows the occurrence of cascade effects. Because of the increased energy prices many agricultural products have now higher prices hence leading to a trade deterioration regarding the agricultural products.

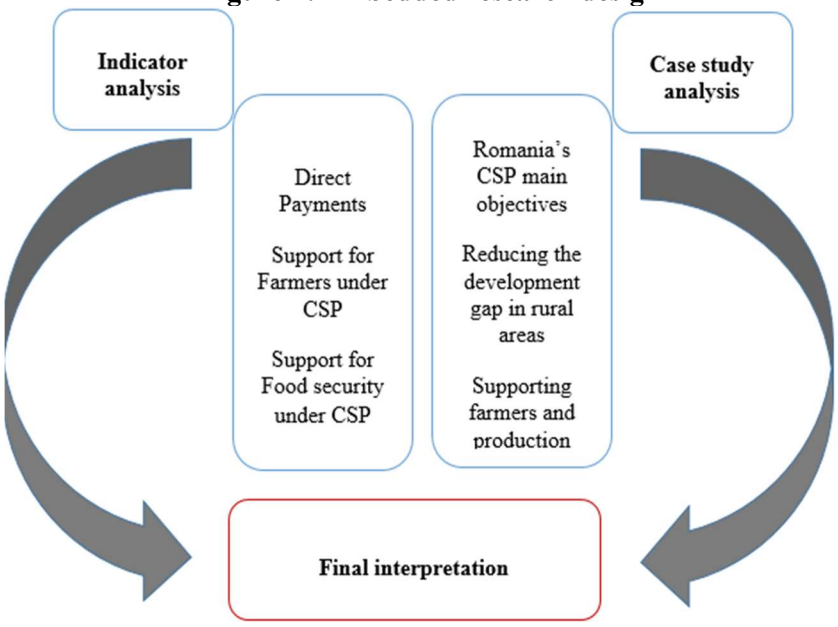
Thirdly, the farmers' incomes have been also severely deteriorated.

In view of all mentioned previously, we believe that while remaining faithful to its green ambitious the future CAP must now take into consideration the new challenges brought by the war in Ukraine in two key fields: food security and famers' income. Luckily tough thoroughly regulated, as stated by some recent analyses (Hasler et al., 2022), CAP is now also proposing a flexible and adaptive approach (Labarthe & Beck, 2022) through its newest financial tool – the CSP. This tool allows to all the Member States a balanced approach between sustainable rural development and food security while enhancing the support for agricultural production.

2. Methodology, objectives and limitation of the current research

Our research design is a mixed one (Figure 1) using a comparative analysis and a case study. The comparative analysis uses the data published by the DG Agriculture and Rural Development regarding the approved CSP of all the Member States during 2022 – 2023. The selected data will be grouped in two categories related to the two pillars of CAP and our analysis aims to depict how the finance has shifted in order to increase production, support for farmers income and food security. The case study relies on Romania's CSP.

Figure 1: Embedded research design



Source: Author representation.

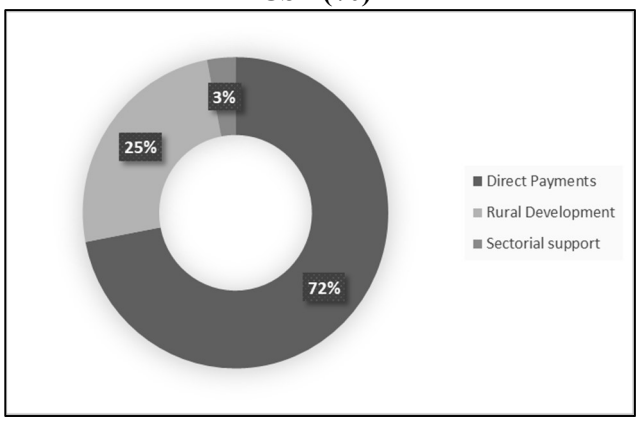
The limitation of the current research is linked to the flexibility of the CSP approach. According with CAP legislative framework, Member States can easily switch funds between the two pillars, hence the published data from current CSP could change amid new crisis or external shocks. According with Commission Delegated Regulation 2023/370 the Member States can amend their CSP in case of emergencies due to natural disasters and catastrophic events without any administrative burden (EC, a, 2023).

3. CAP Strategic Plan – a comparative approach across the Member states

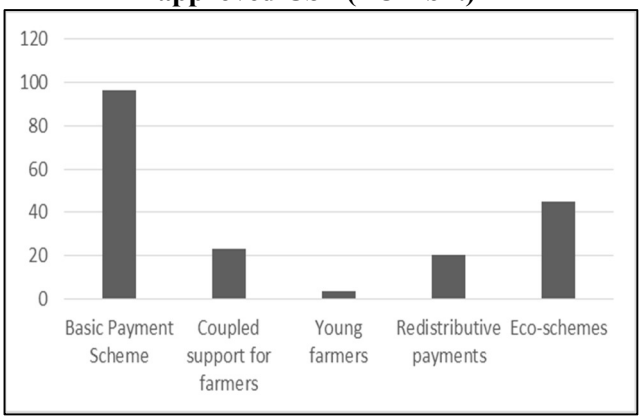
According with the most recent data published by DG Agriculture and Rural Development (2023) the first CSP started to be approved on August 2022 and the latest on April 2023. Currently all the Member States

have their plans approved. A comparative analysis of the approved CSP shows a balanced approach between green ambitious and food security objectives. The war in Ukraine has led to an increase interest from the majority of EU countries for production support and farmers' income support. Those two objectives will be financed mostly through the I Pillar using the Direct Payments tool. Funding from the CAP Strategic Plan is carried out from both pillars through the EAGF and EAFRD and must follow the principles of sustainability, but can also be directed towards specific objectives and challenges existing in the rural areas of the Member States. The Direct Payments remain in all the approved CSP the preferred tool for financing agriculture and rural areas across EU (Graph 1).

Graph 1: Share of Direct Payments in approved CSP (%)



Graph 2: The support for farmers' income in approved CSP (EUR bn.)

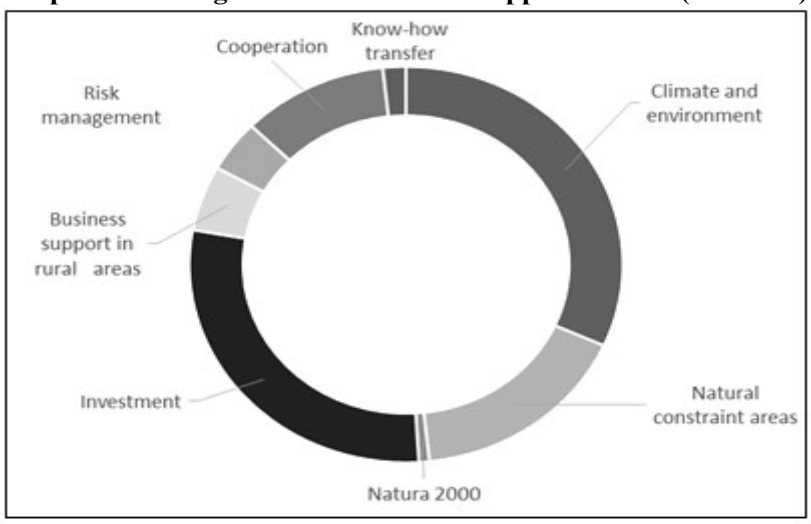


Source: Author based on data published by DG Agriculture and Rural Development, 2023, https://agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans/approved-csp-0_en (2023).

Within Direct Payments, the funding goes to a series of specific objectives such is the basic payment per hectare, couples support, farmers support and eco-schemes (designed to sustain green objectives such as ecological agriculture, organic farming, and grassland preservation).

We may see in Graph 2 that while the support for farmers' income remain important, the Member States have also choose to prioritise the green objectives using eco-schemes. In the second pillar of CAP the majority of funding goes on green objectives hence contributing to a more sustainable rural development, but significant funds are also allocated to investment and know-how to boost the European agricultural production (Graph 3).

Graph 3: Funding in the II Pillar in all approved CSP (EUR bn.)



Source: Author based on data published by DG Agriculture and Rural Development, 2023, https://agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans/approved-csp-0_en (2023).

The comparative analysis of all approved CSP shows a mixed approach between a greener CAP and a fairer CAP, all the Member States granting important funds for attracting young farmers in rural areas, reducing farming income gap, but also supporting the green development through eco-schemes (Graph 3).

The approved CSP are also showing an increased interest for increasing the competitiveness of European farms allowing farmers to work together to strengthen their position in the food supply chain. This new approach will includes derogations from higher sustainability standards as well as possibilities for supply regulation for foodstuffs with protected geographical names, hence encouraging European agricultural production.

This new paradigm clearly show that while the green path of CAP remains important, its future is also undeniable linked to a strong support for production, farmers and food security hence delivering one of the first commitments of this common policy: to provide quality food at affordable prices for all the EU's citizens.

The tomorrow's CAP has at its core the interests of EU's farmers, while the income support ranks high in all Member States funding in both pillars. Through the current CAP regulation reducing the income gap become possible firstly though Basic Payment Scheme but also though other types of Direct Payments. Firstly, the Member States may apply up to 85% reductions for amounts exceeding EUR 60,000 applicable to the basic income support received by a single farm. Secondly, Member States may allow the subtraction of farm salary costs - including unpaid (family) work - from the amount of direct support to ensure that farm employment is not unduly affected and thirdly while they may also impose an upper cap on the amount received, at EUR 100.000 any savings from reduction/capping will stay within their national CAP budgets.

As shown by the comparative analysis regarding all approved CSP the Member States prioritized agricultural production and support for farmers' income without jeopardizing the green development objectives. Such balanced approach was possible due to the new flexible architecture of CAP that enables a funding design according to each state specific challenges and objectives for agriculture and rural areas.

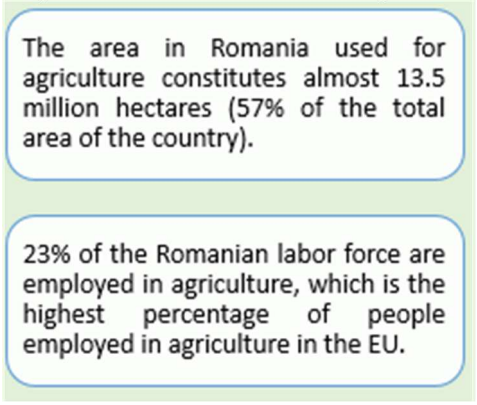
A preliminary assessment of the published CSP also shows an increased support for the fair funding and social cohesion in rural areas. Such objectives are key for a sustainable and equitable development of rural areas across EU especially since the post-pandemic era saw a sharpening of development gaps against the background of certain imbalances that were exacerbated due to the limitations and restrictions imposed during the pandemic period. Even if the rural communities response to all the post-pandemic challenges shows a strong resilience, new crisis such the one generated by the war in Ukraine require new support measures for EU's agricultural sector.

Some demand-supply imbalances that started during pandemic are now worsening against the disrupting effects of the war on the global value chains. A recent study published by the European Commission show that the war in Ukraine continues to impact EU farmers amid uncertainties about energy supply for the next winter and recent financial market tensions. (European Commission, b, 2023). Although fertilisers, especially nitrogen-based ones, could become more available and affordable compared with 2022, the prices are still high compared with previous situation before the war, hence farmers must adapt opting for crops with lower fertiliser needs. Financial support for farmers is needed also for countering high input costs and farm income loss.

4. Measures to support the farmers and the agricultural production under CSP – the case of Romania

The analysis of Romania's CSP shows that in this state where the agricultural activity is still a very large part of the economic activity attracting a large but aging work force (Figure 2) there is a mixed approach for sustainable development and support for national production.

Figure 2: Romania's particularities and their implication for national CSP



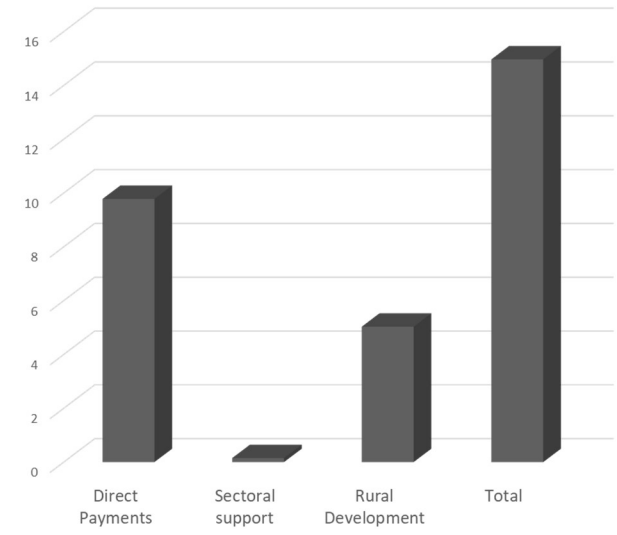
Romania is also one of the countries with the highest share of farmers over 65 years (44.3%).

Source: Author based on Romania's CAP Strategic Plan.

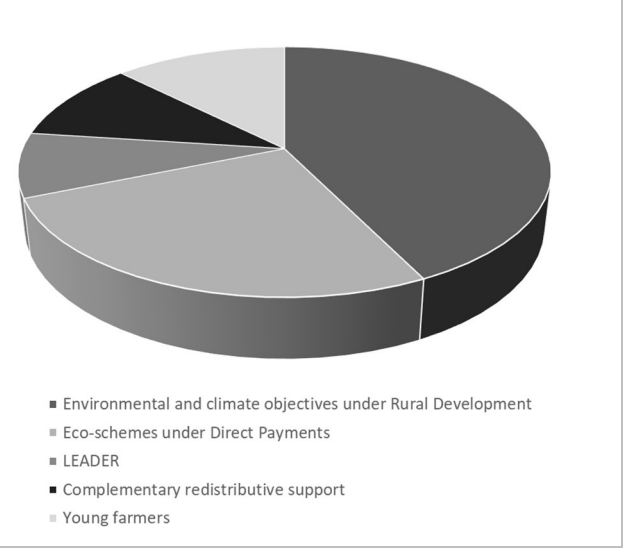
Romania has some vulnerabilities regarding its agricultural sector (aging farmers, lack of significant farm modernization, fragmentation of rural propriety, the large number of subsistence farms), but also opportunities (large fertile land, important workforce). Hence Romania's Plan aims to address these challenges through targeted measures to support both rural development and agricultural production. Some studies (Stângă et al., 2012; Filimon et al., 2024) have underlined that any strategic approach concerning the fair and sustainable development of Romania's rural areas should focus on boosting the competitive and green agriculture while also encouraging the diversification of rural economic activities (e.g. rural tourism, rural business based on traditional crafts).

The strategic objectives of Romania's Plan are to develop through Direct Payments a resilient and sustainable agricultural sector by increasing the economic viability of farms, reducing income disparities between farms and increasing the market orientation and competitiveness of the agricultural sector as a whole (see Graph 4). The plan will also support farmers who contribute to protecting the environment, increasing the welfare of farm animals and ensuring a coherent socio-economic development of rural areas (Graph 5).

Graph 4: CSP funding EUR bn.



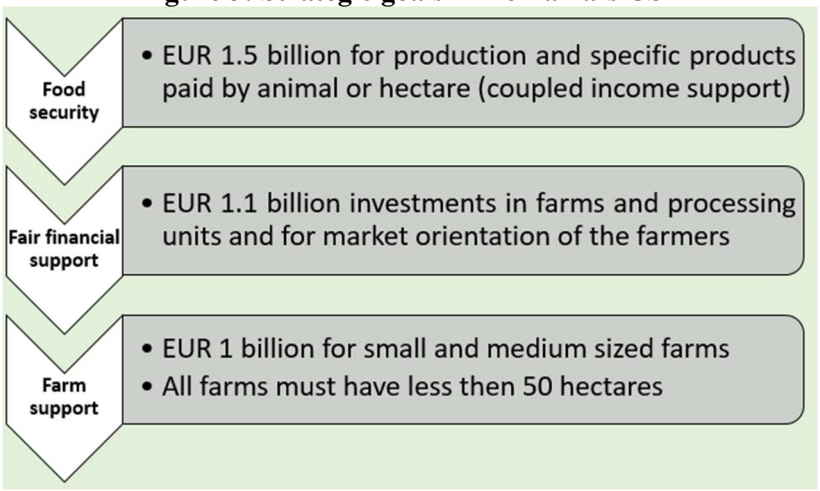
Graph 5: CSP main objectives (%)



Source: Author based on Romania's CSP.

According with the amounts allocated in Romania's CSP for the major objectives we may see a balanced approach between food security and farm support (Figure 3). The farm support is vital for increasing both the agricultural production and reducing farmers' income gap at national level, while granting funds for young farmers could help mitigate the challenges created by the ageing population trend in Romania's rural areas. As some studies have revealed (Kulcsár & Brădăţan, 2014) creating financial opportunities for young farmers could be a solution to reduce the negative impact of the ageing population on rural community well-being while also improving the social cohesion in rural areas of Romania. Preserving food security amid current geopolitical turmoil represents also a strategic objective in national CSP (Figure 3). Such approach is all the more justified since, as recent studies (Sohag et al., 2022) have shown the Russia – Ukraine war has impacted both food prices and food security in neighbouring countries and at global level. Moreover, while the war in Ukraine unfolds without any hope for a potential end in the near future, farmers must be protected against some of its major consequences such as increased energy prices, lack of fertilizers, disruption of logistics and food supply chains, access to agricultural inputs (Jagtap et al., 2022).

Figure 3: Strategic goals in Romania's CSP



Source: Author based on Romania's CAP Strategic Plan.

Through its CSP Romania will allocate important funds for green development in its rural areas. According to its CSP 25% of the Direct Payments will go to the eco-schemes, which represent incentives to farmers that go beyond the legal requirements or usual practice in terms of climate and environment.

Significant support (41% of the rural development budget) will also be used to encourage environmentally friendly practices for areas with high natural value, for example areas that are important for the life of birds and butterflies. Annually, farmers are expected to apply these practices on 611,000 hectares of land. Moreover Romania's Plan will support the creation of more than 12,000 jobs in rural areas. Entrepreneurship in rural areas will be promoted through support for farmers that want to diversify their activities (also through non-agricultural activities). LEADER, which is a community-led local development approach bringing together public, private and civil-society stakeholders to find shared solutions for rural areas, is one of the key interventions of the Plan.

In this framework, 206 local development strategies will be put in place (with a support of EUR 500 million), reaching 86% of the rural population.

Considering the size of the livestock sector in Romania, the CSP sets very ambitious targets for the improvement of animal welfare. The support will concern the rearing of pigs, poultry, laying hens and reproductive hens, milking cows and calves with funding up to EUR 884 million for all the dedicated interventions under eco-schemes and rural development measures.

Almost 5 million livestock units will benefit from enhanced animal welfare standards, such as increasing the space of animals in stables, providing better bedding materials and increasing the quality of air.

The analysis of financial allocations in Romania's CSP highlight a fair and equitable distribution of funds (see Figure 3). The Plan is designed not only to accelerate the transition to a sustainable and resilient agricultural sector but also to fairly distribute funds for small farms and young farmers. Romania's CSP also support farmers to adopt innovation from precision farming to agro-ecological products. Through its proposed measures Romania's CSP may become a cornerstone for food security and for farming communities.

However, as shown by the European Commission's observation letter concerning Romania's CSP (European Commission, b, 2023) the support for climate ambitions could be increased while the fairer distribution of Direct Payments (especially from bigger to smaller and medium-size farms, possibly through the use of capping) could also be improved.

Also there is still need for increase funding for organic farming while only only 3.53% of the Utilised Agricultural Areas (UAA) is allocated to this objective according with Romania's CSP.

While Romania's commitment to increase its green architecture in the CSP could increase, the European Commission's evaluation shows that Romania should aim at a closer fit of LEADER (the community-led local development) with the identified needs of socio-economic fabric of rural areas.

The evaluation of Romania's CSP also shows that while the animal welfare interventions under both pillars cover a wide range of species with an ambitious target in number and budget there is still need for improvement especially since many objectives are too generic. Romania could also include specific interventions and detailed actions to address the need to increase biosecurity in the entire animal sector, in particular in small

and medium commercial farms (for instance increased control actions for the prevention, control, and eradication of African swine fever (ASF).

Also another vulnerability of Romania's CSP is the lack of a strategy for better supporting the digitalisation in farming and rural areas. Some studies (Ilie et al., 2022) have highlighted that the smart village could be the answer for many of the rural areas vulnerabilities related to economic growth and employment. While the local initiatives could bring significant progress in the field of digitalisation in farming and rural economic activities, it should be noted that the lack of a national coordinated approach prevents reaching the real development potential in this field (Matei & Iordache, 2016).

Finally, we believe that a comprehensive rural development strategy should address all the current challenges (the existing imbalances on cereal market caused by the war in Ukraine), but without abdicating from the *no-backsliding principle* related to the green ambitious of the CAP. As the war in Ukraine poses significant challenges for agricultural trade and food security (Ben & El Bilali, 2022), Romanian authorities must find the best solutions for protecting the national agricultural production while supporting Ukraine's just cause (currently Romania is allowing only the transit but not the import of wheat, corn, sunflower and rape originating in Ukraine).

The rural areas may bring a huge potential for Romania's future economic growth while the flexible approach facilitated by the EU's regulations on the CSP presents significant opportunities for an equitable and green national agenda for agriculture and rural development.

5. Conclusion

The war in Ukraine was definitively a game changer not only for the geopolitical framework but also for the economic strategies in EU and in all Member States. CAP has also shifted its approach to better support the EU's agriculture and the European farmers through the current economic turmoil.

Our main finding is that the war in Ukraine has underlined the importance of preserving food security and stable value chains for the agricultural products hence many Member States have designed their CSP accordingly, providing specific support for production, young farmers and small farms.

Our second finding is that, in Romania's case the new CAP bring important opportunities for the long term development of its agricultural sector and rural areas. While pursuing the important objective of greening its rural policies, Romania may also grant significant support to young farmers and small farms while targeting a fairer and socially sustainable incentive policy for its rural areas. Romania's approved CSP aims to increase the profitability of the agricultural sector (that is lower compared with other MS) by increasing farms' profitability, productivity, market orientation and encouraging younger generations to take up agricultural activities.

Also, the analysis of Romania's strategic objectives for 2023-2027 is showing that the CSP is targeting the development of a resilient and sustainable agricultural sector by increasing the economic viability of farms, reducing income disparities between farms and increasing the market orientation and competitiveness of the agricultural sector as a whole. Romania's CSP will also support farmers who contribute to protecting the environment, increasing the welfare of farm animals and ensuring a coherent socio-economic development of rural areas, hence contributing to the broader green ambitious of CAP in the current financial framework.

The future of CAP funding in Romania will be shaped by the green ambitious and food security desiderates, while significant challenges remains due to the dual structural character of agricultural holdings in Romania (where an extremely high number of small farms coexist, with large competitive farms). In our opinion some targets regarding the green ambitious could be improved, while specific measures and interventions may be added in the animal welfare sector. While Romania's CSP aims to contribute effectively to the strengthening of the socio-economic fabric of rural areas, there is not very clear how this objective may be achieved while the proposed measures are targeting only partially the identified needs of rural areas. The flexibility of the new CAP will most likely allow a better tailored approach in the following years while Romanian authorities could improve some of the initial measures of the CSP.

References:

[1] Benton, T. G., Froggatt, A., Wellesley, L., Grafham, O., King, R., Morisetti, N., Nixey, J., Schröder, P. (2022). The Ukraine war and threats to food and energy security. *Chatham House—International Affairs Think Tank*. https://www.chathamhouse.org/2022/04/ukraine-war-and-threats-food-and-energy-security

[2] Ben Hassen, T., & El Bilali, H. (2022). Impacts of the Russia-Ukraine war on global food security: towards more sustainable and resilient food systems?. *Foods*, *11*(15), 2301.

[3] Chepeliev, M., Maliszewska, M., & Pereira, M. F. S. E. (2023). The war in Ukraine, food security and the role for Europe. *EuroChoices*, *22*(1), 4-13. https://onlinelibrary.wiley.com/doi/full/10.1111/1746-692X.12389
[4] Détang-Dessendre, C. (2023). Evolving the Common Agricultural Policy for Tomorrow's Challenges. *Evolving the Common Agricultural Policy for Tomorrow's Challenges*, 1-100. https://www.torrossa.com/en/resources/an/5466896
[5] DG Agricultural and Rural Development (2023). Approved CAP Strategic Plans. https://agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans/approved-csp-0_en
[6] European Commission (a) (2023). Commission Delegated Regulation 2023/370 supplementing Regulation (EU) 2021/2115 of the European Parliament and of the Council with regard to procedures, time limits for submission by Member States of requests for amendments of CAP Strategic Plans, and further cases for which the maximum number of amendments of CAP Strategic Plans does not apply. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R0370
[7] European Commission (b) (2023). *Short-term outlook report: war in Ukraine continues to impact EU farmers*. https://agriculture.ec.europa.eu/news/short-term-outlook-report-war-ukraine-continues-impact-eu-farmers-2023-03-30_en
[8] European Commission (c) (2023). Observations on the proposal by Romania for a CAP Strategic Plan 2023-2027 - CCI: 2023RO006AFSP001. https://agriculture.ec.europa.eu/system/files/2022-07/observation-letter-romania_en.pdf
[9] Filimon, C., Filimon, L., & Nemeş, V. (2014). Agriculture between identity and vulnerability. The case of Ţara Beiuşului (Beiuş Land). *Analele Universităţii din Oradea, Seria Geografie*, *24*(1), 23-31.
[10] Galanakis, C. M. (2023). The "vertigo" of the food sector within the triangle of climate change, the post-pandemic world, and the Russian-Ukrainian war. *Foods*, *12*(4), 721. https://www.mdpi.com/2304-8158/12/4/721
[11] Girardone, C. (2022). Russian sanctions and the banking sector. *British Journal of Management*, *33*(4), 1683-1688. https://onlinelibrary.wiley.com/doi/full/10.1111/1467-8551.12656
[12] Glauben, T., Svanidze, M., Götz, L., Prehn, S., Jamali Jaghdani, T., Đurić, I., & Kuhn, L. (2022). The war in Ukraine, agricultural trade and risks to global food security. *Intereconomics*, *57*(3), 157-163. https://link.springer.com/article/10.1007/s10272-022-1052-7
[13] Guenette, J. D., Kenworthy, P. G., & Wheeler, C. M. (2022). Implications of the War in Ukraine for the Global Economy. https://thedocs.worldbank.org/en/doc/5d903e848db1d1b83e0ec8f744e55570-0350012021/related/Implications-of-the-War-in-Ukraine-for-the-Global-Economy.pdf
[14] Hasler, B., Termansen, M., Nielsen, H. Ø., Daugbjerg, C., Wunder, S., & Latacz-Lohmann, U. (2022). European agri-environmental policy: Evolution, effectiveness, and challenges. *Review of Environmental Economics and Policy*, *16*(1), 105-125. https://www.journals.uchicago.edu/doi/abs/10.1086/718212
[15] Ilie, N. M., Oprea, I. A., Turcea, V. C., & Părnuș, A. R. (2022). New dimensions of rural communities'development in Romania–smart village concept. *Scientific Papers: Management, Economic Engineering in Agriculture & Rural Development*, *22*(2).
[16] Jagtap, Sandeep, Hana Trollman, Frank Trollman, Guillermo Garcia-Garcia, Carlos Parra-López, Linh Duong, Wayne Martindale et al. "The Russia-Ukraine conflict: Its implications for the global food supply chains." *Foods* 11, no. 14 (2022): 2098.
[17] Kammer, A., Azour, J., Selassie, A. A., Goldfajn, I., & Rhee, C. (2022). How war in Ukraine is reverberating across world's regions. *Washington: IMF, March*, *15*, 2022. https://www.imf.org/en/Blogs/Articles/2022/03/15/blog-how-war-in-ukraine-is-reverberating-across-worlds-regions-031522
[18] Khudaykulova, M., Yuanqiong, H., & Khudaykulov, A. (2022). Economic consequences and implications of the Ukraine-russia war. *International Journal of Management Science and Business Administration*, *8*(4), 44-52. https://researchleap.com/economic-consequences-and-implications-of-the-ukraine-russia-war/#:~:text=The%20current%20Russia%2DUkraine%20war,Loh%20and%20Tang%2C%202020).
[19] Kulcsár, L. J., & Brădăţan, C. (2014). The greying periphery—Ageing and community development in rural Romania and Bulgaria. *Europe-Asia Studies*, *66*(5), 794-810.
[20] Labarthe, P., & Beck, M. (2022). CAP and Advisory Services: From Farm Advisory Systems to Innovation Support. *EuroChoices*, *21*(1), 5-14.
[21] Orhan, E. (2022). The effects of the Russia-Ukraine war on global trade. *Journal of International Trade, Logistics and Law*, *8*(1), 141-146. http://jital.org/index.php/jital/article/view/277
[22] Rabbi, M. F., Ben Hassen, T., El Bilali, H., Raheem, D., & Raposo, A. (2023). Food Security Challenges in Europe in the Context of the Prolonged Russian–Ukrainian Conflict. *Sustainability*, *15*(6), 4745. https://www.mdpi.com/2071-1050/15/6/4745
[23] Sohag, K., Islam, M. M., Tomas Žiković, I., & Mansour, H. (2022). Food inflation and geopolitical risks: analyzing European regions amid the Russia-Ukraine war. *British Food Journal*.
[24] Stângă, I. C., & Grozavu, A. (2012). Quantifying human vulnerability in rural areas: Case study of Tutova Hills (Eastern Romania). *Natural Hazards and Earth System Sciences*, *12*(6), 1987-2001.
[25] Żuk, P., & Żuk, P. (2022). National energy security or acceleration of transition? Energy policy after the war in Ukraine. *Joule*, *6*(4), 709-712. https://www.sciencedirect.com/science/article/pii/S2542435122001362

The RDI System in Romania as Compared to Other Member States of The European Union

OANA CHINDRIȘ-VĂSIOIU
Structural Changes in the Global Economy
Institute for World Economy, Romanian Academy
13 September no.13, Bucharest
ROMANIA
oana.vasioiu@gmail.com

Abstract: Research, technological development and innovation contribute directly to Europe's prosperity and well-being of citizens and society. The European Union has a leading role in the international science and technology. In terms of innovation, Romania belongs to the group of emerging innovative countries in the European Union. Its RDI system has interrelated shortcomings, being at a considerable distance even from the countries in the group of emerging innovators. Against this background, this paper analyses key factors that hinder innovative activities in Romania, as well as the position occupied in the European rankings as compared to the group of innovative leader countries, but also with the group of emerging innovative countries. The methodology used in the research topic is qualitative, with specific methods (document analysis, comparative analysis), but also quantitative. The objective of the paper is to identify, present and analyse innovation barriers in Romania compared to other member states of the European Union. The work also has certain limitations, and the most important one is that the data available at this moment in the European databases are up to the level of the years 2020-2021.

Keywords: research, development, innovation, PhD graduates, "knowledge intensive" activities, economic forecast.

JEL Classification: C53, D80, O30, O31.

1. Introduction

Investing in research, development and innovation (RDI) means investing in Europe's future. These investments help EU to compete globally while preserving its unique social model. They have a large contribution to well-being in Europe and around the world, helping to solve some of the major societal challenges. It is important to prioritize investments in RDI to create more and better jobs in Europe, to improve the quality of life and to increase the competitiveness of the EU economy. The EU is one of the global leaders in this regard, as almost two-thirds of its economic growth in recent decades has been generated by innovation. In addition, the EU has a share of almost 20% of global RDI investment and wants to increase its spending on research and development. According to Grassano et al. (2022), the technology race intensified in 2021 with EU companies showing a recovery, US and Chinese companies continuing to increase sharply their R&D investments and Japanese companies following behind. As a result, the share in global R&D investment of EU companies decreased to 17.6% while that of US companies reached 40.2% in 2021. Chinese companies continued to increase their R&D share sharply, reaching 17.9%. In contrast, Japanese companies' share of global Scoreboard R&D continued to shrink (10.4%).

Innovation has become the symbol of modern society, a solution for solving many problems and a phenomenon that must be studied. Innovation gained real importance in the 20th century. Innovation does not represent just the implementation of new ideas or methods, but it can be defined as a process involving multiple activities to discover new ways of doing things. For this reason, innovation is so important in the socio-economic development of a country.

This paper analyses the indicators regarding the RDI system in Romania and have been forecasted the trends of these indicators until the year 2030. Ranga (2018) emphasized the important role that smart specialization has in catalysing the development of regional innovation systems at an early stage in less advanced regions, by facilitating the emergence of some defining elements that were missing or by accelerating the

development of existing ones. Ranga (2018) and Scutaru, Prelipcean & Cozorici (2019) studied the opportunities for exploitation of Romania's competitive advantages by small and medium-sized enterprises (SMEs), through the development of innovative clusters, which stimulate the performance of research and development activities and increase the competitiveness of companies (Scutaru, Prelipcean & Cozorici, 2019). Şerbănica examined territorial innovation patterns in Romania, a country labelled as a "modest innovator" (Șerbănică, 2021).

2. Presentation of indicators

According to the European Innovation Scoreboard 2022, in terms of performance of the innovation system, Romania falls into the group of emerging innovative countries. With performance "well below the EU average" of 70%, Romania lags behind the innovation's leaders, strong innovators and moderate innovators, but also behind all the other EU member states included in the same group, namely: Hungary, Croatia, Slovakia, Poland, Latvia and Bulgaria (European Commission, 2022a). It is important to mention the over-fragmentation of the system of public organizations performing RDI. This 'system' is not a system, but a constellation of institutions of various types and origins, which are the product of historical developments (European Commission, 2022b).

Performance is measured through a set of indicators classified in the following categories: human resources, attractive research systems, digitalisation, finance and support, firm investments, use of information technologies, innovators, linkages, intellectual assets, employment impact, sales impact and environmental sustainability. In this paper are taken into account the following four indicators, these being the ones that raise the most significant problems in the field of RDI in Romania.

First, the number of PhD graduates is far below the target set by the Romanian authorities (3.000 per year) (Ministry of Research, Innovation and Digitization, Framework document regarding National Research Strategy, Innovation and Smart Specialisation 2021-2027, 2021). One of the main reasons is the low attractiveness of doctoral studies because the amount of money for those who get a scholarship is very small and the doctoral students have too little time left to complete their studies (they have to work as research assistants or in other fields to earn a living). This lack of coherence between ambition and the will to invest sufficiently in Romania's next generation of advanced human capital results in a very low graduation rate from doctoral schools in the country and a limited number of well-trained young researchers available for the Romanian research-innovation system. On the other hand, the labour market in Romania has difficulties in absorbing PhD graduates because most companies are SMEs without research or innovation departments (UEFISCDI, 2022a).

Most PhD graduates are purely academically oriented, and the current supply of PhD holders does not match the demand and absorptive capacity of the RDI labour market. In addition, the number of PhD graduates per capita followed a positive trend until 2013 (due to funding of PhD programmes through the European Regional Development Fund). However, since then it has steadily declined. Moreover, even the increased number of new PhD holders in the past has not been reflected in the increase in the number of researchers in science and technology.

Second, *RDI expenditure (both in the public and business sector)* is at a very low level in Romania, being only 0.47% of GDP the expenses made by the Romanian state even falling marginally. Currently, a package of financial facilities for research and development activities in Romania includes an additional deduction of 50% of the total expenses incurred for this purpose, accelerated depreciation of assets used for research and development purposes and an exemption from tax on employee incomes. It is worth noting that in Lithuania, Slovakia, Hungary, Poland and Croatia, additional deductions reach significant values (of up to 300% of total expenses).

The new target assumed by the authorities through the National Plan for Research, Development and Innovation in the period 2022-2027 is 2% of GDP. This target has the potential to create the conditions for the structural convergence of the national RDI system with the systems of the other European Union countries, with increased visibility, sustainability and impact. The public investment in RDI will also support the training of innovation in the private sector, contributing to Romania's innovation-based competitiveness and social cohesion (UEFISCDI, 2022a).

Third, there are few *companies in Romania that provide information and communications technology (ICT) training to their own staff*. To increase their productivity, it is necessary for companies, especially SMEs, to invest in the training of personnel in the ICT sector. One of the main benefits of training employees in ICT is the increase in business opportunities.

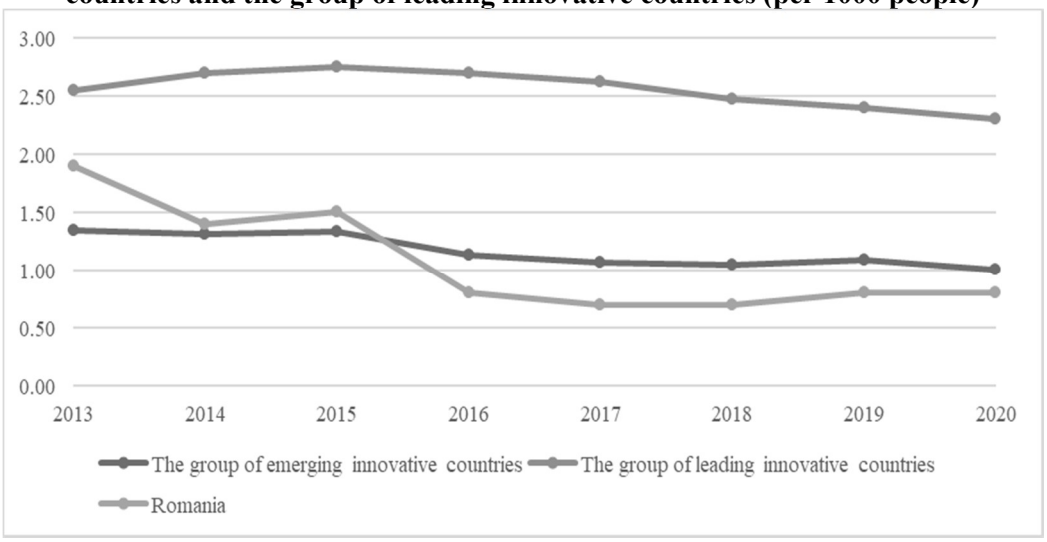
Fourth, employment in "knowledge intensive" activities in our country has a low share, although the number of employees of the largest "knowledge intensive" firms has seen a constant increase in the last decade. It is worth underlining that "knowledge intensive" services include activities carried out for the purpose of creating, acquiring and disseminating knowledge. The "knowledge intensive" service sector is at a high level in developed countries, in contrast to Romania.

In the following sections will be analysed the indicators mentioned above. The forecasts have been realized with special software.

3. Graduates of doctoral programs

The total number of PhD graduates in Romania has declined significantly over the past decade. If in 2013 Romania was above the European Union average in terms of the number of graduates of doctoral programs per thousand people, in 2020 our country was at a considerable distance below the EU average, standing at half of it (Chart 1). On the one hand, a significant decrease in doctoral graduates was registered in Romania in 2016 due to some legislative provisions (application of Government Decision 681/2011, in force since March 10, 2016) regarding the approval of the Code of doctoral university studies, by which were limited both the age of doctoral supervisors and the maximum number of doctoral students which could be coordinated simultaneously by a doctoral supervisor. On the other hand, in recent years, funding instruments for high-performing young researchers have been reduced, causing them to go abroad, to work in RDI in other European countries, or even to migrate to other economic sectors more attractive from a financial point of view. Recent research underscores the brain drain phenomenon, with its negative effects on the Romanian RDI system (European Commission, 2022b).

Chart 1: Graduates of doctoral programs in Romania, as compared to the group of emerging innovative countries and the group of leading innovative countries (per 1000 people)

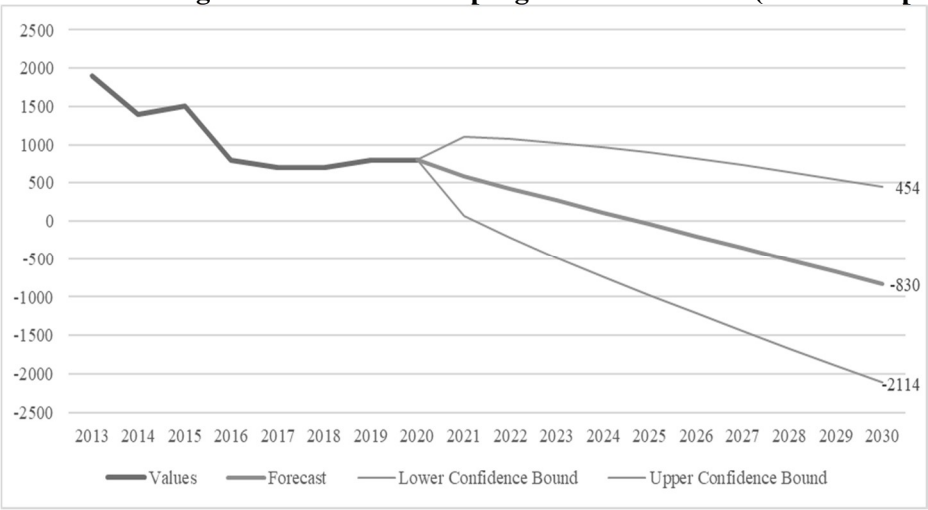


Source: Own representation based on https://ec.europa.eu/eurostat/databrowser/view/educ_uoe_grad06/default/table?lang=en

During the analysed period, one can observe the unfavourable evolution of doctoral graduates per 1000 people in our country compared to the group of emerging innovative countries. If between the years 2013-2015 Romania recorded a higher level compared to the countries in its group, during the period 2016-2020 our country constantly recorded levels of doctoral graduates below the average of the group of emerging innovative countries.

It is worth mentioning that during the analysed period the gap between Romania and the group of leading innovative countries deepened, the level of doctoral graduates in our country being one third compared to the average level of doctoral graduates from the group of leading innovative countries in 2020.

Chart 2: Forecast of graduates of doctoral programs in Romania (number of people)



Source: author own processing based on https://ec.europa.eu/eurostat/databrowser/view/educ_uoe_grad06/default/table?lang=en

Following the forecast made, it can be observed that in the current decade the downward trend of doctoral graduates is maintained, being able to appreciate that Romania will not reach the target of increasing the average number of doctoral graduates to 3000 per year in 2030, in the case of a natural evolution of the indicator (Chart 2).

4. Research-development-innovation expenses

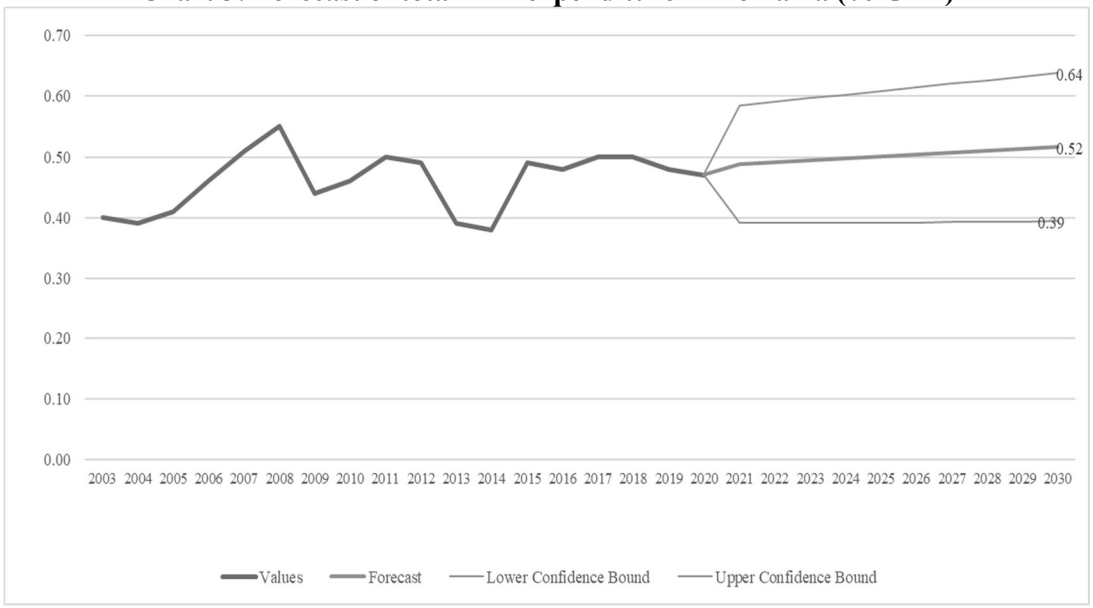
In a competitive society, RDI expenses must be looked at more carefully, their impact on the future development of the economy being essential. The most important premise for the development of the research-development-innovation sector is the investment intended for various relevant activities. According to the OECD, expenditure committed to RDI activities is an indicator of a country's efforts to drive innovation. These activities mainly cover three areas: basic research, applied research and experimental development. The indicator used to measure the intensity of specific activities is the total expenditure on research and development activity as a percentage of GDP. They represent, according to the definition of the National Institute of Statistics, a percentage of the expenses made by all sectors of a country for the research and development activity, in relation to the GDP, and provide the level of financial resources allocated to the development of the research activity. The indicator has the advantage of also allowing comparisons to be made between countries, a particularly important aspect in the context of highlighting the role that RDI plays in the economy (Eurostat, 2023).

In the specialized literature there are extended studies and investigations regarding the RDI sector in Romania. In order to bring elements of novelty, this research focuses on the own forecasts to analyse the achievement of the targets that our country proposed through the National Strategy for Research, Innovation and Intelligent Specialization 2022-2027 (UEFISCDI, 2022b).

The total expenditure on RDI in our country is below the average of emerging innovative countries, 2007-2008 being the only period in which Romania came close to the average of this group. Regarding the average RDI allocations in the leading innovative countries, we can appreciate that this is almost seven times higher than Romania's financial allocation.

The accelerated growth of investments in research-development-innovation opens opportunities for the structural integration of national RDI systems with other national systems of European countries to increase visibility, sustainability and impact. That is why we consider it important to analyse whether our country will reach the target of 2% of the Gross Domestic Product spent on research-development-innovation, a target assumed by the National Strategy for Research, Innovation and Intelligent Specialization 2022-2027.

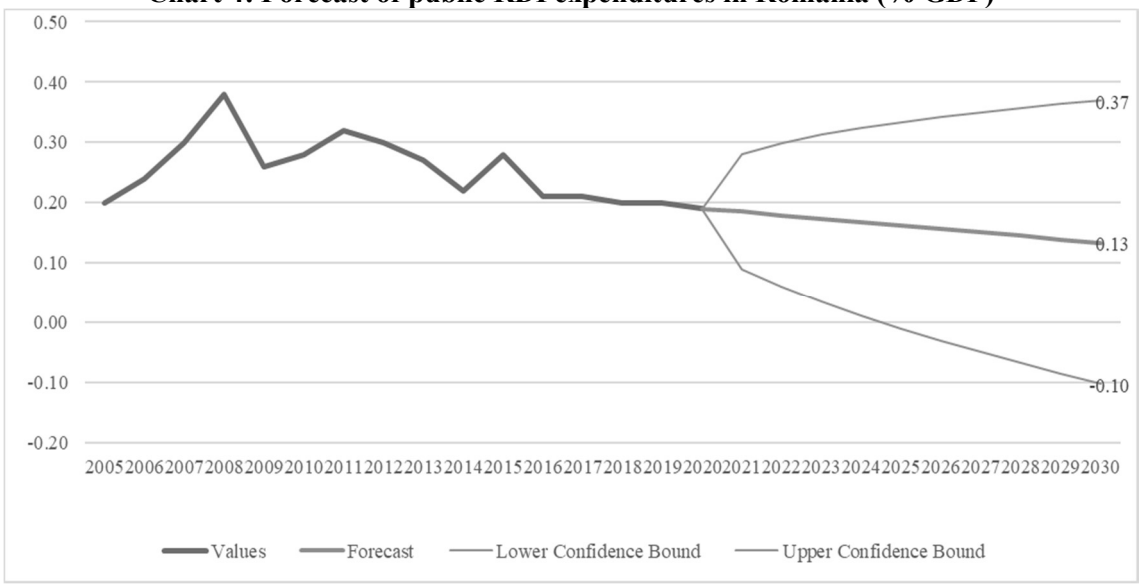
Chart 3: Forecast of total RDI expenditure in Romania (% GDP)



Source: author own processing based on https://ec.europa.eu/eurostat/databrowser/view/rd_e_gerdsc/default/table?lang=en

According to the forecast, the share of research-development-innovation expenses in Romania will be in the year 2030, with a probability of 95%, in the range of 0.39% - 0.64%, if the current evolution continues (Chart 3). The average forecasted value is 0.52%, thus resulting in a gap of 1.48% compared to the 2030 target. Thus, we can appreciate that our country will not be able to reach the 2030 target (2%) only through the simple natural evolution of the indicator.

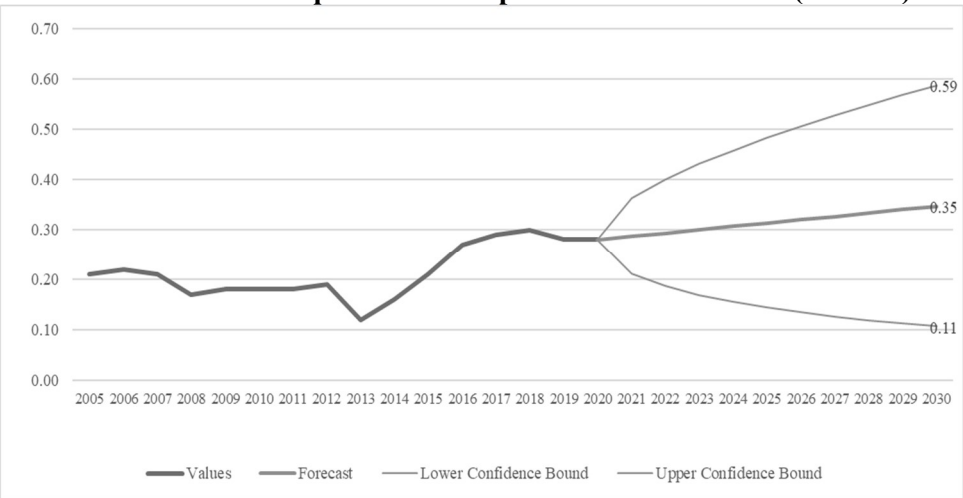
Chart 4: Forecast of public RDI expenditures in Romania (% GDP)



Source: author own processing based on https://ec.europa.eu/eurostat/databrowser/product/view/rd_e_berdcostr2?lang=en

Following the forecast, it turned out that the share of public expenditure on research-development-innovation in Romania will be in the year 2030, with a probability of 95%, in the range -0.10% - 0.37%, if a natural evolution will occur (Chart 4). The average forecast value is 0.13%, thus resulting in a gap of 0.87% compared to the 2030 target. Thus, we can appreciate not only that our country will not be able to reach the 2030 target (1%) only through the simple natural evolution of indicator, but the share of public RDI expenditures in the Gross Domestic Product will decrease by 0.06 percent.

Chart 5: Forecast of private RDI expenditures in Romania (% GDP)



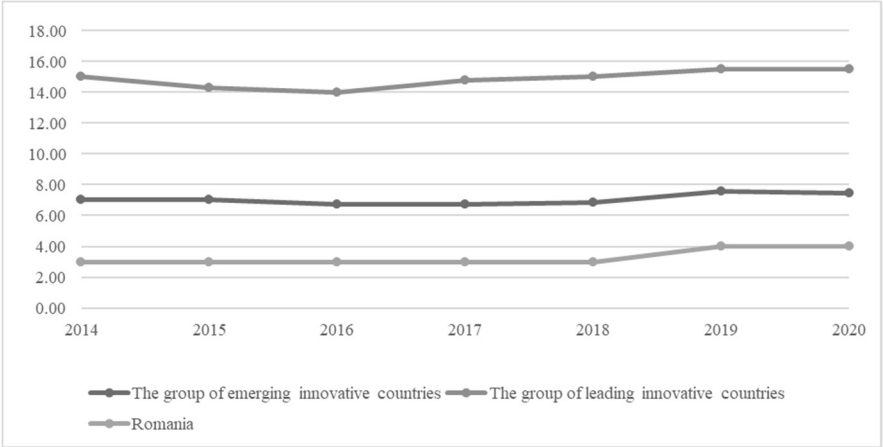
Source: author own processing Source: author own processing based on https://ec.europa.eu/eurostat/databrowser/product/view/rd_e_berdcostr2?lang=en

The forecast shows that the share of private expenditure on research-development-innovation in Romania will be in the year 2030, with a probability of 95%, in the range of 0.11% - 0.59%, if there is a natural evolution (Chart 5). The average forecast value is 0.35%, thus resulting in a gap of 0.65% compared to the 2030 target. Thus, we note that the share of private spending will increase slightly (by 0.07%), but we estimate that our country will not reach the 2030 target (1%) only through the simple natural evolution of the indicator.

5. Companies that provide ICT training to their own staff

In recent years, only 4 percent of Romanian enterprises provided their employees with ICT training (a slight increase compared to the period 2014-2018) (Chart 6). In comparison, the European average was 10 percent. It is evident that a coherent intervention regarding this dimension would greatly improve Romania's score in the European Innovation Index, but it must be done constantly and consistently in order to increase the degree of digitization of SMEs.

Chart 6: Enterprises that provide ICT training to their own staff in Romania as compared to the group of emerging innovative countries and the group of leading innovative countries (% of total)



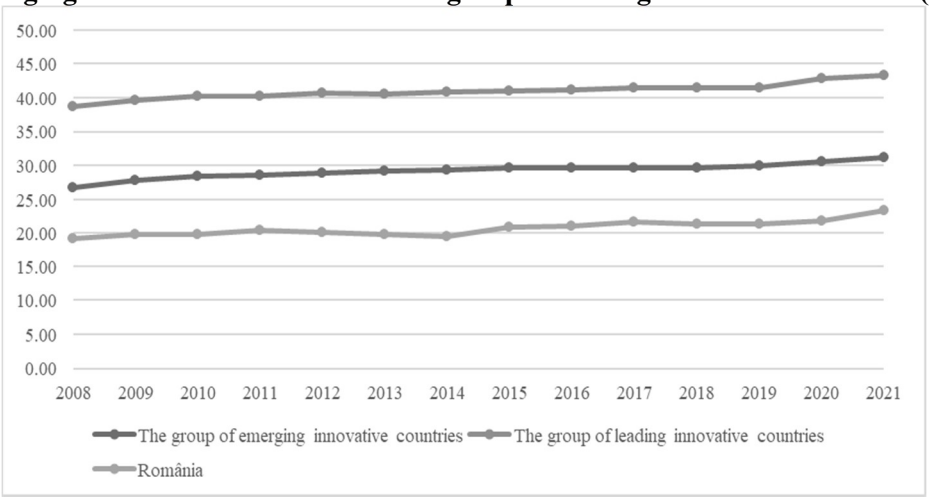
Source: author own processing based on https://ec.europa.eu/eurostat/databrowser/product/view/isoc_ske_ittn2?lang=en

Regarding this indicator, Romania's level is half compared to the average of the group of emerging innovative countries and a quarter compared to the average of the group of leading innovative countries. Therefore, it is very important for our country to advance rapidly and sustainably on this component both for digital convergence with European countries, but also to contribute to the unitary economic development of the EU.

6. Employment in "knowledge intensive" activities

"Knowledge intensive" activities have a specific contribution to economic development, creating the main added value. Although the trend followed by Romania in terms of employment in "knowledge intensive" activities is a slightly increasing one, our country is still 13.6% away from the average level of the European Union countries (Chart 7).

Chart 7: Employment in "knowledge intensive" activities in Romania as compared to the group of emerging innovative countries and the group of leading innovative countries (%)



Source: author own processing based on https://ec.europa.eu/eurostat/databrowser/view/isoc_ske_ittn2/default/table?lang=en

Regarding this indicator, Romania is below the average of the group of emerging innovative countries and at a considerable distance from the group of leading innovative countries. The most jobs were created in IT, and the fewest in creative professions. Compared to the rest of Europe, Romania has several relative strengths. The main strength is represented by telecommunications, followed by high-tech manufacturing and IT services. On the other hand, Romania's weaknesses are in the field of the pharmaceutical industry, design and other creative activities, but also in the field of management.

7. Conclusions

Our first finding is that the existing research-development-innovation system in Romania is not able to ensure a sustainable catching up within the EU. This is due to some of its weaknesses, among which the most important are: extremely small expenses for RDI as compared to the leading innovative countries and even to the average of the European Union, the excessive priority given by some institutes to fundamental research to the detriment of applied research, the lack of adequate incentives in favour of RDI, the lack of a periodic analysis of the real correlation between the needs of society Romanian and priority programs as research direction within the national programs.

Our second finding shows that, in line with research by the European Commission, a series of necessary actions can be taken in order to stimulate innovation in Romania. Among these can be mentioned: higher result-oriented allocations for research-development-innovation activity from both public and private funds; improved performance of doctoral education; increased public-private collaboration for involvement in innovation projects and capitalizing on the results; increased innovation entrepreneurship through balanced public-private funding; broader participation in European Union programs in the field of RDI on the basis of long-term partnerships.

References:

[1] European Commission (2022a). European Innovation Scoreboard, https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en, September 22. [Accessed 23 May 2023].

[2] European Commission (2022b). Country Review of the Romanian Research and Innovation System, Directorate-General for Research and Innovation, Brussels, February, https://ec.europa.eu/research-and-innovation/sites/default/files/rio/report/PSF-RO-Final-Report_03.06.2022.pdf. [Accessed 23 May 2023].

[3] Grassano, N., Hernández Guevara, H., Fako, P. et al. (2022). The 2022 EU industrial R&D investment scoreboard – Extended summary of key findings and policy implications, Publications Office of the European Union, European Commission, Joint Research Centre, https://data.europa.eu/doi/10.2760/08410. [Accessed 22 May 2023].
[4] Ministry of Research, Innovation and Digitization (2021). Framework document regarding National Research Strategy, Innovation and Smart Specialisation 2021-2027, https://www.poc.research.gov.ro [Accessed 9 May 2023].
[5] Ranga, M. (2018). Smart specialization as a strategy to develop early-stage regional innovation systems, European Planning Studies, 26(11), 2125-2146, https://ideas.repec.org/a/taf/eurpls/v26y2018i11p2125-2146.html [Accessed 11 May 2023].
[6] Romanian Government (2011). Government Decision 681/2011 regarding the approval of the Code of doctoral university studies, with subsequent amendments, www.edu.ro. [Accessed 3 May 2023].
[7] Romania's Executive Agency for Financing Higher Education, Research, Development and Innovation (UEFISCDI) (2022a). Framework Document on the National Research Development Innovation Plan 2022-2027, Ministry of Research, Innovation and Digitalization, https://sgg.gov.ro/1/wp-content/uploads/2022/09/ANEXA-33.pdf. [Accessed 20 April 2023].
[8] Scutaru, L., Prelipcean, G., Cozorici, A. N. (2019). Smart specialization in supporting SMES in the tourism sector through innovative clusters, Caring and Sharing: The cultural heritage environment as an agent for change (pp. 189-201). Springer, Cham, https://ideas.repec.org/h/spr/prbchp/978-3-319-89468-3_16.html [Accessed 15 May 2023].
[9] Șerbănică, C. (2021). Territorial Innovation Patterns in Romania. Future Pathways for Smart Specialization, Transylvanian Review of Administrative Sciences, 17(62), 153-175, https://rtsa.ro/tras/index.php/tras/article/view/660 [Accessed 15 May 2023].
[10] UEFISCDI (2022b). National Strategy for Research, Innovation and Smart Specialization 2022-2027 [online], https://www.old.research.gov.ro/uploads/comunicate/2022/strategia-na-ional-de-cercetare-inovare-i-specializare-inteligent-2022-2027.pdf [Accessed 9 May 2023].
[11] Eurostat (2023). Database on RDI, https://ec.europa.eu/eurostat/data/database [Accessed 20 April 2023].

The German Economy's Growing Dependence on China: A Critical Assessment

ANA-CRISTINA BÂLGĂR
PhD., Institute for World Economy, Romanian Academy
ROMANIA
anacristinabalgar@gmail.com

Abstract: Against the background of the recent intensification of global geopolitical tensions and, in this framework, of the announcement made by the German authorities regarding a future "historic turning point" (Zeitenwende) in the country's foreign policy, meant to contribute (among others) to the reduction of the economic dependence on countries with a totalitarian regime, our research aims at obtaining an in-depth image of the current status of the economic relations between Germany and China. Based on the quantitative measurement analyses performed, the article emphasises China's role and importance for the German traditional export-centred development model, as well as the challenges resulting from the deepening of these interdependencies. At the same time, we emphasise, on the one hand, the strategic motivations underlying the orientation of Chinese investment flows towards the acquisition of German high technology and related know-how, as well as the factors that determine the accelerating trend of German investments on the Chinese market and, on the other hand, the risks that German companies face at present as a result of China's increased assertiveness on the international stage.

Keywords: Germany, China, economic dependence, export, import, foreign direct investment (FDI), outward direct investment (ODI)

JEL classification: F21, F49, F59

1. Introduction

During the more than 50 years that have passed since the establishment of the economic relations between Germany and China (1972), the mutual interdependencies between the two countries gradually extended to increasingly varied fields, based on a cooperation model driven by converging interests that generated mutually advantageous benefits. Such benefits, up to a certain point, did not pay heed to the fundamental differences between the individual social systems and economic development levels of the two countries. Germany's strongly export-oriented economy considerably benefited from China's fulminant growth and from its integration into the rule-based international order, which mainly occurred once the country adhered to the World Trade Organisation (WTO) in 2001. From a German perspective, these evolutions seemed to confirm the liberal-like argument of the "change through trade," in the sense that the establishment and consolidation of bilateral economic ties could lead to the achievement of political reforms that might determine a societal change in China. However, the experience of the period after Xi Jinping became president (2013) showed that China's development direction seems to distance further and further from the conceptual premises of the rule of law and from the international principles related to the respect of human rights. In these conditions, beginning in 2019, a shift occurred in Germany's foreign policy in relation to China, in the sense that, beyond the position as *partner and competitor*, this country has mainly become a *systemic rival*[1] for Germany. In the light of the geopolitical tensions and of the geo-economic disturbances generated by the military conflict started by the Russian Federation in Ukraine, German decision-makers understood both the consequences that this systemic rivalry may have on economic relations, and the fact that close relations developed with autocratic countries may lead not only to increased prosperity, but also to the creation of critical interdependencies that could be politically exploited.

This is why the German authorities recently announced their intention to recalibrate their economic and commercial interrelations with China and to find a functional balance that could enable the identification of

[1] Given that the Chinese state continues to play a particularly important role in allocating resources at national level, and that the intervention of government agencies on the market takes a variety of forms, contributing to and fuelling a systemic competition/rivalry between Germany and China.

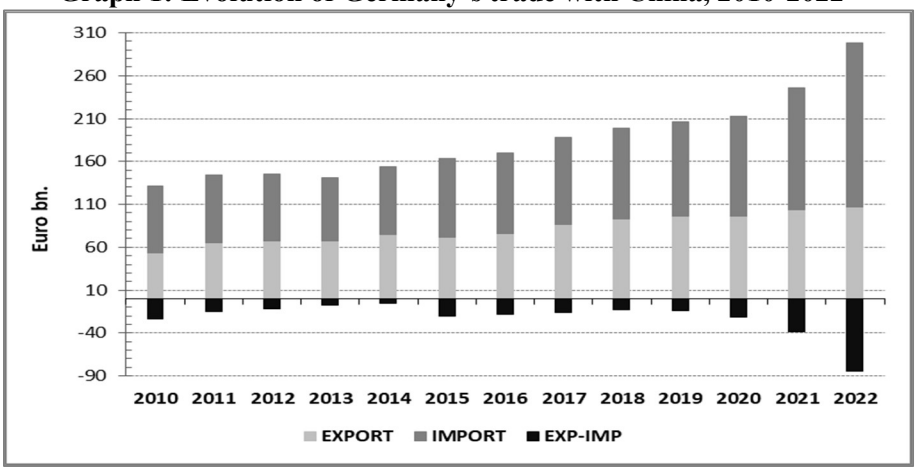
adequate response measures to the increasingly aggressive Chinese industrial policy, while at the same time avoiding the risk of applying an excessive state control. In other words, in order to align itself best to the contemporary geopolitical circumstances, Germany's strategic thinking towards China will attempt to simultaneously ensure: a) that the openness of the national economy is maintained (a fundamental characteristic of the liberal order); b) that the sales and purchases markets are diversified; c) that the internal market is effectively protected against the destabilising pressures that the presence of Chinese companies places on the competitional environment and on the (neo)liberal order, however without sliding towards protectionism (like the U.S.).

2. The German-Chinese relations in recent years: between special partnership and systemic rivalry

2.1. The deepening of Germany's commercial dependence on China

Given Germany's traditional export-centred development model, China was always particularly important for the federal economy, not only because of its large market and the increased demand for the German products, but also because China is a significant supplier of raw materials and intermediary inputs for Germany's industrial sector. As a result, during 2016[2]-2022 (the last seven consecutive years), China was Germany's main commercial partner and the total value of their bilateral trade, which already exceeded the annual threshold of EUR 200 billion in 2019, amounted to around EUR 299 billion in 2022 [Graph 1] (Federal Statistical Office/Destatis, 2023a). Nevertheless, in 2022, in the hierarchy of the main countries of destination for German exports, China ranked fourth,[3] surpassed by the U.S., France and The Netherlands, with figures higher than China's around 7% of the total German foreign sales (Graph 2). It can also be seen that the position as Germany's main commercial partner is based on the high volume of imports coming from the Chinese market which, in 2022, totalled around EUR 192 billion, corresponding to a share of approximately 13% of the total.[4]

Graph 1: Evolution of Germany's trade with China, 2010-2022*

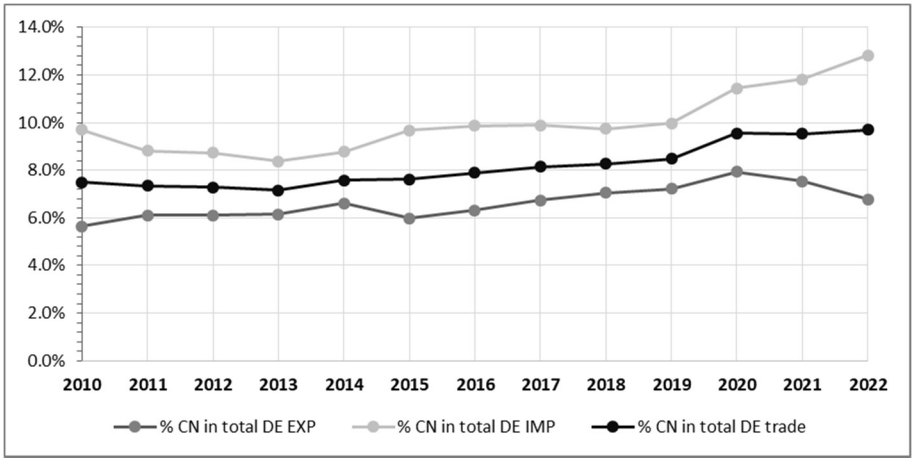


Note: *For 2022, the data presented are based on preliminary results.
Source: Graphic representation by the author based on the data published by the Federal Statistical Office (Destatis, 2023b).

In fact, since 2015, the share of German imports from China was situated close to the 10% threshold of the annual total, until 2020, when this threshold was exceeded.

[2] The year in which China surpassed the U.S. in the hierarchy of Germany's main commercial partners, after it ranked fourth in this classification in 2015 and after it held a consistent third place in the previous years.
[3] After the value of German exports to China exceeded in 2021 that of the sales to France or The Netherlands, two of the most important outlet markets for German goods.
[4] In fact, throughout the analysed interval (2010-2022), China was the main source of origin of German imports, with the exception of the first semester of 2020 when, as a result of the onset of the COVID-19 pandemic, Germany applied measures at federal level seeking to temporarily discontinue production and to close the borders for the transports of goods.

Graph 2: China's share of Germany's total foreign trade, 2010-2022*



Note: *For 2022, the data presented are based on preliminary results.
Source: Calculations and graphic representation by the author based on the data published by the Federal Statistical Office (Destatis, 2022a,b).

The higher-paced increase of imports compared to exports, a trend that was valid throughout the analysed period (2010-2022), resulted in a permanent deficit of Germany's commercial balance with China which, with the exception of years 2013 and 2014, constantly recorded two-figure values (Graph 1). In 2022, the German-Chinese trade deficit recorded a historical "peak" of approximately EUR 85 billion, thus exceeding the maximum threshold recorded in the previous year (of approximately EUR 39 billion).

As regards the structure of German exports to China, according to the *Standard international trade classification* (SITC Rev. 4), in the analysed period of over a decade (2020-2022), they were dominated by the *machinery and transport equipment* group, with an average share of around 70% of the total value of German exports for this period, followed, at significantly lower shares, by *chemicals and related products* (approximately10%) and by the *miscellaneous manufactured articles* group (9%).[5] This trend, which actually reflects the country's industrial specialisation and the output of sectors in which Germany holds competitive advantages, was also maintained in 2022, when the predominant export group totalled around EUR 73 billion.

According to the same classification, the predominant structural group in the German imports originating from China was also the *machinery and transport equipment* group (which totalled a share of around 53% in the 2010-2022 interval), in particular *automotive and mechanical equipment,* and, in year 2022 exceeded the threshold value of EUR 100 billion (Federal Statistical Office/Destatis, 2023c). At a considerable distance, the following groups of goods that dominated German imports from China during the last 13 years were: *other processing industry goods* (with an aggregated average share of approximately 27%) and the *chemicals and related products* subdivision (around 10%).

As the deficit of the commercial balance with China deepened during the last few years, caused by the accelerated increase of imports associated with a weakening of exports – a trend that was also determined, as we will show further on in our analysis, by the gradual externalisation of the production of German companies on the Chinese market – the federal economy became increasingly dependent on China (Matthes, 2019), thus reversing the trend that had been valid until around three decades ago.[6]

Given the increased risks entailed by the German trade deficit in relation to China, in particular in the recent context of intensified geopolitical tensions,[7] according to the official statements of German Minister for the Economy, Robert Habeck (who is also Germany's Vice-Chancellor), the German Government is at present in full process of preparing a new commercial policy in relation to China, which seeks, among others: a) to adopt measures to curb the dependence on the procurement of raw materials; b) to diversify procurement sources and

[5] The data presented are based on the author's calculations using the data published by the Federal Statistical Office (Destatis, 2023c).
[6] Towards the end of the 1980s, Germany had a major quasi-permanent surplus in the bilateral commercial balance, determined mainly by the massive increase of Chinese imports of goods incorporating German high technology.
[7] Because, as a result of the escalation of the situation in Taiwan, which could trigger the application of international sanctions against China, German companies doing business with China would be particularly exposed to losses, leading even to bankruptcy.

to pursue other emerging Asian markets; c) to reduce the incentives granted to companies involved in commercial transactions with Chinese partners, etc. (Hallam, 2022; Meza, 2023).

2.2. Evolution of bilateral relations in the field of investments

The generation and use of scientific knowledge, materialised in the applicability of this knowledge in the technological sector, represents a key-resource for contemporary economies, a central element in creating and maintaining the countries' competitiveness, which is essentially reflected in their national economic performance. While technological development at international level was traditionally led by developed economies (in particular the U.S. and the Member States of the European Union, among which Germany held a leading position), as a result of China's affirmation as a new power centre in science, technology and innovation (S&T&I), we are currently witnessing a reconfiguration of global leadership in this field.

The acceleration of scientific and technological progress, which was visibly manifest during the last decades, as well as its organic integration in the national economy, represented primordial strategic "targets" of Chinese policies which, through a *top-down* approach, were permanently oriented towards finding the synergic optimum between the procurement of advanced technologies from abroad, and the development of the country's own technological base. As a result of the political measures adopted very early by the Chinese authorities[8], correlated with the sustained efforts towards supporting and stimulating research, development and innovation activities (R&D&I) to create a knowledge-based economy, China gradually bridged the gap that was separating it from the technological frontier, and became one of the main competitors in the race for global technological supremacy.

Nevertheless, since the domestic technological capacity did not allow for the achievement of the central objective of the 2015 strategy entitled *Made in China 2025* (*MIC 2025*), namely world dominance in the field of "cutting-edge" technologies and the reduction of foreign dependence until 2049, the absorption of technology from developed countries became an indispensable condition for achieving the goals set, in particular in the knowledge-intensive industrial branches[9].

As such, after 2015, China's industrial ambitions were accompanied by increasingly aggressive investment strategies meant to channel ODI and FDI flows towards the ten high-tech sectors of national interest covered by the *Made in China 2025* programme document. Therefore, by adopting specific measures, the Chinese authorities sought to guide capital movements to generate an inflow of advanced technologies. These measures include: a) increased support granted to national enterprises (usually SOEs), which, by externalising their activity (through ODI) procured technologies and then transferred it on a large scale to the internal market; b) the granting of incentives for directing FDI inflows towards priority industries and making FDI approval conditional on the existence of potential technological transfers; c) restrictions on the share of foreign interest in joint ventures in certain branches.

The accelerated increase of Chinese investment flows that looked for strategic assets and their predominant orientation towards the sectors referred to in the *MIC 2025* increased the fears of German decision-makers that such practices could lead to an "exodus" of key German technologies towards China, favouring the creation of national "champions" with global influence which could lead to the erosion of the global technological supremacy held by developed countries (Hanemann & Mikko, 2017; Jungbluth, Is China Systematically Buying Up Key Technologies? Chinese M&A transactions in Germany in the context of "Made in China 2025", 2018).

2.2.1 Chinese investments in Germany: trends and strategic motivations

As it can be seen, to fulfil the objectives established by the new development plans oriented towards quality and innovation, beginning mid-2010s, the policy for the internationalisation of Chinese enterprises entered a new phase, in which foreign investments were mainly channelled towards productive activities with a high added value so that, through a reverse transfer of technology, they could contribute to the modernisation of the related national industries. In essence, China's industrial strategy sought to use capital for the acquisition of technologies from developed economies which, after the takeover, absorption/indigenisation and perfecting processes were

[8] Measures aimed at regulating and targeting foreign direct investment (FDI) in accordance with the country's own industrial modernisation strategies, followed by directing the outward direct investment (ODI) flows in accordance with the same national interests

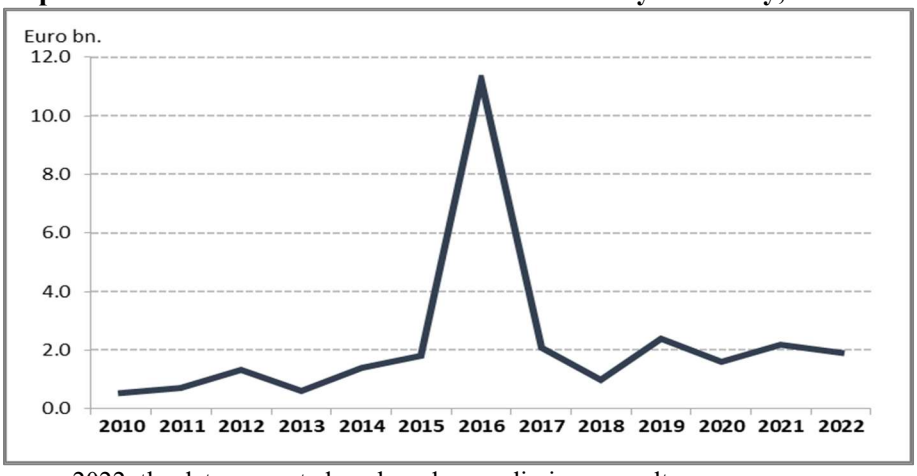
[9] Sectors in which there were already huge gaps between the assumed political ambitions and the domestic technological capabilities (Wübbeke, Meissner, Zenglein, Ives, & Conard, Made in China 2025: The making of a high-tech superpower and consequences for industrial countries, 2016).

completed, were to be applied for obtaining advantages in the international competition with the origin countries (De La Bruyère & Picarsic, 2020)[10].

Also, Chinese government authorities, which had aligned the strategic priorities of *MIC 2025* to those of the German "*Industry 4.0"* development plan, saw Germany as a main source for acquiring technologies and production methods that could aid China in taking a leap forward in terms of innovation, which would have helped bridge the gap in relation to the U.S., China's main competitor in the race for technological leadership. This is why, given the first-line position held by Germany in the world hierarchy of industrial producers – on the same tier with the U.S. – as well as the solidity of the bilateral relations resting on a tradition of several decades, the German economy became the preferred European destination for Chinese ODI, with the main aim of repositioning China within the global value chains and taking it to a new stage of autonomous development, centred on internal innovation generated by national companies.

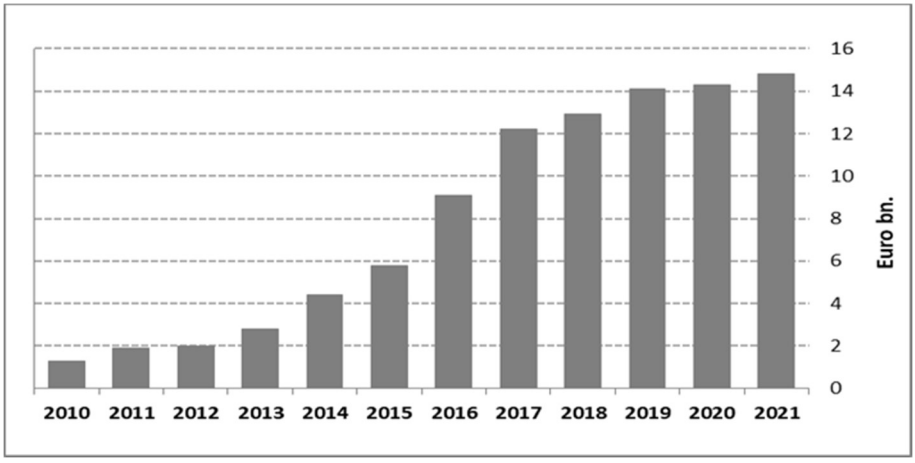
After 2016, the increased appetite of Chinese investors for the absorption of German technological know-how was reflected in the exponential growth of the ODI flow towards the German economy, which grew around six times compared to 2015, totalling a historical maximum of approximately EUR 11 billion (Graph 3). Evidently this trend was also observed at the level of the total balance of Chinese investments in Germany, which recorded a growth of approximately 60% compared to the previous year (Graph 4).

Graph 3: Evolution of Chinese FDI flows received by Germany, 2010-2022*



Note: *For year 2022, the data presented are based on preliminary results.
Source: Graphic representation by the author based on the data published by the Deutsche Bundesbank Eurosystem (2023a) and the Joint report of the Mercator Institute for China Studies (MERICS) and Rhodium Group (2023).

Graph 4: Value of Chinese FDI stocks in Germany, 2010-2021*



Note: The most recent statistical data available at the time the analysis was prepared.

[10] In other words, China was aiming at developing its national innovation capacity by indirect means, namely by accessing the capacity already existent in developed countries and in which these countries had already invested.

Source: Graphic representation by the author based on the data published by Deutsche Bundesbank Eurosystem (2022b).

At the same time, another trend captured in premiere in 2016 in the investment relationship between the two countries was marked by the fact that inflows of Chinese investments in Germany were of a higher value than the capital movements taking place in opposite direction, namely from Germany to China (+55%).
Despite the positive effects of capital inflows on the economic development of a receiving country and, in this regard, of the policy traditionally applied by Germany to attract Chinese investments, once the provisions of the plans to transform China from the world's workshop into its "research lab" were implemented, together with the investment strategies adopted as a consequence, German government authorities became increasingly concerned about the potential risks resulting from the acceleration of Chinese ODIs directed towards the German productive sectors that relied heavily on advanced technologies. One of the main challenges faced by the German economy after 2016 was the structural[11] and directional change of the investment inflow from China, which sought to favour both the access to "cutting-edge" technologies specific to the priority industries set out in the *MIC 2025*, and the rapid absorption of these technologies. As such, the increased interest of Chinese investors in the ten "intelligent" production fields listed on China's industrial reform agenda was materialised, beginning with 2016, in the increased share of ODI in the form of mergers and acquisitions in these (sub-)branches in which Germany had a significant competitive advantage.

Also, in the context of a higher investment volume, another concern of the German authorities was the political influence underlying the M&A projects, because given the opaque nature of ownership forms and the lack of transparency characterising the Chinese enterprises' financing networks, it was not always clear what role did the Beijing government actually have in the transaction and acquisition processes (Wübbeke, Meissner, Zenglein, Ives, & Conard, Made in China 2025: The making of a high-tech superpower and consequences for industrial countries, 2016; Jungbluth, 2018). As such, although in accordance with official data, of the total number of Chinese acquiring enterprises present on the German market in 2016, the share of state-owned enterprises was below 20%, the externalisation of the activity of private companies seeking the acquisition of technologies and related know-how from Germany and from other industrial states was often directly or indirectly supported from government sources, which determined a distortion of competition for the other companies active in the host country. Also, the acceleration of Chinese investments in search of strategic assets controlled by the state risked damaging Germany's leadership position in the development of frontier technologies, as it enabled China's access to a large range of knowledge resources which, after the takeover, could easily be reapplied. In fact, the acquisition by China of German industrial giants in the reference year (2016) – in particular the takeover of the leading robotics engineering group *Kuka* by the *Midea*[12] industrial group – brought to the foreground of political debates the risks Germany was exposed to as a result of the ensuing facilitation of the transfer of "cutting-edge" technology to a country for which the essential goal of obtaining new technological means is *"to combine the appropriation of technology with the geopolitical expansion of power"* (Sigmar Gabriel, German Ministry for the Economy during 2013-2017) [Gabriel S. *apud* Larres (2016), p. 1].

As "intelligent" production is largely based on the generation, transmission and storage of highly-sensitive commercial and production data, the accuracy and safety of which is essential for the proper functioning of manufacturing processes, German leaders saw another potential risk factor in the possible exposure of confidential business information to China, an action that could have endangered their security, in particular since Chinese legislation has very strict rules regarding cybersecurity governance.

Also, another problematic aspect identified by German decision-makers was the lack of reciprocity in terms of national regulations on the FDI regime, because while the access of Chinese enterprises on the German market was not facing significant restrictions, the Chinese government was deliberately protecting its internal strategic industries from the presence of foreign companies. As such, regulations on the entry on the Chinese market were usually pursuing the priority objectives of the industrial policy – first the state would encourage FDI inflows to facilitate the takeover of foreign technology, know-how, technological and managerial skills, and then, once

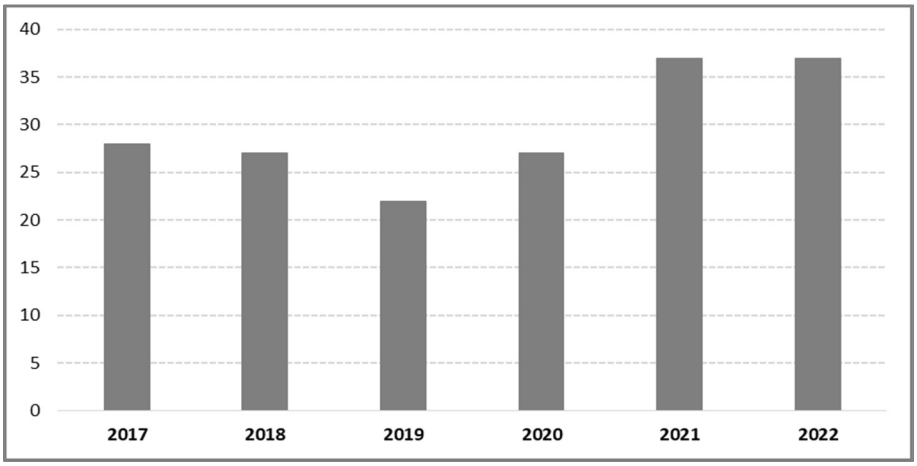
[11] Through the prevalence of *brownfield* investments, in particular mergers and acquisitions (M&A), which facilitated the more rapid takeover of new generation technologies sought after by China.
[12] This acquisition has a significant symbolical value, resulting from the fact that it raised awareness among German decision-makers that Chinese investments – pursuing the achievement of the *MIC 2025* strategy objectives – had become predominantly oriented towards the absorption of key German technologies, knowledge and know-how (Bâlgăr & Pencea, 2022).

national companies bridged the initial technological gaps, it would apply measures to protect local industries by erecting barriers to limit the access of foreign companies.

All these circumstances – and especially the Kuka acquisition case – generated a profound dilemma within the German political environment, in the sense that Germany, a country with an export-centred development model and a fervent supporter of maintaining an economy opened to foreign investors – was faced with the need to tighten its investment legislation to counteract the uncertainties and risks created by the massive flow of Chinese ODI in certain sectors of national strategical importance.

As a result, in 2017, with the amendment of the *Foreign Trade and Payments Ordinance*, the German executive decided to tighten the legislation on the review of investments, by granting more power in this regard to the German Ministry of Economic Affairs and Energy, which it delegated to closely monitor transactions in the form of mergers and acquisitions by foreign (non-European) companies in fields related to the critical national infrastructure, if they exceeded the threshold of 25% of the subscribed share capital of the resident enterprise (Federal Ministry for Economic Affairs and Climate Action, 2023a). However, because this high ceiling permitted some of the acquiring companies to circumvent the verification mechanism, in 2018, German authorities adjusted the rules for the review of investments form non-EU countries so as to enable the examination of any acquisition exceeding a share of 10% of the capital of a national company operating in a series of sectors, such as defence, critical infrastructure and technologies, mass-media, etc. As such, following the review of any form of direct purchase of shares or of takeover of the control of enterprises/assets in the fields considered relevant, the Federal Ministry of Economy could reject a transaction if it deemed it represented an increased risk for national security (Graph 5; Box 1).

Graph 5: The number of acquisition bids originating from China that were monitored by the German authorities, 2017-2022*



Note: * Cases of monitoring required in accordance with the German legislation, distinct from those required by European regulations.
Source: Graphic representation by the author based on the data published by the Federal Ministry for Economic Affairs and Climate Action (2023b).

Box 1: Chinese investment projects rejected by the German authorities, 2018-2022

Investing company (China)	Target company (Germany)	Business sector	Final status of the transaction/motivation for blocking/rejecting the authorisation
Yantai Taihai	Leinfield Metal Spinning AG	Manufacture of advanced technology machinery and equipment	**Abandonment by the investing company (2018):** following the analysis carried out, the German Ministry of Economic Affairs and Energy (BMWi) made the decision to block the transaction, invoking concerns related to national security, given that the Chinese investing company was involved in the nuclear sector. Although this was the first time the BMWi exercised its veto right to reject a takeover of assets by a foreign company, the Chinese bidder withdrew its bid before the official resolution was

Investing company (China)	Target company (Germany)	Business sector	Final status of the transaction/motivation for blocking/rejecting the authorisation
			issued, to avoid receiving a public objection from the federal government (Bian, 2021).
State Grid Corporation of China	50Hertz Transmission GmbH	Energy	**Rejected (2018):** according to government statements, the transaction was not approved because of political reasons related to the protection of the national energy infrastructure. At the same time, the Belgian majority shareholder, the company Elia Transmission, exercised its pre-emption right concerning the transaction;
China Aerospace Science and Industry Corporation (CASIC), through its subsidiary Addsino	IMST GmbH	Industrial engineering, radio systems and microelectronics	**Rejected (2020):** BMWi decided that the acquisition would endanger national security and economic sovereignty, given that IMST GmbH was one of the most important natural producers of satellite communication systems, radars and radio technology;
Zhejiang Shuanghuan Transmission Machinery	Schmiedetechnik Plettenberg GmbH & Co. KG	Automotive industry	**Abandonment of the investing company (2020):** in the absence of a consensus with BMWi on the revision of certain aspects that did not comply with the national foreign investment regime in force (Kratz, Zenglein, & Sebastian, 2022a);
Vital Materials Co.	PPM Pure Metals GmbH (part of the French group Recyclex)	Metallurgy	**Rejected (2020)**: the German government opposed the acquisition by veto, in the conditions in which the company was one of the main German suppliers of metals for the manufacture of semiconductors and infrared detectors used in military technology (Heinrich & Kuhn, 2020);
Aeonmed Group	Heyer Medical AG	Pharmaceuticals, biotechnology, health	**Rejected (2022):** following an examination process that lasted around two years,[13] BMWK decided that the transaction could affect national security as far as the supply of medical products essential to the health sector was concerned and, at the same time, would enable a political insinuation of the Chinese government in a key technological branch (Von Bieberstein, 2022).

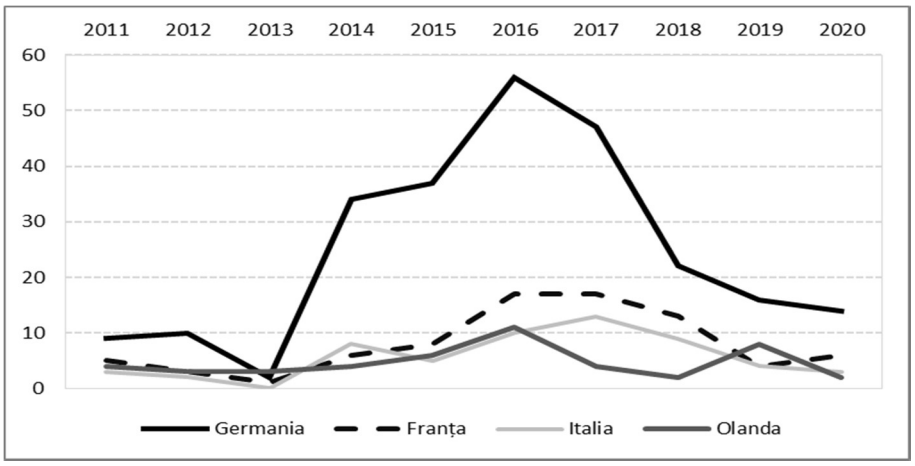
Source: Synthesis by the author, based on the bibliography cited in the box.

At the same time, in 2019, a EU regulation was adopted establishing a uniform framework for examining foreign direct investment originating from outside the Union, meant to offer Member States the means necessary to approach the potential risks for national security or national order in a comprehensive manner, while at the same time maintaining the flexibility required for monitoring them in accordance with the particularities specific for each individual state.

Although, after the launch and consolidation of the federal investment monitoring mechanism (2017/2018), the Chinese flows of capital directed towards Germany decreased dramatically compared to the level of 2016 – as can be seen from the data presented in Graph 1 – the federal economy still continued to represent the preferred European destination for acquisitions originating in China (Graph 6).

[13] Making it necessary to extend the examination period, because the standard time interval for reviewing a transaction is of six month.

Graph 6: Main countries of destination for Chinese M&A projects, 2011-2020



Source: Graphic representation by the author based on FDI Intelligence (2022); Datenna (2022).

Also, as regards sectoral orientation, Chinese ODI followed a diversification trend after 2018, which shows both China's more recent objective to extend its coverage of production networks in order to integrate them in the global value chains, and the increased orientation towards the takeover of certain important brand names, so as to favour the more efficient use of assets obtained from acquisitions (Bastian, 2020). As such, in addition to the strategically important fields outlined by the MIC 2025 industrial development programme, Chinese companies began paying attention to other areas relevant for the German corporate ecosystem, such as financial services, the hotel industry, etc.

Therefore, although during the last years transactions decreased in volume, as a result of the measures adopted at national and EU level to tighten the regulations regarding the inflows of foreign investments from non-EU countries, and because of the Covid-19 pandemic, Germany continued to attract Chinese ODI, which shows that China maintained its interest in the technological innovation that was strongly concentrated at the level of the large German companies.

2.2.2 German investments in China: opportunities and challenges. Case study: the automotive industry

As China advanced within its new development cycle and in deepening its reform processes, the need to absorb foreign investments was growing stronger at national level, both in terms of financial capital, and in terms of advanced technologies, managerial expertise and quality production, as it could facilitate the industrial development process and support the transition towards an innovation-intensive and consumption-dominated economy.

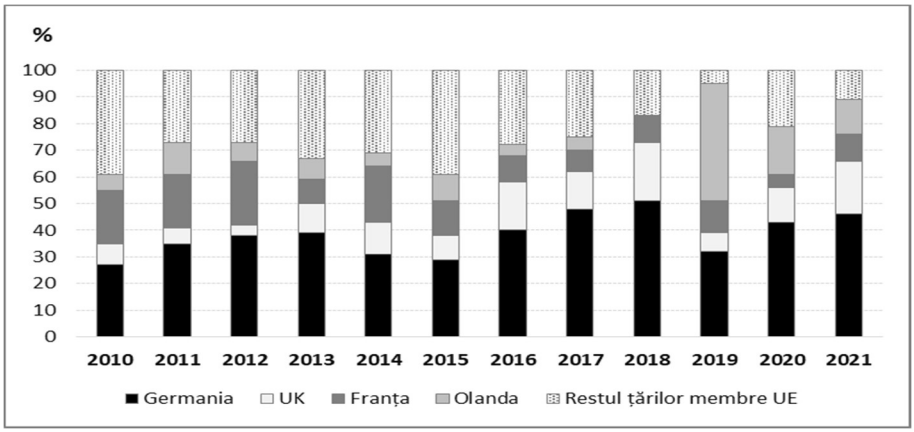
Given the awareness of the need for foreign entrepreneurial capital to achieve all these objectives, when the *13th Five-Year Plan* (2016-2020) was launched, the Chinese government proposed to prepare and initiate new policies that could contribute to the "full opening" of the national economy and the stimulation of FDI inflows, by facilitating the access thereof to new economic sectors and by relaxing the limiting barriers existing on the market (NDRC, 2016). As such, beginning in 2018, a change of paradigm occurred in China's approach of the FDI policy, materialised in the gradual evolution of the national legislation regarding investment inflows, from more restrictive rules to rules that promoted the active selection and encouragement of received flows, and the financing supported by foreign investors became both a major vector supporting China's technological and industrial modernisation, and a favourable factor for maintaining a dynamic competitive environment.

Despite the progressive liberalisation of the foreign investment regime implemented during the last years, China still continues to maintain a detailed FDI monitoring, control and administration system, in which the *Catalogue for the Guidance of Foreign Investment Industries*[14] plays a central role. Nevertheless, given its immense market potential, the relatively low cost of labour and the increasingly ample policy encouraging the inflow of foreign investments applied by the national authorities during the last years, China represented one of the preferred destinations for German capital flows during the last decade. In fact, during this decade, from among the EU Member States, Germany constantly appeared as main investor – except for 2019, when it was surpassed

[14] Depending on the potential receiving industries, the Catalogue divides FDI into three groups (encouraged, restricted and prohibited), a classification that determines both different degrees of examination for approval, and distinct levels of conditionality or of regulation for those investments.

by The Netherlands – with an aggregate average share of around 40% of total European FDI directed to China (Graph 7).

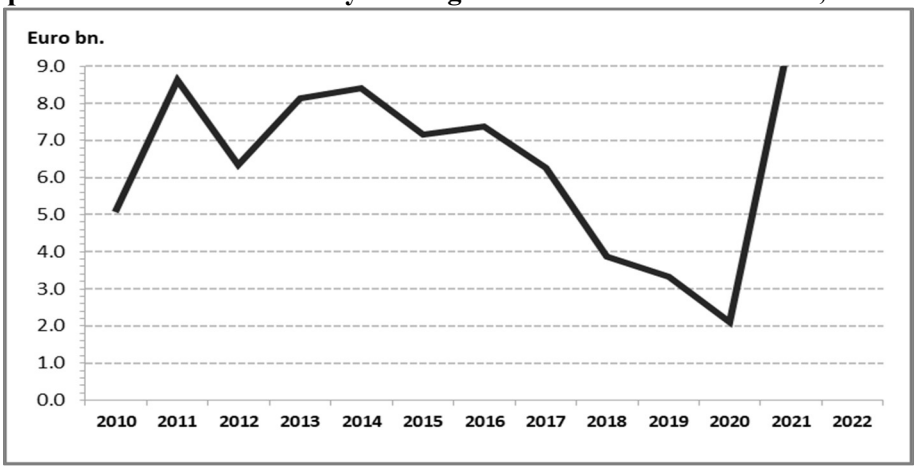
Graph 7: Germany – main European country investing in China, 2010-2021



Source: Graphic representation by the author based on the data published by Rhodium Group (Rhg, 2022).

This trend is based, on the one hand, on the fact that German companies accessed the Chinese market early on (given the long-standing bilateral partnership established between the two countries as early as 1972) and, on the other hand, on the fact that they are usually operating in capital-intensive productive industries, which implicitly require higher investments, related to sectors which, during the last decades, saw a strong growth in China. As such, despite the oscillating trend of German FDI flows towards China in the period 2018-2021 (Graph 8) – an interval marked by the occurrence of the Covid-19 pandemic which had an increased negative impact on international capital movements, leading to a postponement of investment plans or even to divestitures – several large German companies were among the top European investors totalling an average share of around 34% of all EU investments directed towards the Chinese market (Kratz, Barkin, & Dudley, 2022b) [Table 1].

Graph 8: Evolution of Germany's foreign direct investment in China, 2010-2021



Source: Representation by the author based on the data published by Deutsche Bundesbank Eurosystem (2023c).

Table 1: Position held by German companies in the hierarchy of the top five companies investing in China in the period 2018-2021*

Rank	2018	2019	2020	2021
1.	Volkswagen AG **(DE)**	Heineken NV **(NL)**	Girfols SA **(ES)**	Volkswagen AG **(DE)**
2.	Diaego PLC **(UK)**	Volkswagen AG **(DE)**	Volkswagen AG **(DE**	BASF SE **(DE)**
3.	Allianz SE **(DE)**	IKEA BV **(SE)**	BASF SE **(DE)**	BMW AG **(DE)**
4.	Daimler AG** **(DE)**	Daimler AG **(DE)**	Daimler AG **(DE)**	Veolia SA **(FR)**
5.	Vailog SRL **(IT)**	AXA SA **(FR)**	Permira PLC **(UK)**	CrystecPharma **(UK)**

Note: *As percentage of the total value of annual transaction
Source: Kratz, Barkin, & Dudley (2022b), Rhodium Group.

The fact that during the last ten years or more, China became one of the preferred destinations for investments and, implicitly, for the manufacturing activity of German companies is reflected in the German ODI stocks which tripled in value between 2010 and 2020 (from EUR 29 billion to approximately EUR 90 billion). However, by 2020, China's position in the preferences of German investors was lower than that held at EU level or in the U.S., in the conditions in which China's share in the total German ODI stocks amounted to around 7%, compared to 34% (in the EU), and 27% in the U.S., respectively (Jungbluth, et al., 2023).

As regards sectoral distribution, the Chinese automotive industry accounted for the largest share of the total German investments in 2020, i.e., 41% of the annual FDI balance, in the conditions in which the value of stocks in this sector increased by around 65% compared to 2015, reaching a figure of approximately EUR 33.6 billion. In fact, as we stated in the previous sub-sections, the federal government permanently used foreign policy instruments to encourage this trend. Although government authorities revised their position against the background of increased concerns related to: a) China's growing assertiveness; b) the German economy's deepened dependence on China; and c) the loss of industrial competitiveness in recent years,[15] the three main manufacturers of the German automotive industry – i.e., BMW AG, Mercedes Benz and Volkswagen AG – continue to massively invest in China.

The main reasons that determined the acceleration of investments in China made by the most important German automotive manufacturers include: a) the reduced competitive pressure exercised by local manufacturers; b) the use of the Chinese innovation ecosystem, namely, the localisation advantages offered by this market (Box 2).

Box 2: Reasons for the decision to invest on the Chinese market in the case of the German automotive companies

Aspects related to the competition on the Chinese market	☑ Once China reached a share of 55% of the world production of electric vehicles (EVs) and, implicitly, obtained the global leadership position in the field, Chinese government authorities decided that local manufacturers are ready to tap into the advantages offered by international competition and, as such, relaxed the regime of foreign direct investments in this sector, thus permitting German automotive manufacturers to increase the share capital or interest held in joint ventures created in partnership with Chinese companies. ☑ On the other hand, the three major German companies in the automotive sector – BMW AG, Mercedes Benz and Volkswagen AG, which developed their electric vehicle production segment relatively recently and which, as a consequence, were facing the risk of a reduced market share in China, given the increased EV demand, saw the Chinese policy change as an opportunity for: ✓ *The increase of profit margins and of the decision-making power within joint ventures set up in China*. For instance: a) the BMW group invested EUR 3.7 billion to increase its participation interest in the joint venture set up with Brilliance Automotive from 50 to 75 % (2021); b) Volkswagen AG concluded a partnership with JAC Motor, a Chinese company specialising in the production and development of electric vehicles (2020); ✓ *The changing of the investment model, by channelling capital flows towards local research and development hubs.* If, to avoid the transfer of technology to China, the R&D processes used to be carried out only nationally – in specialised units located in Munich, Stuttgart or Wolfsburg – now, against the background of the increased competitive pressure exercised by Chinese competitors, the large German automotive manufacturers relocated the largest part of their R&D activity to this market, by creating multiple partnerships with national companies in the field, based on the pooling of German hardware know-how with Chinese software technology expertise.
Advantages offered by the Chinese technological ecosystem	☑ The determining factors of the integration of German automotive manufacturers on the Chinese market, by creating partnerships with local companies involved in R&D, are: ⇨ *The Chinese dominance of the entire global electric vehicle manufacturing chain,* as a result of the industrial policy applied during the last years by the Chinese government and of the sustained financing directed to this sector; ⇨ *The increased capacity for innovation of Chinese companies and the acceleration of the R&D activity,* in the context in which China was the first country to adopt a policy for

[15] For example, in May 2022, the German government refused the request mad by Volkswagen AG for an extension of the guarantee on the investments made in China – as security against economic and political risks – invoking as argument the violation of human rights by the Chinese authorities (Sebastian, 2022).

	subsidising the purchase of electric vehicles, in order to stimulate national innovation in the field; ⇨ *The dynamic nature of the internal market:* China is the world leader in terms of number of models of electric vehicles developed – around 300; ⇨ *The acceleration of development cycles, through the involvement in this sector of the major Chinese technological groups Baidu and Xiaomi*, which implemented digital solutions that helped reduce the time interval for the creation of new prototypes, from 4-5 years in the past to 2-3 years in the present.

Source: Synthesis by the author based on Sebastian (2022).

However, notwithstanding the opportunities arising from the externalisation of manufacturing and R&D activities on the Chinese market, German automotive manufacturers face a series of significant challenges and risks that could even endanger their global performances:
a) The fact that R&D results are kept in China, given that the automotive sector is of central concern for Chinese regulatory authorities in relation to the management of cross-border data transfers;
b) The endowment of Chinese competitors with cutting-edge technology: although during the last years China improved its national regime for the protection of intellectual property rights (IPR), this regime continues to have major flaws, in particular in the field of know-how and business practices. As a result, the conclusion of cooperation agreements with the Chinese manufacturers of technology for the automotive industry entails an increased risk of leaks of technological information to China;
c) The increased vulnerability of investing companies, in a global context marked by geopolitical tensions: through an increased volume of investments in China, German companies deepen their dependence on this market and, at the same time, favour the expansion of the control leverage held by the Chinese government authorities;
d) The involuntary and indirect involvement in human rights infringements, which are sanctioned by the international community: for example, the company DJI Sciences& Technologies Ltd., a partner of Volkswagen AG, is currently the subject of international debates regarding the application of sanctions, given its alleged involvement in the drone monitoring of the Uigur population in the Xinjiang province. The development of such partnerships is obviously likely to generate negative reactions on the part of consumers outside China.
e) Also, through the gradual externalisation of R&D activities in China – determined, as we have shown, by the attempt to maintain the acquired market share – German automotive companies could cause an *erosion of Germany's production and innovation capacity* under the conditions in which, on the one hand, it is not very clear whether they will continue to be able to transfer the technologies thus developed to the market of origin, and, on the other hand, the benefits of such technologies will be first felt in China.

3. Conclusions

Strongly rooted in the policy that defined the configuration of Germany's international position during the Cold War era – *Ostpolitik* – the development model governed by the axiomatic principle of the "change through trade," which propelled the evolution of the German economy during the last five decades or so, seems not only to have lost its viability, but also to exercise now a boomerang effect with deep destabilising effects on its future development. After approximately four decades of reform and openness, the Chinese economic system now has a hybrid structure that combines elements specific to the centralised economy, and elements of the market economy. Multiple (direct and indirect) forms of state intervention in the economy create numerous obstacles for the German companies, preventing them from competing on an equal footing with the Chinese companies on the Chinese market.

Although, against the background of the current geopolitical tensions, the stringent priority for German actions is to ensure energy security and to find optimum alternatives to enable the safe decoupling from the imports of natural gas from the Russian Federation, the federal authorities do not forget that the true test for the "new era" of national foreign policy has not started yet, and that it will depend to a large extent on the direction of the future evolution of the relations with China.

Despite the positive results that the German economy obtained from the decades-long expansion of its commercial and investment relations with China, a series of concerns have become increasingly poignant regarding: a) the challenges posed by the deepening of the German dependence on the trade with China; b) the Chinese practices of acquiring German technologies by using bilateral cooperation and by prevalently guiding capital movements towards high-tech sectors that are set out in the national strategic plans; c) the unfair

competition exercised on the German and European market by Chinese companies subsidised by the state; d) the unequal treatment of German companies operating in China (asymmetrical openness, to the detriment of Germany); and, last but not least, e) the increase of China's political assertiveness after Xi Jinping became the country's leader.

However, due to the deep interdependencies built over time – which, among others, result from the fact that during the last seven years China was Germany's main trade partner and an important external production market for the large national groups (in particular those in the automotive industry) – the decoupling (even gradually) will not be an easy process. In the context in which many German companies hold important shares on the Chinese market, they will not be able (nor want to) transfer their production units located in China. But, because the intensification of political differences existent at bilateral level and/or the escalation of geopolitical risks related to the situation in Taiwan could force this decision, the federal government has already taken a series of steps, with the support and participation of the European Commission, that could lead to an increased cooperation with other emerging countries in the Indo-Pacific region.

With the onset of the Russian Federation's military aggression in Ukraine, the latent concerns of German decision-makers related to the risks that arise from the deepening of economic dependencies on countries governed by totalitarian regimes reached a climax, determining a "historic turning point" in German diplomacy. If in the case of the Russian Federation this new political paradigm translates in the decoupling from the purchase of energy raw materials (in particular natural gas), in China's case it will be materialised in an effort to lessen the interdependencies consolidated over time, by diversifying commercial partnerships and the production locations of national companies. As such, once Germany understood the failure of cooperating with countries with divergent political interests, the "golden age" of German-Chinese relations seems to have come to an end, although it is unlikely at present that a sudden or irreconcilable break-up could occur between the two powers. Therefore, our main conclusion is that in the current geopolitical and geo-economic context, marked by deep disturbances, the development of a new German policy on China is in itself a test for democracy, aimed at reducing the interdependency relations with states dominated by totalitarian regimes.

References:

[1] Bâlgăr, A.-C., & Pencea, S. (2022). Bilanțul unui semicentenar de relații germano-chineze: între pragmatism și vulnerabilități. Revista de economie mondială, 14(2), 5-36.

[2] Bastian, J. (2020). They Need Each Other: Reflections on Sino-German Economic Policy Interdependence. Athens: Hellenic Foundation for European &Foreign Policy (ELIAMEP). Retrieved from https://www.eliamep.gr/wp-content/uploads/2020/12/Policy-Paper-47-J-Bastian-final.pdf.

[3] Bian, C. (2021). Reducing Regulatory Hurdles to Investors Through Induced Reciprocity. The Journal of World Investment & Trade, 22(4), 561-595. doi:https://doi.org/10.1163/22119000-12340218.

[4] De La Bruyère, E., & Picarsic, N. (2020). Made in Germany, Co-opted by China. Washington DC: Foundation for Defence of Democracies (FDD). Retrieved from https://www.fdd.org/wp-content/uploads/2020/10/fdd-monograph-made-in-germany-co-opted-by-china.pdf.

[5] Deutsche Bundesbank Eurosystem. (2023a). External sector statistics-Domestic direct investment assets: Transaction values of direct investment. Retrieved from Deutsche Bundesbank : https://www.bundesbank.de/dynamic/action/en/statistics/time-series-databases/time-series-databases/743796/743796?treeAnchor=AUSSENWIRTSCHAFT&s.

[6] Deutsche Bundesbank Eurosystem. (2023b). Deutsche Bundesbank Eurosystem. Retrieved from External setor statistics-Foreign direct investment stock statistics (Extended-Directional-Principle): https://www.bundesbank.de/dynamic/action/en/statistics/time-series-databases/time-series-databases/759784/759784?listId=www_sesbop_aw3_2_2b1_s1__t.

[7] Deutsche Bundesbank Eurosystem. (2023c). Extermnal Statistics. Retrieved from Deutsche Bundesbank Eurosystem - Financial account / Net domestic investment abroad /: https://www.bundesbank.de/dynamic/action/en/statistics/time-series-databases/time-series-databases/745582/745582?tsId=BBFBOPV.A.N.DE.CN.S1.S1.T.A.FA.D.F._Z.EUR._T._X.N.ALL&listId=www_sesbop_aw3_1_1a_s1&dateSelect=2022.

[8] Federal Ministry for Economic Affairs and Climate Action. (2023a). Investment screening. Retrieved April 27, 2023, from Bundesministerium für Wirtschaft und Klimaschutz (BMWK): https://www.bmwk.de/Redaktion/EN/Artikel/Foreign-Trade/investment-screening.html.

[9] Federal Ministry for Economic Affairs and Climate Action. (2023b, January 09). Investment Screening in Germany: Facts and Figures. Retrieved from Bundesministerium für Wirtschaft und Klimaschutz (BMWK): https://www.bmwk.de/Redaktion/EN/Publikationen/Aussenwirtschaft/investment-screening-in-germany-facts-figures.pdf?__blob=publicationFile&v=1.

[10] Federal Statistical Office/Destatis. (2023a). The People's Republic of China is again Germany's main trading partner. Retrieved from Destatis: https://www.destatis.de/EN/Themes/Economy/Foreign-Trade/trading-partners.html.
[11] Federal Statistical Office/Destatis. (2023b, May 12). Ranking of Germany's trading partners in foreign trade (preliminary results). Retrieved from Destatis: https://www.destatis.de/EN/Themes/Economy/Foreign-Trade/Tables/order-rank-germany-trading-partners.pdf?__blob=publicationFile.
[12] Federal Statistical Office/Destatis. (2023c). Foreign trade database [51000]. Retrieved April 28, 2023, from Destatis - Exports and imports (foreign trade): Germany, years, countries, classifications of trading goods (0007): https://www-genesis.destatis.de/genesis/online?language=en&sequenz=statistikTabellen&selectionname=51000#abreadcrumb.
[13] Hallam, M. (2022, November 13). Germany must 'be more careful' with China, Habeck tells DW. Retrieved from Deutsche Welle: https://www.dw.com/en/germany-must-be-more-careful-with-china-habeck-tells-dw/a-63739753.
[14] Hanemann, T., & Mikko, H. (2017). Record flows and growing imbalances: Chinese investment in Europe in 2016. Berlin: Joint report by MERICS and Rhodium Group. Retrieved from https://merics.org/en/report/record-flows-and-growing-imbalances-chinese-investment-europe-2016.
[15] Heinrich, T., & Kuhn, T. (2020, October 30). German foreign investment control. Retrieved from White & Case: https://www.whitecase.com/insight-our-thinking/germany-0.
[16] Jungbluth, C. (2018, October 18). Is China Systematically Buying Up Key Technologies? Chinese M&A transactions in Germany in the context of "Made in China 2025". Gütersloh: Bertelsmann Stiftung. Retrieved from Bertelsmann Stiftung: https://www.bertelsmann-stiftung.de/de/publikationen/publikation/did/is-china-systematically-buying-up-key-technologies.
[17] Jungbluth, C., Matthes, J., Beer, S., Sebastian, G., Zenglein, M. J., Strack, F., & Schaf, F. (2023). Gewinne deutscher Investoren in China – eine erste empirische Bestandsaufnahme. Gütersloh: Bertelsmann Stiftung.
[18] Kratz, A., Barkin, N., & Dudley, L. (2022b, September 14). The Chosen Few: A Fresh Look at European FDI in China. Retrieved from Rhodium Group: https://rhg.com/research/the-chosen-few/.
[19] Kratz, A., Zenglein, M. J., & Sebastian, G. (2022a). CHINESE FDI IN EUROPE 2020 UPDATE: Investment falls to 10-year low in an economically and politically challenging year. Berlin: Joint Report by Rhodium Group and the Mercator Institute for China Studies (MERICS). Retrieved from https://rhg.com/wp-content/uploads/2021/06/MERICSRhodium-GroupCOFDIUpdate2021.pdf.
[20] Larres, K. (2016, November 16). China and Germany: The Honeymoon Is Over. Retrieved from The Diplomat: https://thediplomat.com/2016/11/china-and-gemany-the-honeymoon-is-over/.
[21] Matthes, J. (2019). The German Economy's Dependence on China for Foreign Trade - A Collection of Facts. Köln: Cologne Institute for Economic Research/Institut der deutschen Wirtschaft (IW). Retrieved from https://www.iwkoeln.de/en/studies/juergen-matthes-the-german-economys-dependence-on-china-for-foreign-trade-a-collection-of-facts.html.
[22] Mercator Insitute for China Studies (MERICS) & Rhodium Group. (2023). EV Battery Investments Cushion Drop to Decade Low - Chinese FDI in Europe: 2022 Update. Berlin: MERICS&Rh. Retrieved from https://rhg.com/wp-content/uploads/2023/05/MERICS-Rhodium-9May2023.pdf.
[23] Meza, E. (2023, May 11). German minister opposes economic decoupling from China, but warns against over-reliance. Retrieved from Clean Energy Wire - Journalism for the energy transition: https://www.cleanenergywire.org/news/german-minister-opposes-economic-decoupling-china-warns-against-over-reliance.
[24] NDRC. (2016, December 7). The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China. Retrieved from The National Development and Reform Commission of the People's Republic of Chin: http://en.ndrc.gov.cn/policyrelease/201612/P020161207645766966662.pdf.
[25] Rhodium Group (Rhg). (2022, September 14). The Chosen Few: A Fresh Look at European FDI in China. Retrieved from Rhg: https://rhg.com/research/the-chosen-few/.
[26] Sebastian, G. (2022). The bumpy road ahead in China for Germany's carmakers. Berlin: Mercator Institute for China Studies (MERICS).
[27] Von Bieberstein, M. (2022, May 09). Germany Prohibits Acquisition of Heyer Medical by Chinese Investor. Retrieved from Cleary Gottlieb: Foreign Investment and International Trade Watch: https://www.clearytradewatch.com/2022/05/germany-prohibits-acquisition-of-heyer-medical-by-chinese-investor/.
[28] Wübbeke, J., Meissner, M., Zenglein, M. J., Ives, J., & Conard, B. (2016, December). Made in China 2025: The making of a high-tech superpower and consequences for industrial countries. Retrieved from Mercator Institute for China's Studies (MERICS) - Papers on China: https://merics.org/sites/default/files/2020-04/Made%20in%20China%202025.pdf.

Canada's Strategy for Key Critical Raw Materials. Case Study: Copper and Graphite

DANIEL BULIN
Economic integration and financial markets
Institute for World Economy – Romanian Academy
13th Septembrie, no. 13, District 5, Bucharest
ROMANIA
daniel.bulin@yahoo.com

Abstract: Critical minerals are of strategic importance in the new economy based on innovation and sustainability, as their unique properties make them essential for a wide range of advanced technologies. The expansion of technology and the demand for high-tech products are driving major world powers to actively seek access to a stable supply of rare minerals, especially in light of the overdependence on some countries or regions for key-resources. Canada is one of the major global players in the production and supply of critical minerals and has recognized their importance through country strategies. This article proposes a qualitative approach, an analysis of two of the most important key minerals –copper and graphite – that are priorities for Canada's critical resource strategy. The research is based on documentary analysis, the results of which are presented in the form of two independent case studies focusing on aspects such as mineral description and use, supply chain, production, Canada's access to resources, and trade. The global competitive component with China, the main player in most critical rare metals markets, is also considered.

Keywords: critical minerals, Canada's strategy, Cooper, Graphite, supply chain, trade

JEL Classification: *E23, F13, F23, L70*

1. Introduction

Canada currently extracts 60 minerals and metals from 200 mines and 6,500 sand and gravel quarries, and is home to nearly half of the world's publicly traded mining and mineral exploration companies, with a presence in over 100 countries and a cumulative market capitalization of these companies of $520 billion (Government of Canada, 2022a). In the National Critical Mineral Strategy, experts recognise that the North American country faces an opportunity as the energy transition and industries of the future depend on access to critical minerals (Government of Canada, 2022b).

Currently, the Canadian list of essential minerals includes 31 resources: aluminum, antimony, bismuth, cesium, chromium, cobalt, copper, fluorine, gallium, germanium, graphite, helium, indium, lithium, magnesium, manganese, molybdenum, nickel, niobium, platinum group metals, potassium, rare earths, scandium, tantalum, tellurium, tin, titanium, tungsten, uranium, vanadium, zinc (Government of Canada, 2022c).

Critical mineral mines, smelters, refineries, or advanced projects are located in all Canadian provinces and territories except Prince Edward Island (Government of Canada, 2022a):

- Alberta: advanced projects and smelters or refineries for the production and processing of lithium, nickel, cobalt, and titanium;
- British Columbia: advanced projects, smelters or refineries, and mines for molybdenum, niobium, aluminium, copper, zinc, bismuth, indium, and germanium;
- Manitoba: advanced projects and nickel, copper and cobalt mines;
- New Brunswick: advanced projects with access to tin, tungsten, indium, and gallium;
- Newfoundland and Labrador: advanced projects, mines, and smelters or refineries that mine or process rare earths, nickel, cobalt, antimony, and fluorspar;
- Northwest Territories: advanced projects mining minerals such as rare earths, cobalt, bismuth and copper;
- Nova Scotia: advanced projects for resources such as tin, tungsten, indium and gallium;
- Nunavut: advanced projects for zinc, copper, nickel, cobalt and platinum;

- Ontario: advanced projects, mines and smelters or refineries for chromium, graphite, nickel, cobalt and platinum;

- Quebec: advanced projects, mines and smelters or refineries for lithium, magnesium, rare earths, graphite, titanium, nickel, cobalt, platinum group metals, vanadium, niobium and aluminium;

- Saskatchewan: advanced projects, mines and smelters or refineries for uranium, potassium and helium deposits;

- Yukon: advanced copper and tungsten projects.

Canadian experts prioritized the minerals on the list, taking into account the urgent need to build supply chains, emphasizing the need to focus efforts on six key minerals: lithium, graphite, nickel, cobalt, copper, and rare earths (Government of Canada, 2022a).

2. Methodology

Based on the classification of critical resources in the Canadian strategy, we propose a qualitative analysis by the case study method for 2 of the 6 minerals in the priority category.

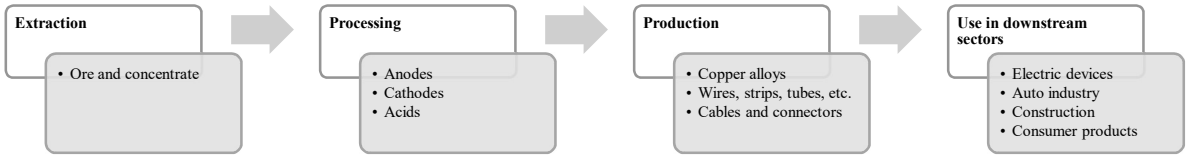
The objective of the analysis is to show Canada's position in the world, focusing on strengths, weaknesses, opportunities and existing threats. The following aspects are taken into account: the current situation of exploration and projects, Canadian production and main producers worldwide, trade and main partners, but also competition with China and its impact on global markets.

The case studies were organised as follows: Description and use (including supply chain), Production, Canada's access to resources, Trade.

3. Case study 1: Analysis of priority critical minerals for Canada: Copper

Description and se. Copper is a soft, corrosion-resistant metal that conducts heat and electricity well and is used in construction, power generation and transmission, electronics manufacturing, industrial machinery and transportation vehicles. This makes it an essential component of telecommunications, the automotive industry, and also many environmentally friendly technologies (e.g., electric vehicles) (Geology.com, 2022a). According to Canadian government statistics, the largest shares of global copper consumption in 2020 were in electrical equipment manufacturing (31%) and building construction (28%), followed by infrastructure projects (16%), transportation (12%), and other miscellaneous industrial uses (13%) (Government of Canada, 2022d).

Figure 1: Copper value chain



Source: Author representation, based on Ontario Mining Association (2022).

Production. Globally, copper production is relatively geographically concentrated in South America - Chile was first with 28.5% market share, Peru second with 11%). China closed the 2021 production podium with an 8.5% share of total global production, nearly three times that of Canada (Table 1).

Table 1: Worldwide copper production and reserves in 2021, in thousands of tons and %

Country	Production (thousand tons)	% production in total	Reserves (thousand tons)	% reserves in total
Chile	5600	27,.2%	200000	23%
China	1700	8.3%	26000	3%
Canada	*570*	*2.8%*	*9800*	*1.1%*
Total	**20600**	**100%**	**880000**	**100%**

Note: The table shows the production and reserves of the leading countries (2021 production), China and Canada.
Source: Author's compilation based on U.S. Geological Survey (2022a).

The world's leading producer, Chile, also has the largest copper reserves, estimated at 200 million tonnes in 2021, accounting for nearly a quarter (23%) of the global total, followed by Peru (11%) and Australia (10%), with Russia (7%), Mexico (6%), the United States (6%), and Poland (4%) also holding significant shares. China,

while leading in production, has reserves representing only about 3% of the world total (in 2021), while the remaining countries accumulate the remaining 31% of total reserves in a fragmented manner, including Canada with a share of only 1.1%.

3.1. Canada's access to resources

Canadian mines produced nearly 570,000 tons of copper concentrate in 2021, or about 2.8% of total world production. Data released by the Canadian government for 2020 show that British Columbia accounts for more than half of national production, and there are other Canadian regions where copper projects are being developed: Manitoba, Northwest Territories, Nunavut, Yukon (Government of Canada, 2022d). According to GlobalData's mining database, the five largest copper mines by production in Canada are located in British Columbia and are open pit mines: (1) Highland Valley Copper Mine - owned by Teck Resources, which produced about 119.3 thousand tons of copper in 2020 and will be in operation until 2040; (2) Gibraltar Mine - owned by Taseko Mines, which produced about 62.78 thousand tons of copper in 2020 and will operate until 2039; (3) Red Chris - owned by Newcrest Mining, produced approximately 40.07 thousand tons of copper in 2020 and will operate until 2043; (4) Mount Milligan Mine, owned by Centerra Gold, produced approximately 37.56 thousand tons of copper in 2020 and will operate until 2029; (5) Copper Mountain - owned by Copper Mountain Mining, produced approximately 35.177 thousand tons of copper in 2020 and will operate until 2051 (Mining Technology, 2021a).

The main copper mining company based in Canada is First Quantum Minerals, which owns its main project in Panama - Cobre Panama (a project that produced more than 715,000 tons of copper in 2020 despite interruptions during the pandemic restrictions), but also two other important projects, both in Zambia - Kansanshi and Sentinel (NS Energy, 2021a).

Chile is a key country in the race for copper (and more) as a resource. The South American country's pioneering relationship with its main partner, China, has turned into one of dependency, with the advance of Chinese investment in strategic sectors such as energy, mining, technology and telecommunications, banking, and health, a pressing issue pointed out by both economists and policymakers (Merics, 2022). The case of the Chilean state-owned company Codelco is also a major controversy (Global Americans, 2021): in 2005, the Chinese company China Minmetals signed a forward purchase agreement that gave it an initial $550 million loan at a 6% interest rate in exchange for preferential interest rates on future copper deliveries. The deal was criticized mainly because the price of Chilean copper was below market levels while international prices were rising.

As a result of situations as the one described abovet, but also because of political changes, the Chilean state has changed its view on mineral resources, with the new regulations in force or proposed being more restrictive than those of the South American state we were used to. In particular, Article 145 of the new Constitution (proposed but rejected in the referendum) (Forbes, 2022) would have provided that the State exercise absolute control over mines and mineral, metallic and non-metallic substances present in the national territory, as well as over deposits of fossil substances and hydrocarbons. Since the new legislation provides that the exploration, exploitation, and use of these substances will be subject to regulation that takes into account their limited, non-renewable nature, intergenerational public interest, and environmental protection, mining companies may be forced to devote more resources to environmental protection, which would mean higher costs (Financial Post, 2022). Although the constitution has not yet been adopted, the trends are obvious, and in this context, Chilean resources could even be an opportunity for Canada, which is known for its policies on environmental requirements. About 55 Canadian mining companies are present in Chile, and the country hosts about 11% of Canada's international mining assets, making Chile Canada's second largest mining market after the United States. While about 28% of Chile's mines are state-owned (operated by Codelco), there are many private mining companies, including from Canada: Teck Resources Ltd. and Los Andes Copper Ltd. are both based in Vancouver, as are Barrick and Yamana Gold Inc. in Toronto. Canadian mining assets in Chile are estimated at about $21.3 billion, according to the Department of Natural Resources (Financial Post, 2022). Notable projects include Vizcachitas, one of South America's largest advanced copper deposits with a copper equivalent of 13 billion pounds, wholly owned by Canadian company Los Andes Copper (Mining Watch Canada, 2022a).

In Peru, another country with significant copper deposits, China has two major projects: (1) the Las Bambas project in Apurimac, owned by China Minmetals (production of approx. 263.396 thousand tons of copper in 2020), which will be in operation by 2038; (2) the Toromocho project, owned by the Aluminum Corporation of China, is an open-pit mine in Junin (production of about 190,074 thousand tons of copper in 2020) that will be in operation by 2056 (Mining Technology, 2021b).

In terms of Canada's opportunities in Peru, the fundamentals for long-term projects are favorable: the two countries have existing trade relations through the Canada-Peru Free Trade Agreement (2009) and the

Comprehensive and Progressive Agreement for the Trans-Pacific Partnership (2021), and Peru is Canada's second largest bilateral trading partner and Canada's second largest destination for direct investment in Central and South America (Government of Canada, 2022e).

3.2. Trade

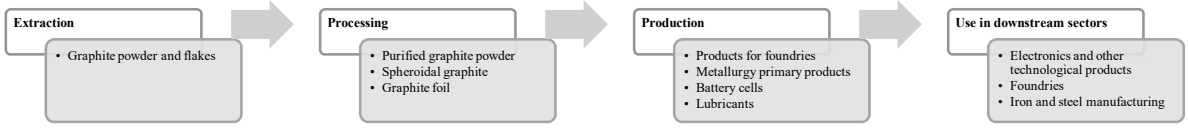
In terms of trade in copper (gross, products only), according to the Observatory of Economic Complexity, Canada exported $1.13 million worth of raw copper in 2020, with the main destination being almost exclusively India ($1.11 million). In contrast, Canada imported $525 million worth of unwrought copper, making it the eighth largest importer of unwrought copper in the world. Canada imported unwrought copper primarily from Chile ($439 million), but also from Zambia ($69.9 million), the United States ($9.92 million), and Macau ($5.58 million) (The Observatory of Economic Complexity [OEC], 2022a).

In comparison, China's position in copper trade shows that exports in 2020 were only $4.53 million in raw copper, with the main destinations being Malaysia ($1.03 million), Singapore ($1.02 million), Burma ($597 thousand), the Netherlands ($568 thousand) and Thailand ($489 thousand), while imports amounted to $5.34 billion- - the largest importer worldwide, had as source markets Zambia ($1.19 billion), Chile ($1.05 billion), Namibia ($933 million, but also the Democratic Republic of Congo ($566 million) or Belgium ($373 million) (The Observatory of Economic Complexity [OEC], 2022b).

4. Case study 2: Analysis of priority critical minerals for Canada: Graphite

Description and use. Graphite is an extremely soft, non-metallic mineral that has a very low specific gravity but is extremely heat resistant and nearly inert in contact with almost all other materials; these extreme properties give it a wide range of uses (Geology.com, 2022b). For example, graphite (natural or synthetic) is used for electrodes, refractory materials, batteries (including lithium-ion batteries), and lubricants, as well as fuel cells, semiconductors, LEDs, and nuclear reactors. Synthetic graphite (about 38% of total graphite) is used for electrodes (32%), carburizing (10%), graphite forming (4%), lubricants (4%), and other purposes (12%), while natural graphite (about 62%) is used for refractory materials (16%), batteries (8%), foundries (5%), and other purposes (9%) (Government of Canada, 2022f).

Figure 2: Graphite value chain



Source: Author representation, based on Ontario Mining Association (2022).

Production. In 2020, global graphite consumption reached 2.7 million tons, with synthetic graphite accounting for about two-thirds of consumption (Government of Canada, 2022g). In 2021, China was the world's largest graphite producer, accounting for over 80% of total global production. In 2021, graphite supply began to recover and China expanded its dominant position on global markets (from around 70% in 2020).

Table 2: Worldwide graphite production and reserves in 2021, in thousands of tons and %

Country	Production (thousand tons)	% production in total	Reserves (thousand tons)	% reserves in total
China	820	82%	73000	22.8
Brazil	68	6.8%	70000	21.9
Canada	***8.6***	***0.86%***	*:*	*:*
Total	**1000**	**100%**	**320000**	**100%**

Note: The table shows the production and reserves of the leading countries (2021 production), China and Canada.
Source: Author's compilation based on U.S. Geological Survey (2022b).

In 2021, global graphite reserves were estimated at around 320 million tonnes. Although Turkey has not had a significant share of production in recent years, it has the largest graphite reserves (90 million tonnes), followed by China and Brazil (the world's second largest producer, but with a share of only 6.8%). Together, Turkey, China and Brazil hold almost three quarters of the world's currently estimated graphite reserves.

4.1. Canada's access to resources

Canadian production in 2021 was estimated at 8.6 million in United States Geological Survey (USGS) statistics, which differ from those published by the Canadian government, representing less than 1% of world production, while Canadian reserves are insignificant relative to world production (U.S. Geological Survey, 2022b).

The main mining companies in Canada engaged in exploration and development of new projects are (Graphene-info, s.a.): Alabama Graphite (active projects in two graphite mines in Alabama, USA), American Graphite Technologies (AGT) (owns mineral resource claims in the state of Quebec), Focus Graphite (formerly Focus Metals) - an Ottawa-based mine development and technology company that owns high-grade technological graphite resources at Lac Knife in Quebec (about 16%), Gratomic - with projects to extract and market graphite products - especially graphene-based nanomaterials. The newly established company Lomiko Metals Inc. with new projects in exploration Mason Graphite is developing the Lac Gueret graphite project (wholly owned) in northeastern Quebec Northern Graphite Corporation with the Bissett Creek graphite project, Saint Jean another publicly traded mining exploration start-up that owns five mining properties in the Canadian province of Quebec (Walker, Wallingford, Zentek Ltd, an Ontario-based mineral exploration and development company developing the Albany graphite deposit - a rare hydrothermal graphite deposit with the potential to produce high-purity natural graphite competitive in the high-tech markets where synthetic graphite is traditionally traded.

Canadian companies also have a number of significant projects outside the country:

- Leading Edge Materials Corp. is a Canadian company that owns a portfolio of critical resource projects in the European Union (the company has 100% ownership of the Woxna graphite mine and processing plant in Sweden) (Investor Intel, 2021);
- NextSource Materials Inc. has developed the Molo graphite project (100% owned) in Madagascar; the Molo processing plant is capable of processing 240 thousand tons of ore per year to produce an average of 17 thousand tons of graphite concentrate; NextSource also has project plans to build battery anode production facilities and to collaborate with Panasonic-Tesla (Mining.com, 2022a).
- The Santa Cruz graphite project is an open-pit graphite mine in the Brazilian state of Bahia being developed by Canadian company South Star Mining, which owns the property through its wholly owned subsidiary Brasil Grafite (Mining Technology, 2021c).

4.2. Trade

According to government statistics, the value of Canadian graphite exports in 2020 was $31.6 million, down 9% from the previous year. Imports also decreased by 33% to $20.9 million in 2020. Natural graphite accounted for 46.7% ($14.8 million) of the value of Canadian graphite exports and 13.5% ($2.8 million) of Canadian graphite imports in 2020 (Government of Canada, 2022f). Synthetic graphite accounted for 53.3% ($16.9 million) of Canadian exports and 86.5% ($18.0 million) of imports. The United States is the top destination for Canadian exports of natural and synthetic graphite, accounting for 85% and 42% of total exports, respectively (in 2022).

According to the The Observatory of Economic Complexity [OEC] (2022c), Canada exported $11.3 million worth of graphite, making it the tenth largest graphite exporter in the world. The main destination of Canadian graphite exports was the United States ($8.78 million), while other markets were rather insignificant in terms of volume (e.g., Germany - $787,000 or Japan - $336,000). In terms of imports, the OEC shows that Canada imported $2.47 million worth of graphite in 2020, mainly from the United States ($1.22 million) and China ($633,000), but also, to a lesser extent, from Germany ($198,000), Madagascar ($139,000), and the United Arab Emirates ($126,000).

China's position in copper trade shows that the Asian country exported $290 million worth of graphite in 2020, making it the world's leading graphite exporter. The main export destinations were South Korea ($101 million), Japan ($91 million) and, to a lesser extent, India ($14.6 million), the United States of America ($14.2 million) and Germany ($10 million). Imports totaled $18.3 million (seventh largest importer), mainly from Madagascar ($6.94 million), Japan ($3.29 million), Germany ($1.1 million), Mozambique ($1.09 million), and the United States ($987 million) (The Observatory of Economic Complexity [OEC], 2022d).

5. Conclusion

The copper price was relatively stable in 2016-2019, but experienced significant fluctuations after 2020, reaching a low in March 2020 compared to recent years, followed by a continuous increase in the following 12

months, which then followed fluctuating dynamics (Macrotrends, 2023). The transition to green energy will increase copper demand due to its benefits for the necessary expansion of electrification networks and technologies. However, new projects in Chile, Congo, Indonesia, and Peru are in progress over the next 5 years, which could (re)stabilise prices (Ontario Mining Association, 2022).

Although China supplies just over 40% of refined and smelted copper, the proportion is not as much of a concern as for other minerals, although there is significant spatial concentration globally (South America). Since copper is generally not included in the list of critical minerals, risks are effectively mitigated, although copper substitutes generally have poorer properties, making them an important material for downstream industries (Ontario Mining Association, 2022). In the short term, graphite prices may continue to face downward pressure as Chinese producers have ramped up production to fill the supply gap created by the COVID -19 pandemic. In the medium to long term, the price is expected to remain relatively stable due to large production capacities, despite expected higher demand (for lithium-ion batteries and high-tech applications). Although production from the main producer, China, has increased with the lifting of restrictions, accelerated electrification in the automotive industry will create strong demand in the short term, while the impact of the expansion of innovative refining technologies will be felt in the medium to long term.

References:

[1] Financial Post (2022). How Chile's political shift to the left could raise risks for Canadian miners, available at: https://financialpost.com/news/economy/canada-chile-trade-miners-business-risks-constitution

[2] Forbes (2022). Chile respinge noua constituție progresistă, available at: https://www.forbes.ro/chile-respinge-noua-constitutie-progresiva-286161

[3] Geology.com (2022a). Uses of Copper. Copper Uses, Resources, Supply, Demand and Production Information, available at: https://geology.com/usgs/uses-of-copper/

[4] Geology.com (2022b). Graphite. Graphite and diamond have the same composition but completely different properties, available at: https://geology.com/minerals/graphite.shtml

[5] Global Americans (2021). Chinese advances in Chile, available at: https://theglobalamericans.org/2021/03/chinese-advances-in-chile/

[6] Government of Canada (2022a). Canada's critical minerals strategy: Discussion paper. Opportunities from Exploration to Recycling: Powering the Green and Digital Economy for Canada and the World, available at: https://www.canada.ca/en/campaign/critical-minerals-in-canada/canada-critical-minerals-strategy-discussion-paper.html

[7] Government of Canada (2022b). The Canadian Critical Minerals Strategy. From Exploration to Recycling: Powering the Green and Digital Economy for Canada and the World, available at: https://www.canada.ca/en/campaign/critical-minerals-in-canada/canadian-critical-minerals-strategy.html

[8] Government of Canada (2022c). Critical minerals: an opportunity for Canada, available at: https://www.canada.ca/en/campaign/critical-minerals-in-canada/critical-minerals-an-opportunity-for-canada.html

[9] Government of Canada (2022d). Copper facts, accesat la: https://www.nrcan.gc.ca/our-natural-resources/minerals-mining/minerals-metals-facts/copper-facts/20506

[10] Government of Canada (2022e). Mining market in Peru, available at: https://www.tradecommissioner.gc.ca/peru-perou/market-reports-etudes-de-marches/0006601.aspx?lang=eng

[11] Government of Canada (2022f). Graphite facts, available at: https://www.nrcan.gc.ca/our-natural-resources/minerals-mining/minerals-metals-facts/graphite-facts/24027

[12] Graphene-info (s.a.). Graphite mining companies, available at: https://www.graphene-info.com/companies-list/graphite-mining-companies

[13] Investor Intel (2021). The Top 5 graphite miners to watch in 2022 as battery materials' prices rise, available at: https://investorintel.com/critical-minerals-rare-earths/the-top-5-graphite-miners-to-watch-in-2022-as-battery-materials-prices-rise/

[14] Macrotrends (2023). Copper Prices - 45 Year Historical Chart, available at: https://www.macrotrends.net/1476/copper-prices-historical-chart-data

[15] Merics (2022). Chile's once-pioneering relationship with China is turning into dependency, available at: https://merics.org/en/chiles-once-pioneering-relationship-china-turning-dependency

[16] Mining Technology (2021a). Five largest copper mines in Canada in 2020, available at: https://www.mining-technology.com/marketdata/five-largest-copper-mines-canada-2020/

[17] Mining Technology (2021b). Five largest copper mines in Peru in 2020, available at: https://www.mining-technology.com/marketdata/five-largest-copper-mines-peru-2020/

[18] Mining Technology (2021c). Santa Cruz Graphite Project, Bahia, available at: https://www.mining-technology.com/projects/santa-cruz-graphite-project-bahia/

[19] Mining Watch Canada (2022a). Chile in the crosshairs of a Canadian resource rush, available at: https://miningwatch.ca/news/2022/2/15/chile-crosshairs-canadian-resource-rush

[20] NS Energy (2021a). Profiling the five largest copper mining companies in the world, available at: https://www.nsenergybusiness.com/features/largest-copper-mining-companies
[21] Ontario Mining Association (2022). Critical Minerals Analysis, available at: https://oma.on.ca/en/ontario-mining/2022_OMA_Mineral_Profiles.pdf
[22] The Observatory of Economic Complexity [OEC] (2022b). Raw Cooper in China, available at: https://oec.world/en/profile/bilateral-product/raw-copper/reporter/chn
[23] The Observatory of Economic Complexity [OEC] (2022c). Graphite in Canada, baza de date interactivă accesată la: https://oec.world/en/profile/bilateral-product/graphite/reporter/can
[24] The Observatory of Economic Complexity [OEC] (2022d). Graphite in China, available at: https://oec.world/en/profile/bilateral-product/graphite/reporter/chn
[25] The Observatory of Economic Complexity [OEC](2022a). Raw Cooper in Canada, baza de available at: https://oec.world/en/profile/bilateral-product/raw-copper/reporter/can
[26] U.S. Geological Survey (2022a), Copper. Mineral Commodity Summaries, January 2022, available at: https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-copper.pdf
[27] U.S. Geological Survey (2022b), Graphite. Mineral Commodity Summaries, January 2022, available at: https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-graphite.pdf

Critical Minerals - Vital Ingredients and Huge Challenge to Energy Transition

SARMIZA PENCEA
Economic Development Models Dept.
Institute for World Economy
Calea 13 Septembrie nr. 13, Sector 5, Bucureşti
ROMÂNIA
pen_sar@yahoo.com

Abstract: As mankind engages on yet another bold development cycle, all the newly-designed high technologies for a more sustainable future, primarily the technologies required by the energy transition, depend, inevitably, in terms of their implementation, on the mineral resources that our planet can provide. Especially the minerals deemed critical. This article looks at the impact that the switch to a new paradigm in the way we produce and consume energy is inflicting on the global demand for critical minerals, at the challenges and risks posed by this unavoidable process, as well as at the opportunities and the positive spillovers brought by it, providing relevant examples and data from the industries involved. Throughout this analysis, the conventional fossil fuels-based energy system and the renewable energy-based new system are compared from different angles, both in terms of their impact on the industries and markets of critical minerals, and of their strong influence on the socio-economic environment, on the international relations between states and the strategic and geopolitical interplay between the most important global technological powers of our time.

Keywords: critical minerals, high technologies, energy transition, electric cars, EV, rechargeable batteries, photovoltaic panels, PV, wind turbines, renewable energy

JEL Classification: N70, O13, Q40, Q42

1. A new paradigm in energy production and use

Humankind has developed and kept progressing by using both our planet's natural resources and human resources of smartness and creativity. Mankind exists and thrives thanks to humans' ability to harness not only our planet's flora, fauna and soil, but also the metallic and non-metallic minerals, the chemical elements and their compounds, as well as the fossil fuels that form deposits in the earth's crust.

As an expression of the utmost importance that mineral resources had in our evolution, the very first stages of human existence were identified in history as time-frames in which early collectivities made their main discoveries on how to extract, transform and use the planet crust's resources, naming these stages accordingly: as the first humans used minimally and rudimentary finished rocks to serve as tools or weapons, this evolutionary stage in their existence was named *the stone age*; later on, as they have gradually discovered and learned how to extract and process certain metals for their needs, the successive development stages of mankind were named after the metal predominantly used, *the bronze age* and then *the iron age*. Gold and silver, some of the first metals processed by man, have initially been used to create adornments, but later, with the advent and fillip of trade, they were also processed into coins, becoming payment instruments in commercial exchanges and giving a huge boost to development. Similarly, every other mineral, metal or source of energy discovered, processed and used along millennia contributed to the economic, technological and social progress of mankind, sometimes acting even as triggers of deeply transformative industrial revolutions.

As, on the one hand, they are essential to meeting peoples' primary needs (heating, light, cooked food) and, on the other hand, they are indispensable to the great majority of manufacturing and transport activities, *fossil fuels energy resources* (coal, oil, natural gas) were, and they still are, the pivot around which the world economy is organized and functions, having a huge impact on both the economic progress, the living standards, the national security of states and on their place in the world economy and hierarchies. Also – as the recent history shows – they can become potent geopolitical and geostrategic instruments of coercion of the states that are short of such resources, by the states that control them (see OPEC or Russia's oil and gas policies, for instance).

For centuries *fossil fuels* have been the premises of progress, richness and power, but also, as we more recently realize, they have been one of the main root-causes of the current environmental damage through land, water and air pollution, greenhouse effect and global warming that lead to climate change and extreme phenomena (floods, hurricanes, drought, wildfires etc.) which not only make havoc and victims increasingly often in various parts of the world, but they also gradually transform the geography itself (by desertification, glaciers and polar ice cap melting, sinking islands and ocean shores etc.) and deplete Earth's flora and fauna.

Life on Earth is seriously endangered. Therefore, it has become increasingly clear and accepted that the ***fossil fuel energy resources have neared the end of their pivotal role in the economic development of nations and in the economic, commercial, political and geostrategic relations between states.*** In terms of energy needs, nations must completely rethink both how they obtain and how they consume energy. In fact, the current industrial revolution envisages what life itself imposes on us with a high degree of emergency: a worldwide switch from fossil fuels used as source of energy, to new technologies that harness only clean and preferably renewable energy sources, doubled by a steady focus on drastically reducing pollution, wastage and the carbon content in the atmosphere, as well as a greater concern for recycling and efficient waste management. In a nutshell, we need to completely change the way in which we live, work, travel and produce goods and services.

In the new rationale of decarbonisation, the vehicles propelled by internal combustion engines and powered by fuels of fossil origin are already being replaced by new transport means - electric vehicles (EV) - equipped with electric engines powered by rechargeable electric batteries. In its turn, the electricity these batteries are stocking, or that which is used for heating, productive activities and everywhere else, should come either from the well-established technology of hydropower stations, or from solar parks, land and sea wind farms, geothermal installations and other new types of power producing units that harness clean and renewable energy from the water and air kinetics, solar radiation, or the Earth's inside heat.

The technologies and part of the new equipment and installations needed by this transition exist, are in production and some are already in use in sufficiently large numbers to reach the necessary economies of scale that make prices plunge and become accessible to customers while they are still profitable for producers, with no further need for subsidization.

Still, adopting the new paradigm of clean energy and of the world economy "turning green", brings important new challenges. They are primarily connected with the raw materials needed (i) to build the new types of power producing equipment – such as the photovoltaic panels (PV) for solar parks, or the turbines for wind farms –, (ii) to manufacture the devices that can efficiently stock and provide electricity according to needs (EV batteries, but also larger energy storage devices to be integral parts of the power grid systems) and (iii) to produce and use extensively new, non-polluting means of transport by land, water and air. All of these require both much larger quantities and a broader range of different raw materials, some of them quasi-ignored, hardly used and even thrown away in the past, but essential and irreplaceable when implementing these new technologies. As the minerals they are extracted from are either found in insufficient quantities and sometimes in just a few places on Earth, as they are often very difficult and polluting to extract and to process, as they may be subject to a (quasi)monopolistic regime or may be located in politically and economically unstable countries, they a prone to often disrupt the value chains of all the new high tech products and revolutionary technologies that depend on them and, as such, providing enough of them will be a great challenge for the global energy transition. That is why they are now considered *critical mineral resources* (CMR).

The most technologically developed countries of our time – US, EU, Japan, South Korea, Canada, Australia – have put together national lists of the minerals that are deemed critical from their specific point of view, lists which they periodically revise and upgrade with the purpose of better monitoring CMRs' availability and of devising the proper strategies to ensure that their high tech industries are not hampered by insufficient access to these inputs. Nevertheless, their totally justified alertness is late, as most of these critical mineral resources many of the raw materials and even the final products that are processed from them are currently controlled by China, a country known for its long-term approach in its strategies, that has already envisaged the issue and is decades ahead in implementing policies that placed itself in this favorable position, to the disadvantage of the other actors in the global markets, who are now dependent on China and quite vulnerable. Besides CMRs scarcity, access control by China is another big challenge that the other countries have to face during the energy transition and, in the case of some, primarily the US, in their technology war with China.

2. Energy transition and the demand for critical minerals

As mankind engages on yet another bold development cycle, all the newly-designed high technologies for a more sustainable future, primarily the technologies required by the energy transition, depend, inevitably, in terms of their implementation, on the mineral resources that our planet can provide. Especially the minerals deemed critical.

According to current knowledge on global mineral deposits, many critical minerals are scarce, either geographically concentrated in a few countries, or extremely dispersed all over the globe, so that they are rarely found in sufficient volumes to be mined at a profit. Additionally, they are difficult and very polluting to extract and process, and are often under the control of only a few actors, either their source-countries, or, most often, China. That is why procurement is and will continue to be difficult and value chains are and will continue to be easily disrupted.

On the other hand, CMRs are vital for the new technologies in general and specifically for the energy transition, many of them having unique qualities that render them irreplaceable, at least at this stage of technological development. As such, in the foreseeable future, demand will be on the rise and countries will have to fiercely compete for these resources. That will further trigger price upswings, but it might also encourage investors to reopen former inefficient mines and new explorations might be decided and financed. Still, new mines often need long time-frames, sometimes more than a decade, to become operational and, therefore, their positive impact on the market is most probably going to be felt with a considerable delay.

Energy transition and the ambitious plans of many countries regarding the *green revolution* have already triggered a considerable upswing in critical minerals demand and prices. In fact, ***the most active part of the critical minerals demand comes from the key industries involved in the low-carbon emissions crusade waged as part of the energy transition process*** – the manufacturers of electric vehicles (EV), photovoltaic panels (PV), wind turbines, batteries and other equipment that can store electricity etc. – ***as well as from their subcontractors*** – the producers of various types of semiconductors, electric batteries, permanent magnets, alloys, oxides and other secondary processing commodities etc. Hence, ***clean energy transition turned the energy sector into a major force in the minerals' global markets, where it had been an insignificant presence before 2015, but afterwards it started playing an increasingly important role.*** In the synoptic table hereunder one can see the most significant metals involved in the current energy transition – including those processed from critical minerals –, along with the final products and technologies which require them.

Table 1: Critical mineral inputs for the transition to new energy technologies

Critical minerals	Electric engines	Concentrating solar power	Energy Storage	Carbon capture and Storage	Electric Vehicles (EV)	Nuclear electricity generation	Photovoltaic panels (PV)	Light emitting diodes	Wind Turbines
Aluminum	■	■	■	■			■	■	■
Chromium				■		■		■	■
Cobalt			■	■	■	■			
Copper	■			■	■	■	■	■	■
Indium					■	■	■	■	
Iron(cast)		■	■					■	■
Iron(magnet)	■								■
Lead						■	■	■	■
Lithium			■		■				
Manganese			■	■	■				■
Molybdenum				■		■	■	■	■
Neodymium*					■				■

Nickel			▪	▪	▪	▪	▪	▪	▪
Silver		▪			▪	▪	▪	▪	
Steel									▪
Zinc							▪	▪	

Note: *A proxy for rare earths (REE).
Source: World Bank (2017).

The newly developed technologies for the energy transition and the materials they use are creating the prospect of a swift increase in the demand for minerals that used to be produced only in comparative small quantities not long ago. This is, for instance, the case of *lithium, cobalt* or *nickel,* needed for the *rechargeable batteries* that equip the EVs, or of the *rare earths elements* (REEs), which are now indispensable for the *fluorescent bulbs* production and, more importantly, for the manufacturing of the *permanent magnets* that are vital for wind turbines and electric vehicles, or it is the case of elements such as *cadmium, tellurium, indium*, needed to produce the *photovoltaic cells* (Eggert, 2010; IEA, 2020). Hereunder we exemplify in more concrete terms how the critical minerals demand is propelled by the pressure exerted by the downstream industries involved in the energy transition.

Example no. 1: electric vehicles and batteries

There were 11.2 million electric cars in use in 2020, but according to IEA[1], if governments intensify their efforts to reach the energy transition and climate goals, the global EV number is expected to reach 145 million units by the end of this decade and 230 million units by 2050. A single EV needs on average 1 kg of REEs to produce the permanent magnets that make a vital part of its electric engine, therefore, such an upswing in expected EV production will be reflected in a similarly abrupt growth of REE demand. Another important and at the same time the most expensive component of any EV is its rechargeable battery and again when the EV global fleet is expected to register such a growth, the demand for electric batteries is of course expected to increase accordingly. This upswing will further trigger a considerable increase in the global demand for *lithium, cobalt, nickel, graphite* and the other metals and materials used in the electric battery production.

To give a rough idea on the critical minerals growing needs under the circumstances, Table 2 presents the mineral mix in an average electric Li-ion battery, while Table 3 provides a relevant comparison between the usual lead-acid battery technology for an internal combustion car, and the new technology of the Li-ion battery for EVs, in terms of the metals they require: while the older technology needs only lead and steel, the second one, for EVs, needs six different metals, at least four of them included in the critical minerals listings of all the technologically developed countries. Also, as Table 2 reveals, not only the diversity of metals required by the newer technology, as seen in Table 3, but also the quantities of metals needed for an average Li-ion battery that propels electric vehicles, critical ones included, are quite impressive.

Table 2: The metals and minerals[2] mix in an average Li-ion battery for EV (60KWh), 2020

Minerals used in a 60KWh Li-ion battery	The components in which they are used	Total quantity per average battery (kg)	Percentage of the battery weight (%)	Notes*
1. Graphite	Anode	52	28.1	Abundant, cheap resource, with a long life cycle.
2. Aluminum	Cathode, case, electricity collectors	35	18.9	

[1] IEA = International Energy Agency
[2] The materials used in the electrolytes, glues, separators and cases are not included.

3. Nickel	Cathode	29	15.7	It is used to increase the energy density
4. Copper	Electricity collectors	20	10.8	It has the highest electric conductivity
5. Steel	Case	20	10.8	
6. Manganese	Cathode	10	5.4	It is a stabilizer, it increases safety
7. Cobalt	Cathode	8	4.3	It is a stabilizer, it increases safety
8. Lithium	Cathode	6	3.2	
9. Iron	Cathode	5	2.7	
TOTAL		185 Kg	100%	

Note: *Based on the general literature in the field.
Source: Bhutada (2022).

Table 3: Comparison of the metal content in lead-acid and Li-ion batteries

Metals required	Energy storage batteries	
	Lead-acid	Lithium-ion
Aluminum		▪
Cobalt		▪
Lead	▪	
Lithium		▪
Manganese		▪
Nickel		▪
Steel	▪	▪

Source: World Bank (2017).

Moreover, keeping in mind the expected up-swing in EV production and considering the data in Table 4, which provides another relevant comparison, this time between the metals needed for the manufacturing of an electric car, versus those necessary for building a conventional one, we can get a pretty good idea on the huge size that demand for critical minerals might come to reach by 2030 and further on by 2050 and on the pressure that EV manufacturing might inflict on the critical mineral resources, on their exploration, mining, processing, pricing, competition and trade between firms and between countries.

Table 4: Metal demand – comparison: electric car vs. conventional car

Kg/car	Copper	Lithium	Nickel	Manganese	Cobalt	Graphite	Zinc	REE
Electric car	53.2	8.9	39.9	24.5	13.3	66.3	0.1	0.5
Conventional car	22.3	-	-	11.2	-	-	0.1	-

Source: IEA (2020; 2021).

Manufacturing more electric vehicles is going to push up the extension of production capacities for electric batteries. In 2020, the global production capacity of rechargeable electric batteries cumulated 755 GWh, but in the project and building phases there were additional capacities of other 3792 GWh (or 3.8TWh) by 2030, accounting for a 402% capacity increase in the 2020-2030 time-frame. Out of the entire 2030 global production capacity, 70% is projected to be built in China, 16% in Europe and 11% in North America. Against this

background, *lithium* demand is estimated to jump from 300,000 m.t.[3] in 2020, to 1 million m.t. in 2025 and to 2 million tons in 2030 (Palandrani, 2021). Due to its central role in replacing fossil fuels with EVs in transports, *lithium* is considered the „oil of the future" (Durkin, 2021).

According to the EU forecasts, *cobalt* demand is going to increase 5 times by 2030 while *lithium* demand will grow 18 times by 2030 and 60 times by 2050 (Eggert, 2010; IEA, 2020; Wrede, 2022). Also, in one of its studies IEA (2021) forecasted a 50 times larger demand for *lithium* and 30 times larger for *cobalt* and *graphite* in 2040, as compared to their levels of 2020.

According to market analysts, the world's largest auto-makers plan to spend nearly USD1.2 trillion in order to develop and manufacture millions of electric vehicles, batteries and raw materials for these (Barrera, 2023). The impact of the global automotive industry's growing demand for the critical minerals needed in the EV production is already being felt, pushing raw materials prices up, and this trend is going to continue.

Example no. 2: wind turbines

In 2020, the size of the global market for wind turbines was evaluated at USD 54.3 billion and forecasted to reach USD 98.4 billion in 2030, at a compound annual growth rate (CAGR), going to become, as such, one of the most dynamic energy sector.

According to IREA[4], to reach carbon emissions neutrality by the middle of this century, the global cumulated capacity of land wind turbines should triple by 2030 (up to 1787 GW) and to increase nine times by 2050 (up to 5044 GW) relative to the 2018 level, when the global installed capacity totaled 542 GW. With such a fillip of wind turbines installations, the need for permanent magnets and implicitly for the heavy rare earths (HREE) they are made from (neodymium, praseodymium, dysprosium, and terbium) is expected to grow explosively. Considering that just one terrestrial wind turbine needs to be equipped with permanent magnets that require 600 kg of heavy rare earths to be produced, it is obviously anticipated that the pressure on REE mining and refining will become huge, the more so as HREEs normally make only one third of the total REE volumes extracted (Mitchel, 2022)[5].

Permanent magnets are used not only in wind turbines production, but also in the manufacturing of electric engines for EVs. For 2021-2030, *Adams Intelligence* consultancy predicts a jump at 9.7% CAGR in the world demand of REE oxides for permanent magnets (mainly for neodymium, praseodymium and didymium) estimating that the global shortfall for these oxides will reach 16000t in 2030. This is expected to further generate an annual 48000t deficit in the global offer of neodymium-iron-boron powder and alloy by 2030, which is the necessary quantity to produce 25-30 millions electric engines for EVs (Mitchel, 2022).

Growing demand for HREEs already pushes prices up and the trend will certainly go on.

Example no. 3: photovoltaic panels

Similarly, photovoltaic panels demand is expected to rapidly grow, as the electricity from solar source has already become the cheapest electricity ever produced by mankind. Also, one can expect a swift surge in global photovoltaic panels demand considering IEA's predictions that, as compared to 2019 when solar energy met only 2% of global electricity demand, by 2050 the photovoltaic parks' production will come to cover about one third of the world's electricity demand (Watson, 2022).

Investors feel encouraged to massively finance solar parks installation. Only China, the largest world manufacturer of PVs and leader of this upward trend, plans to increase its installed solar capacities by 25 GW annually by 2030, an endeavor that will determine that one third of the worldwide solar capacity installed between 2019 and 2030 to be in this country. Obviously, such an upswing in demand for PV production and installations will generate a huge demand for the necessary critical minerals, especially for *gallium, cadmium, tellurium, indium,* but also for *aluminum* (Umar, 2019).

[3] m.t. = metric tons

[4] IREA = International Renewable Energy Agency

[5] There are 17 different elements included in the group called rare earths/rare metals (REEs), some of them light (LREEs), some heavy (HREEs). They have very different features, but are to be found mixed together in common ore deposits, which makes industrial separation a complex, difficult and highly polluting process. For high tech industries the heavy rare earths are of interest, but these normally make only one third of the mixed ores extracted, therefore to get the necessary quantities it must be roughly mined and refined a three times bigger quantity of REE ore. This has obviously an impact on costs, prices and the necessary time to produce the required HREE volumes.

Example no 4: semiconductors

The most advanced technologies of present and future, including the fundamental ones for the energy transition, depend on the capacity of humankind to manufacture increasingly sophisticated and advanced semiconductors[6] (e.g. *leading-node logic chips,* the most advanced semiconductors that are essential for the on-coming quantum computing, artificial intelligence, robotics, advanced wireless networks and all the other daring technologies of the future). At the very least, manufacturing any logic semiconductors requires over 300 different materials (i.e. minerals, industrial gases and chemicals, with very specific and sometimes unique features that render them irreplaceable).

Almost a decade ago, the American chip-maker *Intel* stated – and it was later on confirmed by the evaluations of the *UK Office of Science and Technology* -, that if in the 1980s production of semiconductors for computers used raw materials derived from 11 chemical elements and in the 1990s there were used to the same purpose 10-15 elements, by 2020 microchip manufacturing was already using 60 elements from the Periodical Table. Altogether, in 2020 the minerals' and metals' usage rate increase triggered by the down-stream industries demand reached 80% of the global production of *REEs, indium, gallium*, and of all the metals in the *platinum group*, relative to the situation in 1980 (Eggert, 2010; Umar, 2019).

Minerals are crucial for semiconductor industry, some of the most used of them including *silicon, gallium arsenide, REEs and cobalt.* As semiconductors are required in more and more diverse and sophisticated applications, their demand has soared in terms of both quality (speed, safety of operation etc.) and quantity, generating in recent years a steep surge in the demand for the critical minerals and metals that they use. For instance, *cobalt* demand has grown by 30% during the short 2019-2020 time-frame, while the demand for *ruthenium* and *iridium* increased by triple digits between early 2020 and early 2022 and *silicon* demand jumped by 300% in less than a year, between August and December 2021 (Dwivedi & Wischer, 2022). Such abrupt surges in demand almost always determine significant supply shortages and prices up-swings, and the more so this happens in the case of the minerals deemed critical.

To better understand the impact that the shortage of critical minerals might inflict on the semiconductor industry, the US case - the country where this technology was born and which still remains one of the few major chipmakers in the world -, seems to be most telling: in 2018 the US Geological Survey identified and listed 35 minerals as *"... critical to the economic and national security of the United States"*. Out of the 35 critical minerals, not less than 30 have a direct impact on chip production, for 23 of these 30 minerals, the US import reliance goes beyond 75%, and for 12 of the 23, there is an import reliance of 100% on a single source, and that source is China (Dwivedi & Wischer, 2022). Obviously US microchip production influences global demand for most of the critical minerals in the US list (30 of the total 35!) and insufficient supply of any of the 30 minerals, which in their great majority are imported, have a considerable potential to disrupt US semiconductor supply chains and production. As China is dominant in both the mining and refining of most of the critical minerals included in the highly developed countries' lists, not only the US, but also the EU, Japan, South Korea and probably others are in different degrees vulnerable, risking supply disruptions, price manipulation and even geo-political pressure and blackmail.

3. Energy transition and the critical minerals' challenges

Energy transition is not an easy or quick process. On the contrary, switching to a completely new paradigm in energy production and consumption, replacing fossil fuels with renewable and non-polluting energy sources and completely reforming and reorganizing the functioning of our future world around a new pivot, the critical mineral resources are very complex, lengthy and challenging transformations, both on the demand and supply side. At the same time is unavoidable.

3.1 Demand-side challenges

As already demonstrated, ***energy transition is intensive in critical mineral resources***, leading as such to a strong surge in critical minerals demand. The energy systems resting on technologies that harness clean and renewable energy resources differ profoundly from the conventional ones still in operation, which rely on burning fossil fuels. Building photovoltaic parks, wind farms or electric vehicles, as the new paradigm requires, consumes

[6] Semiconductors, integrated circuits, (micro)chips are notions roughly equivalent and are generally, as well as in this article, used interchangeably.

considerable more mineral resources than the power stations that produce electricity or the installations that provide heating by simply burning coal, natural gas or oil-based products (IEA, 2021).

Building a land wind farm needs 9 times more mineral resources than building a gas power station, while an average electric car needs 6 times more mineral inputs than a conventional one equipped with an internal combustion engine. In Table 5 we have a comparative illustration of the critical minerals needs for building green or conventional energy producing installations.

Table 5: Needed mineral quantities for energy-producing installations, by energy source

Energy type Kg/MW	Copper	Nickel	Manganese	Cobalt	Chromium	Molybdenum	Zinc	REE
Offshore wind	8000	240	790	-	525	109	5500	239
Onshore wind	2900	404	780	-	470	99	5500	14
Solar PV	2822	1,3	-	-	-	-	30	-
Nuclear	1473	1297	148	-	2190	70	-	0,5
Coal	1150	721	4,6	201	308	66	-	-
Natural gas	1100	16	-	1,8	48,3	-	-	-

Source: IEA (2021).

The critical minerals required by energy transition and the markets' dynamics differ according to technology (IEA, 2021):

- *Lithium, nickel, cobalt, manganese* and *graphite* resources are crucial for the technical performance, recharging speed, energy density, longevity and safety of the electric batteries for EV. In these minerals' markets, demand will follow the evolution of the EV demand.
- *REE* resources are essential for manufacturing permanent magnets which, in their turn, are vital for wind turbines and electric engines production, but are also important for making other car devices, that improve comfort, as for instance the automatic adjustment of mirrors, windows and seats. In the HREE market demand will be strongly influenced by the evolution of wind turbines and EVs markets, but the LREE demand, which is not influenced by the energy transition, demand will stay stable.
- *Copper* and *aluminum* resources are needed in high quantities for the extension of power grids. In their case, demand will be influenced by the compounded impulses coming from the numerous down-stream industries that use them.

3.2 Supply-side challenges

Still, for the great majority of critical resources the main concerns are not demand-side focused, but connected with supply-side issues: the available quantities of critical minerals are increasing much slower than their demand does, both for technical reasons and, more worryingly, because of the insufficient quantities existing on our planet. Under the circumstances, competition flares up, prices soar and at least a part of the green energy cheapening, which was obtained due to economies of scale, is risking to be lost. At the same time, as quite many critical resource markets are (quasi)monopolized, the risk of price manipulation, or that of turning resources into means of coercion of the dependent and vulnerable countries by the ones that detain control over these resources and/or over their refining capacities and technologies, are significant.

To increase critical minerals supply, large investments in exploration and mining are needed. According to estimations by *Wood Mackenzie* consultancy, in the next 15 years the global mining industry needs additional investments of USD 1700 billion in order to be able to provide the mineral supply asked for by the renewable energy technologies (LePan, 2021). However, new mines often need 7 to 15 years to become fully operational and the return to investments come similarly late, acting as such as a discouraging factor for investors.

In the meantime, under additional the impact of the COVID-19 pandemic and of the war waged by Russia in Ukraine, the critical minerals demand/supply gap kept getting larger, pushing prices up. For the great majority of the resources that are vital for the energy transition the 2021- Q1/2022 price increases exceeded by far their largest upsurge in the 2010s. From solar and wind farms to batteries, the steady downward trend of production costs registered in the preceding decades was almost reversed as a result of the 2021 price surge in critical

minerals: the estimated price of the wind turbines mounted by 9%, that of the photovoltaic modules by 16% and for Li-ion rechargeable batteries by 5% (Kim, 2022).

An important peculiarity of the critical minerals production and refining is their high geographic concentration. For instance, just one country, D.R. Congo, mines 80% of the *cobalt* produced yearly on the planet, China produces 70% of the *REEs,* Australia 52% of *lithium,* Indonesia 33% of *nickel*, while Chile, Argentina, R.D. Congo and Peru provide together the largest part of the annual global *copper* supply (Klare, 2021). Geographic concentration takes a toll on the accessibility to critical minerals, on the safe functioning of their global value chains and it creates vulnerabilities and relations of dependency between states.

Increasing mining in order to push up production of critical minerals rises many specific problems too, as for instance:

- *The decreasing quality of deposits.* For instance, the average quality of the copper ore in Chile has decreased by 30% in the last 15 years;
- *The production of critical minerals that are secondary products to other minerals' mining depends on how the demand for the main mineral evolves;*
- *The most promising deposits of some minerals are located in economically and politically unstable countries;*
- *The high costs and risks of investments in new mining projects vs. much delayed returns dampen investors;*
- *The highly polluting effect of some of the minerals' mining or refining processes that determine the communities' refuse to accept new mining projects* (e.g. the rejected lithium mining projects in Ireland, Greenland or Serbia).

Besides the geographic concentration of mining, which is the result of natural distribution of global resources, there is also a geographic concentration of the industrial separation and refining processes, which is often the result of deliberate policies that decide if a country is ready to assume the risk of inducing high pollution in its territory, or it would rather prefer to simply import the raw materials that are obtained through very polluting secondary processing.

China accepted a few decades ago to carry out and develop these highly polluting activities and at present is separating and processing 87% of the rare earths, 90% of the heavy rare earths (dysprosium and neodymium used for permanent magnets fabrication), 65% of the cobalt, 58% of the lithium, 40% of the copper, 35% of the nickel etc., produced yearly in the world (Edward, 2022; Venditti, 2022; Klare, 2021; Umar, 2019). Altogether, China refines 45% of all the critical resources mined annually worldwide, ranking first, while the other 10 big providers that follow in the top cover together 35% of the total global supply.

Chinese domination in the global value chains of green energy technologies developed for a low carbon future is overwhelming, extending also to links responsible for key components and even to complete final products as shown in Table 6.

Table 6: Top 3 manufacturing regions of green tech by shares in global wind, solar and EV capacity, 2021

Green Technology	Main links in GVCs	Country/Region ranking 1st by capacity share	Country/Region ranking 2nd by capacity share	Country/Region ranking 3rd by capacity share	Total global capacity
Offshore wind	tower	China: 53%	Europe: 41%	Asia-Pacific*: 6%	18 GW
	nacelle	China: 73%	Europe: 26%	Asia-Pacific : 1%	26 GW
	blades	China: 84%	Europe: 12%	Asia-Pacific : 4%	25 GW
Onshore wind	tower	China: 55%	Europe: 16%	Asia-Pacific : 12%	88 GW
	nacelle	China: 62%	Europe: 10%	Asia-Pacific : 13%	100 GW
	blades	China: 61%	Europe: 18%	Asia-Pacific : 6%	98 GW
Solar	wafers	China: 96%	Asia-Pacific: 3%	-	367 GW
	cells	China: 85%	Asia-Pacific:13%	Europe: 2%	409 GW
	modules	China: 75%	Asia-Pacific:18%	Europe: 3%	461 GW
Electric vehicle	cathodes	China: 68%	Asia-Pacific: 26%	Europe: 2%	1.4 mil.t.
	anodes	China: 86%	Asia-Pacific: 12%	N. America: 1%	0.8 mil.t.
	batteries	China: 75%	Asia-Pacific: 11%	Europe: 8%	899 GWh
	Electric cars	China: 54%	Europe: 27%	Asia-Pacific: 10%	7 mil. cars

Source: Processed after Oguz & Parker (2023).

4. A few final thoughts on the future

Although the difficulties and hurdles that might impede energy transition are quite numerous and hard to settle, the new exploration and mining investments in critical minerals are very costly, risky and long-taking before bearing any fruit and although the international context might be quite unfavorable, ***mankind has no other solution but to get through this transition in order to mitigate climate change, create a low-carbon environment and, ultimately, avoid life extinction on Earth and allow for a clean technology-driven new beginning***.

Energy transition will most probably take quite long, both because of the techno-economic and geo-political reasons mentioned here, and given that no country will be able to abruptly give up fossil fuels, but it will have to transit gradually to using clean energy only, in step with the extent of its accomplishments in new green technologies implementation in its economy, while keeping its national energy system balanced.

To this end, research, development and innovation (RDI) activities will have to play an essential role in (i) finding new and more sustainable solutions of mining and processing ores, (ii) efficiently capitalizing on the secondary minerals in mine debris, (iii) treating polluted land and waters, (iv) capturing and stocking the excessive CO_2 in the atmosphere, (v) recycling used critical metals and materials, (vi) discovering substitutes for rare chemical elements, and much more.

On the other hand, given the extended control and market domination exerted by China on many of the critical resources' mining and processing activities, as well as on the manufacturing of some key parts and components (e.g. permanent magnets, rechargeable batteries, cathodes, electric engines, wafers, solar cells etc.) and even of entire final products, vital for the global energy transition (e.g. electric vehicles, photovoltaic panels), ***no country in the world will be able to successfully complete this transition in the absence of an acceptably good economic relationship with China.*** Irrespective of any efforts the advanced economies would be ready to make in order to mitigate their excessive dependency on imports from China, an honest evaluation of the current status would show that there are no short-term or medium-term realistic prospects to totally eliminate this vulnerability. That is why, especially the US, with its Trumpist decoupling policy, but also the EU, which used to be moderate and more nuanced in its policies, but is now in a cool relationship with China, as well as the other economies worldwide will have no choice but to re-evaluate to what extent maximizing the distance and inflexibility towards this country would allow them to complete their energy transition and succeed in building a low-carbon future, based on renewable clean energy, digitization and high technologies.

It is very important to note here that ***once the energy transition advances significantly more, and especially once it nears completion, the surge in the critical minerals' demand, and prices, determined by the huge needs of the green technologies' implementation process, might soften and, ceteris paribus, also China's power of influence in these markets might start fading***, for a simple reason: unlike fossil resources, critical minerals are not fuels, they are not burnt to obtain energy, they are not consumed in the process of energy production – as coal, oil and natural gas are – and, therefore, they don't require to be continually replaced. Critical minerals are used to build equipment, installations and power grids that harness renewable sources of clean energy (primarily sunlight, wind and water natural kinetics), an energy which is endless and bears no intrinsic costs. ***Moreover, the equipment used to capture, transform into electricity, store and transport renewable energy can be used continually for extended periods of time and the critical materials they include can be recycled once this equipment becomes obsolete or physically worn.*** Critical metals can be recycled over and over again, without losing their qualities. Copper, for instance, can be recycled endlessly in proportion of 100% without losing its exceptional conductivity quality. As such, in the future, besides the critical metals and materials processed after mining, another important source of global supply will be a secondary market of recycled critical metals inputs, which will be easier to re-process and therefore cheaper, while preserving the same qualities. This will most probably be another factor that will push prices down, will diminish the geographic concentration of supply (as recycling, just like renewable energy production, will be developed all around the planet), will help subdue the risks of value chain disruptions and will dent China's market dominance.

Another positive fact regarding critical minerals is that in their industry the ownership structure is totally different from the one dominant in the hydrocarbons' sector: ***while in the oil and gas industry, between 75% and 80% of the oil and gas reserves are controlled by national state companies which typically disregard market signals and act as if they are extensions of their governments' interests, in the critical minerals sector the largest part of the natural reserves and of production is in private ownership and under the control of shareholders, therefore companies act to their owners' best interests, in response to market forces and without willfully distorting market mechanisms.*** More specifically, for instance, none of the first six largest *lithium*

producers in the world, covering 66% of the global market, is a state company. Also none of the first five largest *cobalt* producers in the world, covering 50% of the world's cobalt needs, is a state company. In this latter case thou, a question mark still remains, as these firms are from China, a country where the dividing line between the two major ownership types – state or private – is blurred and difficult to establish. Anyway, until now, companies in the critical minerals field did not significantly behave as if they were implementing their national states' directives (Hendrix, 2022).

Even if now, at the beginning of the energy transition, market tensions, competition and the evolution of prices tend to become explosive, they will not necessarily reach the stage of a major crisis or of an economic war, if, understanding the crucial importance of a smooth switch to a new energy paradigm, countries will develop and manage wisely their trade, investment and cooperation relations, doing their best to succeed together in this transition and not each one against the others. Those actors in the global markets that are controlling the deposits, production and refining capacities of critical resources will still gain important profits, without using their market power as a weapon against competitors, impairing their energy transition.

However, even now, and the more so later on, when the energy transition will have advanced towards its completion, any temporary crises that might still ignite in these markets will never have the economic destruction power that the oil and gas crises had so many times. A temporary supply shortage – be it in the lithium, cobalt or some of the most important REE markets – will generate consequences only in, arguably, a limited number of industries – as for instance in the rechargeable batteries manufacturing and further on in the production of new EVs –, but it will never have the potential that oil or gas supply crises had and still have, of swiftly spreading across continents, across activities and in every aspect of human existence, causing huge economic damages, denting living standards, plunging entire populations in darkness and cold, and impoverishing them by triggering inflation flare-ups.

During a potential temporary supply shortage in one or more of the critical minerals' markets, the installed photovoltaic parks, the wind farms, the hydropower stations and all the other power units that generate green, clean and cheap energy, will continue to do that, uninterrupted, all over the world; power grids will keep on transporting electricity everywhere, people will go on driving their electric vehicles, factories will keep functioning, houses will still have functional lighting and heating and all their electric and electronic devices working, while collectivities will continue to be well supplied with all the goods and services they might need.

REEs, lithium, cobalt and other critical minerals will be, indeed**, **"the oil and gas" of the future, they will turn the former "irreplaceable" fossil fuels into totally replaceable resources for the world's energy needs. But, at the same time, they will be fundamentally different, at least because, from a longer-term perspective, critical minerals won't be equally dangerous for the natural environment and for life on Earth as the fossil fuels have become, and, also as, once in a supply shortage, their crises won't impact the global economic environment as comprehensively and dangerously as the fossil fuels often did.

In a world powered by renewable energy coming from multiple producers spread across the globe, price manipulation and deliberate market distortion induced designed to increase the profits and power of a few big producers, as well as the economic blackmail and the decisions with geopolitical and strategic significance forcefully imposed on others (practices that have long been instrumented by the oil and gas largest global producers acting as extensions of their national states), will no longer be the norm, but at most the exception, and, in case they happen, they will no longer have the same reach and force of impact as fossil fuels did. Still, for that world to come to exist in the future, how energy transition advances globally from now on becomes crucial.

References:

[1] Barrera, P. (2023). *EV market forecasts 2023: Top trends that will affect EVs in 2023*, February, 1, https://investingnews.com/electric-vehicle-forecast/.

[2] Bhutada (2022). *The Key minerals in an EV battery*, May, 2, https://elements.visualcapitalist.com/the-key-minerals-in-an-ev-battery/;

[3] Durkin, A. (2021). *Lithium is „the new oil" as EV market expands*, September, 21, https://www.hinrichfoundation.com/research/article/sustainable/lithium-new-oil-as-electric-vehicle-market-expands/

[4] Dwivedi, Sh., Wischer, G. D., (2022). *Critical materials can make or break America's semiconductor supply chains,* The National Interest, May, 10, https://nationalinterest.org/blog/techland-when-great-power-competition-meets-digital-world/critical-materials-can-make-or-break

[5] Edward, J. (2022). *China's critical minerals strategy*, August, 16, https://skillings.net/chinas-critical-minerals-strategy/;

[6] Eggert, R. (2010). *Critical minerals and emerging technologies*, Science and Technology, Vol. XXVI, No. 4, Summer, https://issues.org/eggert/ ;

[7] Hendrix, C. (2022). *How to avoid a new cold war over critical minerals*, November, 22, https://foreignpolicy.com/2022/11/22/critical-minerals-resources-us-china-competition-cold-war-supply-chains/ ;
[8] IEA, (2020). *Clean energy progress after COVID-19 crisis will need reliable supplies of critical materials,* May, 6, https://www.iea.org/articles/clean-energy-progress-after-the-covid-19-crisis-will-need-reliable-supplies-of-critical-minerals?utm_content=bufferee9c0&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer
[9] IEA, (2021). *The Role of Critical minerals in clean energy,* May, revised March, 2022, https://iea.blob.core.windows.net/assets/ffd2a83b-8c30-4e9d-980a-52b6d9a86fdc/TheRoleofCriticalMineralsinCleanEnergyTransitions.pdf ;
[10] Kim, T-Y, (2022). *Critical minerals threaten decades-long trend of cost declines for clean energy technologies,* May, 18, https://www.iea.org/commentaries/critical-minerals-threaten-a-decades-long-trend-of-cost-declines-for-clean-energy-technologies ;
[11] Klare, M. (2021). *Will there be resource wars in a renewable future?*, May, 25, https://scheerpost.com/2021/05/25/will-there-be-resource-wars-in-a-renewable-future/ ;
[12] LePan, N. (2021). *All the metals for renewable tech*, May, 27, https://elements.visualcapitalist.com/all-the-metals-for-renewable-tech/ ;
[13] Mitchel, J. (2022). *Can the West break China s stranglehold on rare earth supply chains?,* October, 12, https://www.investmentmonitor.ai/sectors/extractive-industries/china-rare-earths-supply-chain-west ;
[14] Oguz, S., Parker, S (2023). *Where are clean-energy technologies manufactured?,* March, 28, https://elements.visualcapitalist.com/where-are-clean-energy-technologies-manufactured/
[15] Palandrani, P. (2021). *All EV roads lead to lithium miners and battery producers*, June, 14, https://globalxetfs.eu/content/files/All-EV-Roads-Lead-to-Lithium-Miners-Battery-Producers.pdf#:~:text=All%20EV%20Roads%20Lead%20to%20Lithium%20Miners%20%26,internal%20combustion%20engines%20%28ICEs%29%20and%20towards%20battery-powered%20vehicles.
[16] Umar, A. (2019). *How dependant is the UK on critical minerals?,* December, https://mine.nridigital.com/mine_dec19/how_dependant_is_the_uk_on_critical_minerals;
[17] USDI / US Department of the Interior, (2022). *US Geological Survey Mineral Commodities Summaries* 2022, January, 31, https://www.sciencebase.gov/catalog/item/6197ccbed34eb622f692ee1c#:~:text=National%20Minerals%20Information%20Center%2C%202022%2C%20Mineral%20commodity%20summaries,production%20statistics%20for%20over%2088%20nonfuel%20mineral%20commodities ;
[18] Venditti, B. (2022). Vizualizing China's dominance in clean energy metals, January, 23, https://www.visualcapitalist.com/chinas-dominance-in-clean-energy-metals/ ;
[19] Watson, C. (2022). *The world's massive need for more solar panels has one shiny catch*, January, 21, https://www.sciencealert.com/solar-panel-boom-s-demand-for-aluminium-is-a-big-carbon-problem ;
[20] World Bank (2017), *The growing role of minerals and metals for a low carbon future,* June, 15 https://documents1.worldbank.org/curated/en/207371500386458722/pdf/117581-WP-P159838-PUBLIC-ClimateSmartMiningJuly.pdf ;
[21] Wrede, I. (2022). *Can EU do without metals from China?,* April, 15, https://www.dw.com/en/the-eus-risky-dependency-on-critical-chinese-metals/a-61462687.

Trade In Skill-Intensive Services - Through the Pandemic and Accelerating Digitalization

GEORGETA ILIE
PhD, Institute for World Economy, Romanian Academy
13, Calea 13 Septembrie, 6th district, Bucharest
ROMANIA
g2009ilie@gmail.com, https://iem.ro/

Abstract: This paper examines how trade in services has navigated the pandemic crisis helped by the intensification of digitalization, highlighting the effects of this phenomenon on different categories of services in both developed and developing economies. The research carried out reveals that the pandemic had challenging effects on the trade in services, depending on the intensity of the skills required in their production-supply process and the level of digitalization. Our analysis also underlines that the end of the pandemic marks the beginning of a new era of restoring the service sectors severely affected by the restrictions imposed during this period, as well as their reconfiguration, depending on the continuous intensification of the implementation of new technologies in services. In the last part of this paper, it is highlighted the need to renew trade policy measures adapted to this phase marked by deep post-pandemic transformations in the field of trade in services, to take advantage especially of those related to the latest technologies.

Keywords: trade in services, skill intensity of services, countries' development, pandemic, digitalization

JEL Classification: F13, I25, J24, L86, O24

1. Introduction

Nowadays, the service sector represents an economic structure whose diversity and complexity of its subcomponents make it difficult to formulate general statements at the level of the sector as a whole (the World Trade Organization classifies approximately *160 sub-services)*. It is therefore necessary to classify them according to similar characteristics in order to highlight the specific developments in this field. Also, in addition to the growth and diversification of the service sector composition, it is also noteworthy that most of these services are traded at the global level, with the World Trade Organization (2023a) classifying the *international modes of supplying them into four categories* (mode 1 - cross-border supply, mode 2 - consumption abroad, mode 3 - commercial presence, and mode 4 - movement of natural persons).

Regarding the broad typology of services, the *intensity of skills required to provide services* is also a major element of an analysis that can divide them into two broad categories (Nayyar & Davies, 2023): (i) *low-skilled services*, which usually require *direct interaction* between supplier and consumer (such as transport, hospitality, personal services, or recreation), and (ii) *high-skilled services* (such as information and communication technologies - ICT, financial and professional services). All these types of services have been highly developed and intensively traded globally since the 1990s due to the development of ICT, ICT representing a service in itself (UNCTAD, 2015) and also a means of transaction for the majority of the other services.

In addition, the services are addressed to both the *private and the public sectors*, and many services that were previously provided only in the public system or only at the national level are now also traded in the private system, worldwide (e.g., telecommunication, but also education and health services), given the favourable regulations adopted at national and international level. Most of these services are weighty inputs for non-service sector activities (for example, transport and logistics services are used as infrastructure for international trade in agricultural and manufactured goods, while ICT services are increasingly important for the management of manufacturing processes).

Today, it is already noticeable the considerable size of the service sector and, implicitly, its contribution to global economic growth (Buckley & Majumdar, 2018). Over the last three decades, services have grown considerably: in 2019, before the outbreak of the devastating phenomenon with an impact on the world economy (the COVID-19 pandemic), services generated 63% of global production and provided 57% of jobs globally. Of

course, a closer look by country category reveals differences between developed and developing countries, with the second category of countries registering lower values (WBD, 2023).

The COVID-19 pandemic has almost completely disrupted the service sector, affecting all its components: most of them negatively (those relying on personal interaction, such as transport and hospitality, have been particularly hard hit by social distancing measures and restrictive regulations related to direct interaction), but some of them being influenced in a *positive* way (those stepping *already in the process of digitalization, such as ICT and professional services have been less affected due to their ability to be operated remotely*). However, the restrictions imposed by the pandemic had also an effect on traditional services, increasing their digitalization, and enabling greater scale and innovation in the service sector, with consequent benefits for other economic sectors.

Against this background, this paper addresses the following analysis directions: (i) the global service sector expansion over the last decades, (ii) the impact of the COVID-19 pandemic on services depending on the intensity of the skills required to provide them, (iii) the role of the digitalization process intensified during the pandemic in stimulating the growth of the service sector after the pandemic, where the entry into a new era of the globalization of services is discussed, and (iv) the need for renewed commercial policies in order to address the future growth potential of trade in services.

2. The global services developments over the last decades

The international literature offers us a lot of evidence of the *contribution of the service sector to global economic growth during the past three decades* (Jong & Vermeulen, 2003), focusing also on the *shift in the development model from manufacturing to services* (Calindi, 2021; WB, 2021), in both developed and developing countries. These claims are supported by the data presented in Table 1, which highlights the evolution of the main indicators related to services between 1990 and 2021.

Table 1: The contribution of services to the macroeconomic indicators, globally and by economies, over the period 1990-2021 (%, USD billion)

Indicators and groups of countries	**1990**	**2000**	**2010**	**2019**	**2020**	**2021**
Services, value added (% of GDP)						
World	-	63.5	62.7	64.8	65.3	64.4
High income economies	-	66.8	69.0	70.3	71.03	70.75
Low- and middle-income economies	42.4	48.8	49.2	54.0	53.94	52.47
Trade in services (% of GDP)						
World	7.7	9.2	11.7	13.6	11.6	11.8
High income economies	7.9	9.2	13.2	16.5	14.6	14.95
Low- and middle-income economies	6.7	9.2	8.5	8.7	6.5	6.7
Employment in services (% of total employment)						
World	-	39.4	44.5	50.6	-	-
High income economies	-	67.7	73.0	74.5	-	-
Low- and middle-income economies	-	32.7	38.1	45.3	-	-
Service exports (USD billion)						
World	886	1713	4049	6275	5188	6073
High income economies	796	1442	3260	5025	4,285	4,928
Low- and middle-income economies	102	283	811	1285	914	1158
Service imports (USD billion)						

Indicators and groups of countries	1990	2000	2010	2019	2020	2021
World	936	1651	3870	5912	4900	5570
High income countries	824	1383	2961	4.381	3769	4249
Low- and middle-income countries	121	273	905	1531	1125	1315

Source: Author based on World Bank Data (2023).

According to data published by the World Bank, before the COVID-19 pandemic, *the added value of services in the GDP* of high-income countries exceeded 70%, and of low- and middle-income countries reached 54%. Also, with regard to the *share of trade in services in the GDP*, a considerable evolution can be noted (in 2019, the developed countries recorded 16.5%, and the emerging and developing countries 8.7%). Also, a relevant indicator for assessing the importance of services in the economies is the share of the *labour force employed in the service sector* in the total labour force employed. Thus, at the level of all the countries analysed by the World Bank, the value of this indicator has been in a continuous upward trend, in 2019, the service sector ensuring 74.5% of the jobs in high-income countries and 45.3% in low- and middle-income ones (WBD, 2023).

A remarkable evolution was observed at the level of *international trade in services,* which increased almost five times for export and four times for import over the three decades, with large differences among countries. Thus, in 2019, high-income countries recorded USD 5 trillion in exports and USD 4.3 trillion in imports (which represents a five-fold increase in exports and four-fold in imports compared to 1990), and low- and middle-income countries recorded USD 1.2 trillion in exports and USD 1.5 trillion in imports (which is a ten-fold increase in both exports and imports from 1990). This development is mainly explained by *changes in international regulations, emerging technologies and marketing challenges, all supporting outsourcing, automation and digital based business models* (Lazzari, 2019).

In 2020, all the analysed indicators were affected by the COVID-19 pandemic crisis, their values decreased compared to the levels of previous years. However, given the *diverse structure* of the service sector, the analyses carried out at the level of the main categories of services reveal different developments: (i) *a sharp decline in services requiring personal interaction* (such as tourism and international transport, in the context of the lockdown measures adopted by most countries and the consequent restrictions on personal mobility), and (ii) an *increase in high-skilled and digitalized services, as well as in services that could be provided remotely*. After the *severe decline in the first year of the pandemic*, in 2021 international trade in services returned to an upward trend, by removing the restrictions imposed in 2020, which made it possible to resume international transactions in services, mainly those related to personal mobility.

The statistical data published by the World Trade Organisation (WTO) reveal the effects of the pandemic on international trade in services (-18% in 2020), a recovery trend after the pandemic crisis (+17% in 2021) and a slowdown of the growth rate in 2022 (+15%). During the pandemic, travel and transport were the most affected segments, with a decrease of 61% and, respectively, 18%, caused by the mobility restrictions, while other commercial services (IT and professional services, financial and insurance) were less affected due to their characteristics and, in particular, the progress of digitalization (Table 2).

Table 2: International trade in services, globally and by segments, between 2019-2021 (year-on-year change, %)

Types of services	2019	2020	2021	2022	2022 versus 2019
Total commercial services	3	-18	17	15	12
-Transport	0	-18	35	25	40
-Travel	2	-61	13	79	-22
-Goods related services	5	-12	14	6	6
-Other commercial services	5	0	13	2	16

Source: Author based on data published by WTO (2023b).

Overcoming the critical moment of the pandemic meant that, from 2021 onwards, service transactions entered into a recovery process, the data in Table 2 highlighting the steps undertaken to re-entry the pre-pandemic

trends, so that 2023 is expected to be a year of full recovery in many service segments. However, the forecasts of further growth in international trade in services in 2023-2024 are marked by the uncertainty generated by the intensification of geopolitical tensions (e.g., US-China commercial frictions, or the Russian-Ukrainian war), the extent of which is still difficult to anticipate, given the disruptions they cause to international markets.

3. The intensity of highly specialized skills – a key determinant of global services expansion

The fact that the service sector has led to economic growth in both developed and developing countries is very noticeable in all data collected before the COVID-19 pandemic. However, it is equally evident that there are significant *differences in terms of the evolution of categories of services* and *groups of countries*, and, consequently, in their contribution to economic development.

The *intensity of the skills* required to create, produce and deliver services, as well as the *capacity to be relocated to a foreign country,* also referred to as offshorable (Blinder, 2009) and the *possibility to be internationally traded* are the criteria of an in-depth analysis in this field, but rather difficult to capture in terms of statistical indicators. Accordingly, two main types of services can be identified: (i) *high-skilled offshorable services* (including ICT, finance, and professional, scientific, and technical services), and (ii) *low-skilled contact services* (including transportation; hospitality; wholesale trade; arts, entertainment, and recreation; retail trade; administrative and support services; and personal services) (Nayyar & Davies, 2023).

The ***high-skilled offshorable services*** are intensively traded at the international level, due to very low personal interaction with customers, the remote delivery not causing any quality losses. The industries providing these services have a low level of employability of workers with face-to-face customer interaction tasks and can therefore be easily *relocated to other countries, without major cultural adaptation efforts*. In addition, these services are often used as *intermediate inputs* by other industries in the domestic economy, offering new business opportunities (for example, three-quarters of the output of professional services are intermediate inputs for other sectors, mainly manufacturing industries).

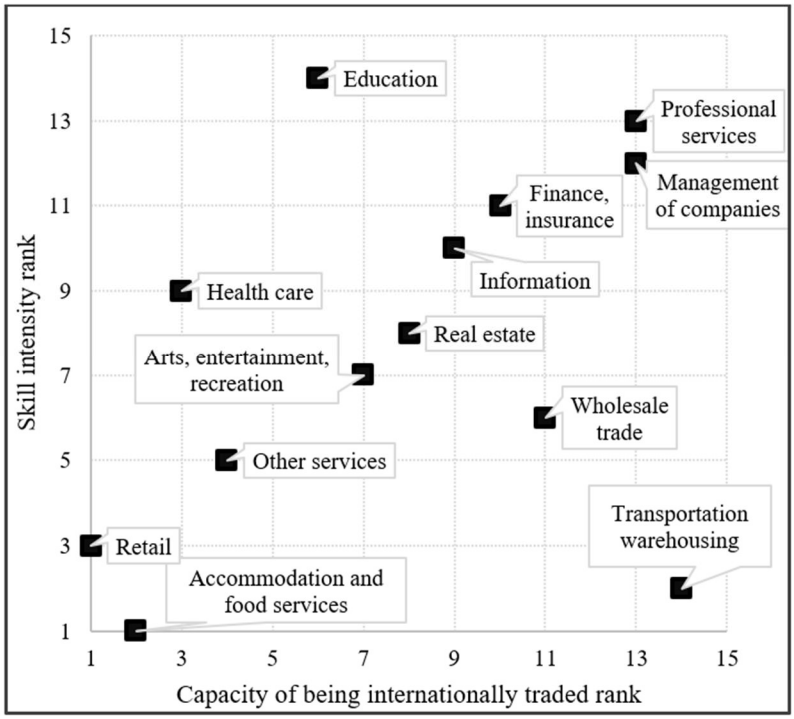
The ***low-skilled contact services*** rely more on human interaction, are labour intensive and thus less internationally tradable than the first category. Some of these services (such as transport and wholesale trade) are highly operated internationally, either separately or as intermediate services associated with international trade in goods. In contrast, hospitality services (accommodation and restaurant services) are largely traded through consumer travel abroad as part of tourism-related travel services.

The ***intensity of skills in service sector*** can be ***measured*** *by the employed workforce*, where *university graduates represent the highly qualified* workforce and those with high school education or below the less qualified workforce, which corresponds to a relative level of services productivity (Pertold-Gebicka, 2010). Another way to measure skill intensity in services is to look at the share of workers employed in manual intensive tasks compared to automatic tasks (Nayyar & Davies, 2023).

The ***degree of offshorability*** is usually used for services traded by developed countries and is measured by the *share of tasks performed by workers* in a country that (i) do not involve face-to-face contact between the provider and the consumer (the only interaction is between co-workers within the same service provider company); (ii) can be done without physical presence at the place of delivery; and (iii) do not experience a decrease in quality when delivered remotely (Nayyar & Davies, 2023). Therefore, the offshorability, seen as the ability to perform work duties in a foreign country (Blinder & Krueger, 2013), reflects the possibility that work tasks may be *shifted from developed countries to emerging and developing countries* where labour costs are lower (MKGI, 2005) and obviously workforce skills are adequate to the required level.

The identification of service categories according to trading and skill intensity was the research interest of Eckert et al. (2019), whose studies, based on US economy data, constructed a graph of the main service categories, where skill intensity was considered as the share of university-educated workers in a service sector, and the level of trading by dividing the sum of exports and imports by output. This graphical representation presented in Figure 1 is very suggestive in understanding the categories of services in relation to the two characteristics analysed in this section.

Figure 1: The place of service categories in relation to international tradability and skill intensity criteria



Note: The rank takes value between 1-15, where 15 is the maximum.
Source: Author representation based on Eckert et al. (2019).

While the contribution of low-skilled contact services to value added growth in developed and developing countries is rather similar in percentage terms (35.8% and 31.9% respectively, the contribution of ***high-skilled offshorable services increases with the level of income per capita*** (Table 3). Thus, high-skilled offshorable services account for around 25.6% of GDP value-added growth in developed countries compared to 14.8% in emerging and developing ones, and for 50% employment growth in developed countries compared to 9.5% in developing ones. These differences are due to the fact that the increase in low-skilled contact services is little related to the increase in exports (these services being dependent on the increase in domestic demand) and the increase in total factor productivity (these services being characterized by high intensity of unskilled labour and low intensity of capital inputs) (Nayyar & Davies, 2023).

Table 3: Contribution of skill-intensive services to value-added growth and employment growth, by economy, between 1990-2018 (average %)

Indicators and categories of countries	High-skilled services	Low-skilled services
Services contribution to GDP value added growth		
Developed economies	25.6	35.8
Emerging and developing economies	14.8	31.9
Services contribution to employment growth		
Developed economies	50.0	38.8
Emerging and developing economies	9.5	43.4

Sources: Author calculations based on data published by Nayyar & Davies (2023).

Over the last three decades, trade in services has evolved and nowadays, many services are no longer constrained by the personal interaction between service providers and consumers, mainly due to the technological advance and its use in many service transactions (digitalization). In the case of low-skilled contact services, such as transport and wholesale trade, exports play a more important role where they are *related to trade in goods*. The share of exports in final demand is also quite large for some highly skilled offshorable services, such as professional services and ICT, where *digital electronic content has made them more storable, codifiable and transferable.* As the constraints of physical interaction between consumers and suppliers have diminished,

professional services can apply *cost-driven business models* comparable to those in manufacturing industries (Gervais & Jensen, 2019), generating significant economies of scale (Thomson et al., 2018). However, international transactions with these services deal with some trade obstacles or impediments, as WTO members are engaged in completing the international regulatory framework to overcome them.

4. The impact of the COVID-19 pandemic on skill intensity services evolution

The economic *contraction during the COVID-19 pandemic was significant for the service sector* (Ando & Hayakawa, 2022). Unlike previous recessions (such as the one in 2008), the supply and consumption of many services declined due to lockdowns and precautionary measures taken by authorities. Even now, after the end of the COVID-19 pandemic, the considerable change in consumption patterns from that period has implications for post-pandemic recovery and new developments in the service sector.

However, the impact of the pandemic on the service sector has not been uniformed across either subsectors and countries, a tie-breaking criterion being the ***qualification level of the skills needed to provide the services***. *Low-skilled contact services* dependent on direct interactions with consumers, such as accommodation, food, and transportation services, have been among the *harmfully affected* sectors. But the *high skilled offshorable services* group, consisting of ICT, professional and financial services, (i) has generally resisted the pandemic disruptions (largely because *digitalization* has helped to make these services flexible for remote delivery and home-based work) and (ii) has even seen growth of output and investment. Even among some low-skilled contact services, the pandemic has accelerated *digitalization*, including in countries where the use of digital technologies was poor.

The overall impact of the pandemic was different depending on the groups of the wide variety of services according to their characteristics, among which, in what follows, we refer to the intensity of skills. In the *low-skilled contact services* group, *hospitality* (accommodation and food services) and *transportation* services were the *most negatively affected*, with ***gross value-added*** *declining* by 40% and 21% respectively in April 2020 compared to April 2019 in emerging and developing countries. In contrast, in the *high-skilled services,* ICT experienced an *increase* of 8.7% in developed countries and the smallest decrease of 2.5% in developing countries at the peak of the pandemic, in April 2020 (Table 4).

Table 4: The changes in value added of services segments, by countries, in April 2020 compared to April 2019 (%)

Categories of services		Emerging and developing countries	Developed countries
High-skilled offshorable	Professional	-7.5	-6.2
	ICT	8.7	-2.5
Low-skilled contact	Commerce	-7.8	-7.2
	Transport	-21.0	-27.8
	Hospitality	-40.2	-51.2

Source: Author based on data published by Nayyar & Davies (2023).

The World Bank data collected over the period 2020-2021 emphasize that the ***largest negative impact on sales*** occurred in *low-skilled services* such as accommodation (-66.9% in 2020), food services (-53.6%), and transportation (-46.6%). The negative impact in these sectors continued through 2021 in developing countries, but some recovery became visible in developed economies due to the advance in taking measures to control the pandemic. In the case of *high-skilled offshorable services* (ICT and financial), a considerable decrease is also observed (-18.4% in 2021), but less compared to the category of low-skill services (Table 5).

Table 5: The changes in services sales during pandemic crises period, globally (year-on-year change, %)

Categories of services		Mid-2020	Early 2021	Late 2021
High-skilled offshorable	Financial	-30.3	-18.3	-18.4
	ICT	-34.4	-22.8	-18.6
Low-skilled -contact	Commerce	-34.1	-22.2	-21.2
	Transport	-46.6	-31.0	-29.1
	Accommodation	-66.9	-53.9	-43.4
	Food services	-53.6	-40.9	-32.9

Source: Author based on data published by Nayyar & Davies (2023).

A similar trend was observed for ***foreign direct investment*** (FDI) inflows into developing countries, where for the majority of service subsectors, the *greenfield projects were lower in 2020 and 2021* than pre-pandemic levels. The largest declines were in *low-skilled contact services*, such as hospitality and other services (including personal services). *High-skilled offshorable services* performed slightly better, although both professional services and financial services saw significant declines. ICT services was the only group that saw an increase in greenfield FDI, rising by one-third between 2019 and 2021.

Table 6: The evolution of greenfield projects in services in developing countries, during pandemic crises (2019 = 100)

Categories of services		**2020**	**2021**
High-skilled offshorable	Professional	50.4	54.9
	Financial	89.9	49.9
	ICT	122.4	135.4
Low-skilled contact	Hospitality	30.1	10.2
	Administrative	38.9	51.8
	Retail	81.5	77.4
	Transport	38.1	46.2

Source: Author based on data published by Nayyar & Davies (2023).

5. The potential of digitalization for the continuous growth of service sector

The pandemic crisis has affected the outlook for service-driven growth. After the peak of the crisis, the need to adopt some recovery models was imposed, as well as the evaluation of future opportunities related to the ***acceleration of digitalization***, strongly exploited during this period.

Therefore, the intensification of digitalization during the pandemic gives hope for growth prospects in the service sector. The developments during the pandemic at the level of *highly qualified offshore services* supported the actions taken in all countries in the direction of encouraging the necessary actions to intensify this process. For example, the share of ICT and digitally deliverable professional services in total service exports of developing countries increased from 40% in 2019 to 50% in 2020.

Even in *low-skilled contact services*, digitalization has been the vehicle for many traditional services. Thus, although they had been on the market for several years and had been already enjoying success, during the pandemic crisis the *streaming platforms*[1] offered the chance to art and entertainment service providers to deliver their creative contents to international markets even to very advantageous costs. Digitalization has offered extraordinary solutions even where physical interaction is a critical condition. This is the case of *e-commerce platforms* which, during the pandemic, allowed retailers and restaurants to offer their services outside their commercial locations. In addition, ICT and management practices have facilitated the standardization in many manufacturing businesses. Thus, digitalization together with the intangible capital enlarged business opportunities, therefore service businesses managed to gain important economies of scale.

Table 7: The evolution of personal interaction index and change in services sales, in 2020 (index, %)

Categories of services		**Direct personal interaction index***	**Remote work index***	**Change in sales 2020/2019 (%)**
High-skilled offshorable	Financial	0.57	0.73	-36.74
	ICT	0.31	0.68	-35.32
Low-skilled contact	Hotels	0.82	0.03	-64.10
	Restaurants	0.82	0.03	-56.73
	Retail and wholesale	0.73	0.32	-41.96
	Transportation & storage	0.33	0.18	-49.39

Note: *Direct personal interaction index and remote work index take value between 0 and 1, where 1 is maximum.
Source: Author based on data published by Nayyar & Davies (2023).

In recent years, in service industries, innovation has largely occurred through the accumulation of tangible and intangible ICT capital. *IT and telecommunications equipment, computer software and database assets* are included in the *tangible capital* category, with a significant development in financial and professional

[1] Netflix was launched in 2007, and now it has 230 million of subscribers worldwide. Google-YouTube was launched in 2015, and now it has 80 million of subscribers worldwide.

services, mainly among developed countries. The *intangible capital* has also increased considerably, here including the *means of disseminating digital technologies* where *software and computer-related data* are contained, but especially intellectual property acquired through research and development and design, accompanied by business skills such as branding, company-specific training and business process engineering. Intangible capital is dominant in the investments of companies in ICT, finance and professional services in developed countries

The accumulation of intangible capital in these highly skilled offshore services has growth prospects due to the spectacular development of artificial intelligence-based machine learning algorithms used in predictive, cognitive problem-solving tasks.

The share of intangible capital in investments is already also a priority in low-skilled contact services such as trade and hospitality, where online ordering facilities dominate the market. Therefore, the increasing complexity of ICT, such as artificial intelligence and machine learning, motivates and attracts complementary investments in intangible capital. As a consequence, the diffusion of ICT services using machine learning algorithms will be equally widespread in many low-skilled services in the coming years.

Table 8: The use and new investments in digital technologies in services industries, during the pandemic, globally (%)

Indicators and categories of services			**Mid-2020**	**Early 2021**	**Late 2021**
The use of digital technologies by companies	High-skilled offshorable	Financial	46.4	55.4	60.7
		ICT	43.6	55.2	60.3
	Low-skilled contact	Commerce	32.8	46.3	46.5
		Transport	21.0	35.7	37.6
		Food services	22.6	40.3	42.9
The new investment in digital technologies by companies	High-skilled offshorable	Financial	30	34	38
		ICT	28	46	41
	Low-skilled contact	Commerce	15	23	25
		Transport	13	21	24
		Food services	14	23	23

Source: Author based on data published by Nayyar & Davies (2023).

Increased digitalization and investment in intangible capital provide ***opportunities*** for innovation and productivity gains *in low-skilled contact services* in many ways: (i) they enable improvements in the efficiency of internal business processes, such as inventory management, accounting, marketing and payments (for example, big data analytics can increase the efficiency of transport services, by enabling real-time tracking of shipments and ensuring the improvement and expansion of navigation, WB, 2020); (ii) ICT-related investments can substitute for rare skills (e.g. ICT applications allow drivers to operate with limited geographical expertise); (iii) the expansion of company capabilities associated with digital technologies, such as marketing and branding, facilitates the increasing of low-skilled contact services that are less suitable for remote delivery (e.g. restaurant chains have invested in ICT and management practices that help them to determine human resources and purchasing optimisation). This type of standardization has allowed many companies to expand by replicating the same process, thanks to the use of information technology in areas that previously seemed unapplicable in this field.

Despite the spread of digital technologies, basic ICT use, which is positively associated with countries' per capita income, is far from widespread among many developing countries, where less than a third of firms use online communication tools in their businesses (Nayyar & Davies, 2023). According to the International Telecommunication Union data, 2.7 billion people worldwide were offline in 2022, with universal connectivity still a distant prospect in the least developed and landlocked developing countries, where on average only 36 % of the population is online (UNCTAD, 2023b).

6. Policy priorities for supporting the forthcoming services expansions

Developments in recent decades have shown an extraordinary increase in the frequency and intensity of interactions and interdependencies between people, companies and countries, both in terms of physical goods but also with services, which is nothing but globalization. Nowadays we can say that through the complex developments in the services field, we are more globalized than ever before, but mainly through intangible flows of goods.

Therefore, political decision-makers must adopt appropriate measures to enable countries to exploit the potential of the service sector to stimulate economic growth. National and international *policies to support the innovation and diffusion of digital technologies* at the level of all countries, especially those with modest possibilities, can bring great benefits to everyone, facilitating development and improving the quality of life around the world. Investing in ICT infrastructure, updating regulatory frameworks (especially with regard to data transfer) and strengthening management capacities and workforce skills can boost the adoption of digital technologies.

Countries can also promote the expansion of highly skilled offshore services by reducing barriers to foreign trade and investment and taking steps to improve skills allocating more investment for education. Last but not least, countries can support investment and implement regulatory reforms that encourage the revival of low-skilled contact services, as important sources for creating jobs and consequently drivers of economic growth. Policies considered include the *reform of regulatory barriers* and the *intensification of skill development by increasing the investment in education* for both high-skilled offshorable and low-skilled contact services.

At the global level, there are discussions about the new developments of economic relations against the background of globalization, which today is totally transformed by services and other intangible assets. The WTO claims that *globalization is entering a new stage*, in which the driving force of this process is represented by *digital technologies that will support international trade and investment in services.* Thus, international organizations are called to ensure the appropriate regulatory framework with the new developments of services and the digital economy at the global level (Ellard, 2023).

A suggestive example is the WTO, which is actively involved in the adoption of regulatory measures imposed by the development and intensive use of digital technologies. Here the member states take measures to reduce the digital gap between countries (in terms of developing digital infrastructure, connectivity, accessibility and strengthening countries' capacities), to eliminate the digital transmissions charging, and to agree other joint initiatives aimed at developing new disciplines on services, digital trade and investment (WTO, 2022; WTO, 2023c).

From all these perspectives, *new directions are highlighted*, namely (i) the *technological advances* that are the basis for the development of a new generation of internationally traded services through digital means (Javeus, 2023), as well as (ii) some *fragmentation* tendencies of the world economy (Georgieva, 2023, Ayhan Kose & Ohnsorge, 2023) that are about to reshape the current stage of globalization.

7. Conclusions

Our work has brought together some insights based on the available statistical analysis of recent trends in services correlated with *an important role of the intensity of skills required to supply services in the international market*. Throughout the paper, we have highlighted the differences between highly skilled offshorable services and low-skilled with high-contact services, and how they interact with recent technological changes, especially in terms of tradability and digitalization. Major differences between the countries are emphasised and also the need to find solutions at the level of political decision-makers within international organizations to reduce the gap between countries in order to offer them the chance to benefit from a modern service intensive development model. These differences have a significant impact on their citizens in terms of the access to certain services, but above all in terms of their possibility to increase the high skilled services in their economies.

The increased use of digitalization during the pandemic has given a strong impulse to service-based business models and their prospects. On the one hand, it has improved the opportunities for international trade in services, not only in highly skilled offshore services, but also through the streaming platforms that enable the remote delivery of services that were previously based on physical interaction. On the other hand, it paved the way to new and increased efficiency gains. Thus, the digitalization brings together labour-intensive services, ICT and intangible forms of capital, reducing the importance of physical interaction in market transactions, improving business processes and facilitating economic expansion.

Despite the current threats of global economic fragmentation, the services technological developments will become the main driver of the globalization process, given the fact that in recent decades the service-intensive economic development model proved to be dominant (as confirmed by the high share of services in GDP). Trade and investment in the service sector have the potential for rapid growth in the coming years, which lead us to believe that the *new generation of services could become the engine of the globalization trend*, a trend that, as in

its previous stages, will generate changes including in the level of positions and competitive advantages of world economies.

References:

[1] Ando, M. & Hayakawa, K. (2022). *Impact of COVID-19 on trade in services*. Japan World Econ. 2022 Jun; 62: 101131. https://doi.org/10.1016%2Fj.japwor.2022.101131 . https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8915575/

[2] Ayhan Kose, M. & Ohnsorge, F. (ed). (2023). *Falling Long-Term Growth Prospects*. World Bank Group. https://www.worldbank.org/en/research/publication/long-term-growth-prospects

[3] Blinder, A. & Krueger, A. (2013). *Alternative Measures of Offshorability: A Survey Approach.* https://www.jstor.org/stable/10.1086/669061

[4] Blinder, A. (2009). *On the measurability of offshorability.* https://cepr.org/voxeu/columns/measurability-offshorability

[5] Buckley, P. & Majumdar, R. *(2018). The services powerhouse: Increasingly vital to world economic growth. https://www2.deloitte.com/us/en/insights/economy/issues-by-the-numbers/trade-in-services-economy-growth.html*

[6] Calindi, A. (2021). *Services: The new staple of 21st century development?* https://trade4devnews.enhancedif.org/en/op-ed/services-new-staple-21st-century-development. 16 November

[7] Eckert, F.; Ganapati, S. & Walsh, C. (2019). *Skilled Tradable Services: The Transformation of U.S. High-Skill Labor Markets*. https://conference.iza.org/conference_files/CREA_2019/eckert_f28800.pdf

[8] Ellard, A. (2023). *The future of globalization is services, digital technology.* https://www.wto.org/english/news_e/news23_e/ddgae_29mar23_e.htm. 28 March

[9] Georgieva, K. (2023). *Confronting Fragmentation Where It Matters Most: Trade, Debt, and Climate Action.* https://www.imf.org/en/Blogs/Articles/2023/01/16/Confronting-fragmentation-where-it-matters-most-trade-debt-and-climate-action. 16 January

[10] Gervais, A. & Jensen, J.B. (2019). *The tradability of services: Geographic concentration and trade costs.* https://doi.org/10.1016/j.jinteco.2019.03.003. https://www.sciencedirect.com/science/article/abs/pii/S0022199619300315

[11] Javeus, J. (2023). *Globalisation 2.0.* Macro & FICC Research: Reflections. https://research.sebgroup.com/macro-ficc/reports/34650. 17 January

[12] Jong, J. & Vermeulen, P. (2003). *Organizing Successful New Service Development: A Literature Review* . https://www.researchgate.net/publication/5012665_Organizing_Successful_New_Service_Development_A_Literature_Review

[13] Lazzari, Z. (2019). *What Are the Causes of Rapid Growth in the Service Industry?* https://smallbusiness.chron.com/market-management-consulting-firm-40047.html. January 22

[14] McKinsey Global Institute [MKGI]. (2005).*The Emerging Global Labor Market: Part I—The Demand for Offshore Talent in Services* https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Employment%20and%20Growth/The%20emerging%20global%20labor%20market%20demand%20for%20offshore%20talent/MGI_Demand_for_offshore_talent_executive_summary.pdf

[15] Nayyar, G. & Davies, E. (2023). *Services-Led Growth: Better Prospects after the Pandemic*? World Bank Group. https://openknowledge.worldbank.org/server/api/core/bitstreams/711f1b37-1ea2-4f8a-813d-76f7a48f59c3/content

[16] Pertold-Gebicka, B. (2010). *Measuring Skill Intensity of Occupations with Imperfect Substitutability Across Skill Types.* https://www.cerge-ei.cz/pdf/wp/Wp421.pdf. October

[17] Thomson, K.; Malam, K. & Williams, L. (2018). *Economies of scale and regional services.* https://www.bitre.gov.au/sites/default/files/Economies_of_scale_and_regional_services-BITRE_Information_Sheet_99.pdf

[18] United Nations Conference on Trade and Development [UNCTAD]. (2015). *International trade in ICT services and ICT-enabled services.* https://unctad.org/system/files/official-document/tn_unctad_ict4d03_en.pdf

[19] United Nations Conference on Trade and Development [UNCTAD]. (2023a). *Intergovernmental Group of Experts on E-commerce and the Digital Economy*. UK Written Contribution on Sixth session, 10-12 May 2023, Geneva. https://unctad.org/system/files/non-official-document/Contribution_by_the_United_Kingdom.pdf

[20] United Nations Conference on Trade and Development [UNCTAD]. (2023b). *Intergovernmental group of experts on e-commerce and the digital economy - 10 May 2023*. https://unctad.org/system/files/non-official-document/ige6_ecde_s04_ITU_en.pdf

[21] World Bank [WB]. (2020). *World Development Report 2020: Trading for Development in the Age of Global Value Chains.* Chapter 6: Technological change. https://openknowledge.worldbank.org/server/api/core/bitstreams/3223e2f7-a67a-5aee-9b39-e3607623f2a0/content

[22] World Bank [WB]. (2021). *At Your Service? The Promise of Services-Led Development.* https://www.worldbank.org/en/topic/competitiveness/publication/promise-of-services-led-development

[23] World Bank Data [WBD]. (2023). *World development indicators.* https://databank.worldbank.org/source/world-development-indicators (accessed in May 2023)

[24] World Trade Organisation [WTO]. (2022). *New commitments for domestic regulation of services move step closer to entry into force.* https://www.wto.org/english/news_e/news22_e/jssdr_20dec22_e.htm. 20 December
[25] World Trade Organisation [WTO]. (2023a). *Services trade*. https://www.wto.org/english/tratop_e/serv_e/serv_e.htm (accessed in May 2023)
[26] World Trade Organisation [WTO]. (2023b*). Global Trade Outlook and Statistics.* https://www.wto.org/english/news_e/news23_e/tfore_05apr23_e.htm. 5 April
[27] World Trade Organisation [WTO]. (2023c). *E-commerce negotiators advance work, discuss development and data issues***.** https://www.wto.org/english/news_e/news23_e/jsec_30mar23_e.htm . 30 March

The Romanian Research-Development System - An Overview in Global Context

MĂDĂLINA TOCAN
Analysis of the International Economic Conjuncture/ Faculty of Financial Management
Institute for World Economy Romanian Academy/ Ecological University of Bucharest
Calea 13 Septembrie No.13/ Bd. Doina Cornea 1G, Bucharest
ROMANIA
madalina.tocan@gmail.com

Abstract: Research, development and innovation play an important role in ensuring sustainable economic growth. By producing new knowledge, research is essential to the development of new and innovative products, processes and services that contribute to increased productivity, industrial competitiveness and ultimately prosperity. For this reason, the encouragement of the research-development and innovation activities has become now an extremely important imperative of the modern socio-economic and technological policies in developed and less developed countries.

The main objective of the present paper is to highlight Romania's performance in the field while presenting the strengths and weaknesses of the national RDI system. In order to achieve the proposed objective, our methodology uses both descriptive and explanatory research. Our research methodology includes a comparative analysis based on Global Innovation Index and other indexes (mentioned in the paper). The analysis of the Global Innovation Index shows that the existing research-development-innovation system in Romania is not able to ensure overcoming the condition of being an emerging innovator, due to some of its weaknesses. Thus, our main finding shows that Romania has untapped potential in the field of RDI, and the current poor performance reflects negatively on the country's competitiveness and long-term growth prospects.

Keywords: innovation, research, development, Romania, innovation performance, research efficiency.

JEL Classification: D80, O10, O30, O39.

1. Introduction

By producing new knowledge, research is essential to the development of new and innovative products, processes and services that enable increased productivity, industrial competitiveness and ultimately prosperity. For this reason, research and innovation plays an important role in generating sustainable economic growth and job creation. Many studies concluded that investing and undertaking effective research and development activities can enhance economic growth (Wang, 2010). Also, Griliches (1995) demonstrates the role of RDI as an important source of growth, in the context of the externalities generated by this activity, and Jones and Williams (1998) state that RDI activities produce significant social effects and constitute an important component of development and growth economic. With the intention of studying the contribution of RDI to economic growth, a study applied to the Australian economy was carried out in 2002. Using data related to the period 1960-2000, the study showed that the constant and long-term economic development at the level of the country was supported by the research undertaken at the local and global level, as well as by the development of innovative ideas (Chou, 2002).

Following the crisis caused by the Covid-19 pandemic, economic growth was, and continues to be, an objective of the government strategies, both at the European and international level. Given that, in the context of the global competitiveness, technological progress is recognized as key element of the sustainable economic development, a central place in this context is occupied by the research, development and innovation sector.

The main objective of the present paper is to highlight Romania's performance in the field while presenting the strengths and weaknesses of the national RDI system. In order to achieve the proposed objective, it was used a combined research methodology using, during the work, both descriptive and explanatory research. Our research methodology includes a comparative analysis based on Global Innovation Index and other indexes

(mentioned in the paper). One limitation of the paper is related to data availability, since in the European database the latest data are at the level of the years 2020-2021.

The importance of the work derives from the fact that research- development-innovation is at the centre of the policies through which the European Commission tries to stimulate employment, economic growth and investments. Horizon 2020, the EU framework program for research-development-innovation (RDI), has strengthened its leadership position in the field of innovation, by promoting excellence in the field of research and development of innovative technologies, in the period 2014-2020 investing 77 billion euros for projects in the field. With a budget of €95.5 billion, Horizon 2020's successor, Horizon Europe, is the EU's main research and innovation funding program for 2021-2027, which aims to: stimulate EU competitiveness and development, strengthen the position of research and innovation in the development, support and implement EU policies, optimize the impact of investments in a European research area. As an EU member, Romania's RDI policy is closely linked to the European one, aiming at joint programming, technological initiatives and pan-European research infrastructures. For the period 2021-2027, the programmatic documents for the RDI sector in Romania are: National Strategy for Research, Innovation and Smart Specialization 2022-2027 and National Plan for Research, Development and Innovation 2022 – 2027 (PNCDI IV).

The Global Innovation Index (GII) report is made by the World Intellectual Property Organization, "Cornell" American University and the French School of Management "INSEAD" and is published annually from 2007 (WIPO,2022). The aim of the Global Innovation Index report is to familiarize interested persons and institutions with all the new aspects in the field of innovations that appear in society and to approach this field beyond traditional innovation mechanisms (Saharnean, 2019). The reasons behind the creation of this report are multiple. Because many governments place innovation at the heart of their economic growth strategies, the first reason is determined by the importance of innovation in driving economic progress and competitiveness – for both developed and developing economies,. The second reason is determined by the expansion of the definition of innovation, which now is not limited to only theoretical research. The Global Innovation Index report adopts a broad definition of innovation, originally introduced in the Oslo Manual developed by the European Communities and Organization for Economic Co-operation and Development (OECD, 2018) - "An innovation is the implementation of a new or significantly improved product (a good or service), or a process, of a new marketing method, or of a new organizational method in business practice, in the organization of workplaces or in external relations" (Maier, 2014). This definition reflects the evolution of the way in which innovation has been perceived and understood in recent decades. Previously, economists and policy makers focused on research, development and product technological innovation, today innovation capacity is seen more as the ability to exploit new technological combinations. According to the Adler and Shenbar (1990) innovation capability is defined as the capacity of: developing new products satisfying market needs, applying appropriate process technologies to produce these new products, developing and adopting new products and processing technologies to satisfy future needs. The last, but not the least, reason is determined by the fact that in emerging markets innovation is a key element in inspiring the next generations of entrepreneurs and innovators.

The GII do not intend to realize a final and definitive ranking of economies in the field of innovation, but aims to improve innovation by measuring it as accurately as possible and by identifying policies, best practices and other levers that encourage innovation. It helps to create an environment where the influencing factors of innovation are under continuous evaluation and provides a key tool and a rich database that can contribute to the development of innovation policies.

Over the past decade, GII has established itself as a leading reference in the field of innovation. Better understanding of the human aspects behind innovation is essential for developing policies that help promote economic development. Recognizing the key role of innovation as a driver of economic growth and prosperity and the need for a broad overview of innovation applicable to developed and emerging economies, the GII includes indicators that go beyond traditional measures of innovation, such as the level of research and development and the amount of investment allocated in innovation (Saharnean, 2019).

The global innovation index is built on the basis of two sub-indices – the input innovation sub-index and the output innovation sub-index. The first targets at the elements that influence innovative activities, such as research and development – while the output innovation sub-index targets at the results of these activities (Cristina, 2020). Each sub-index is divided into pillars; the pillars are divided into sub-pillars while each sub-pillar is composed of individual indicators. The scores for each sub-pillar are calculated as the weighted average of the individual indicators, and the pillar scores are calculated as the weighted average of the sub-pillar scores. The overall global innovation index is calculated as the simple average of the input and output sub-indices. The innovation efficiency ratio is the ratio of the output sub-index to the input sub-index.

The innovation input sub-index is built on the basis of five sub-pillars that assess the factors that enable and favour innovative activities: institutions, human capital and research, infrastructure, market sophistication, business sophistication.

The output sub-index for innovation is built on the basis of two pillars that assess the results of innovative activities within economies - Knowledge and technology outputs, creative outputs. Although it includes only two pillars it has the same weight in calculating the value of the Global Innovation Index as the inputs sub-index (Cristina, 2020).

2. The efficiency of the Romanian research, development and innovation sector

Research in Romania can be categorized as low-performing, under-funded (both from public and private sources) and with a low impact worldwide. The last evaluation of the RDI system in Romania carried out by the European Commission (European Commission, 2022) highlighted more or less the same recurring challenges, including the fragmentation of governance, the focus on fundamental research and the non-use of private potential and, often , improper use of available funds. The report states that" Romania's research sector shows elements of strength, it does not perform as a coherent system. The combination of a fragmented public research sector, lack of financial stability and predictability, fragmented governance, erosion of human capital, weak public-private sector interaction, uneven monitoring and evaluation, and unpredictable political support, form a vicious circle which needs to be broken".

Despite the efforts made in the field of research and development in Romania, there are some weaknesses that directly affect progress and performance in this field. Among them we can mention:

- Insufficient funding: The budget allocated to research and development in Romania is insufficient to support high-quality projects and to attract and retain talented researchers. Lack of adequate financial resources limits the ability of research institutions and universities to carry out innovative research and invest in a modern infrastructure;
- Fragmentation and lack of coordination: Research and development is often fragmented across different institutions and organizations, leading to a lack of coordination and cooperation between them;
- Migration of researchers: Romania is experiencing a significant migration of talented researchers to other countries, where there are more opportunities and better working conditions. This migration directly affects the research and development capacity and leads to the loss of intellectual capital and investment in the training of these specialists;
- Insufficient collaboration between academic environment and industry: Collaboration between universities and industry is often limited in Romania. The lack of a close link between academia and industry leads to a separation between fundamental research and the real needs of industry, which limits technology transfer and innovation in the industrial sector.
- Excessive bureaucracy: Complicated and red tape-laden bureaucratic procedures can hamper the process of financing and implementing research and development projects. This may discourage researchers and institutions from engaging in R&D activities and may affect efficiency.

Despite these weaknesses, the research and development system in Romania has some strengths:

- there are many talented and passionate researchers who achieve results in various scientific fields;
- there are programs and initiatives that encourage young researchers and promote innovation and international collaboration;
- Romania has a good expertise in certain key areas such as IT&C, renewable energy, medicine, biochemistry and agriculture
- Romania collaborates with other countries and international organizations in the field of research and development. There are joint projects, exchanges of experience and funding for frontier research.
- There are programs and initiatives that encourage the involvement and development of researchers. Research grants, fellowships, training programs and academic competitions provide opportunities for researchers to demonstrate their skills and develop their research careers.

Regarding Romania's position in the "Global Innovation Index" and "European Innovation Scoreboard" system of indicators, although some indicators show an improvement, the general trend is a decrease in performance.

The Global Innovation Index 2022 provides a detailed picture of the innovation performance of 132 countries and economies around the world. Its 81 indicators explore a wide area of innovation, including politics, education and business. From year to year the number of innovation performance indicators and the countries participating in the study differed. For example, in 2013 the GII used 84 indicators for the comparative evaluation of the innovation capacities of 142 countries (which included 94.9% of the world's population and constituted 98.7% of the world's GDP). The framework is reviewed every year in a transparent exercise to improve how innovation is measured (Saharnean, 2019).

As can be seen in Table 1 Switzerland and the USA are the innovative leaders of the high-income countries group, occupying the first and second places. Surprisingly, Bulgaria occupies the second place as an innovative leader of the upper middle-income countries group, alongside China and Malaysia, while Romania holds the 8th rank in this group.

Table 1: Innovation leaders by income group according to GII 2022

High-income		**Upper middle-income**		**Lower middle-income**		**Low-income**	
Switzerland	64.6	China	55.9	India	36.6	Rwanda	18.7
USA	61.8	Bulgaria	39.5	Vietnam	34.2	Madagascar	18.6
Sweden	61.6	Malaysia	38.7	Iran	32.9	Ethiopia	16.3

Source: Authors' computations based on the Global Innovation Index 2022

In 2022, Romania occupied the 49th place among the 132 economies included in the GII 2022. It should be noted that the availability of data and the changes made in the GII methodology influence comparisons from one year to another. The statistical confidence interval for Romania's GII 2022 ranking is between 48th and 52nd places. As it can be observed in the Table 2, in 2022 the general position of the Romania descended with one place comparing with 2021 and with three places comparing with 2020. However the position occupied in 2022 was superior to the position occupied in 2019.

Table 2: Romania's position in the Global Innovation Index (2019-2022)

Description	**Position**			
	2019	**2020**	**2021**	**2022**
Innovation input sub-index	53	46	50	56
Innovation output sub-index	54	51	54	43
Global Innovation Index	50	46	48	49

Source: Authors' computations based on the Global Innovation Index 2019-2022

In 2022, Romania obtained better results in terms of innovation outputs than innovation inputs. It ranked 43th place in terms of innovation outputs, occupying a better place comparing with the previous years. In terms of innovation inputs, in 2022 Romania ranked 56th place, this position being lower than the previous years. At the same time, Romania ranks 40th among the 51 economies with high incomes and 31st among the 39 economies in Europe.

Table 3: Romania's position within the GII pillars (2019-2022)

Description	**Position**			
	2019	**2020**	**2021**	**2022**
Institutions	50	53	53	75
Human capital and research	69	76	76	74
Infrastructure	35	37	36	33
Market sophistication	92	83	76	63
Business sophistication	51	53	54	51
Knowledge and technology outputs	41	28	35	31
Creative outputs	71	67	72	57

Source: Authors' computations based on the Global Innovation Index 2019-2022.

The poor performance of the Romanian research system is determined by: the low level of RDI spending, underfunding, the fragmentation of RDI in the public sector and its insufficient orientation towards the needs of the industrial sector, the excessive priority given by some institutes to fundamental research, insufficient number of researchers.

During 2019 -2022 the best positions occupied by Romania are within the pillars Infrastructure and Knowledge and technology outputs. Thus, in the 2022 ranking, within the Knowledge and technology outputs pillar Romania occupied the 31st place (inferior compared to 2021 when it occupied the 34th position, but superior to 2020 when it occupied the 28th position). Within the Infrastructure pillar Romania occupied in 2022 the in 33rd place (superior to the previous years- 2019, 2020, and 2021- when it occupied the 35th, 37th and 36th position). The weakest performance recorded by Romania was registered at human capital and institutions pillar, where it occupied the 74th and 75th place.

Regarding the human capital dimension, it is important to mention that Romania has the lowest number of researchers in the EU 27. As can be seen in table 4, the total research and development staff has decreased substantially since 1993 from over 73,611 to 33,892 in 2000. Since then the number of researchers has stabilized around 30,000, reaching 33,189 in 2020. Demographic changes and the migration of highly skilled labour have led to structural changes in R&D employment. Demographic aging and increasingly fewer generations of young people, the dissolution of many R&D institutes and the reduction of R&D funding have led over time to the reduction of employment in the research field.

Table 4: The evolution of the researchers number

	1993	2000	2007	2014	2015	2016	2017	2018	2019	2020
RDI staff	73611	33892	28977	31391	31331	32232	32586	31933	31665	33189

Source: European Commission, PSF review of the Romanian R&I System, (2021).

The low attractiveness of the research system in Romania is also proven by the small number of foreign PhD students. According to the Report on the state of higher education in Romania in the academic year 2020-2021, a number of 34,447 students studied, and of these only 3%, respectively 970, followed doctoral study programs (Ministry of Education, 2022)

The sub-pillars that positively influenced Romania's position were the Knowledge Impact and Knowledge diffusion. The indicators that favourable influenced those sub-pillars were: Labour productivity growth, ISO 9001 quality certificates, ICT services exports (% total trade) and production and export complexity

Table 5: Romania's Strengths and Weaknesses

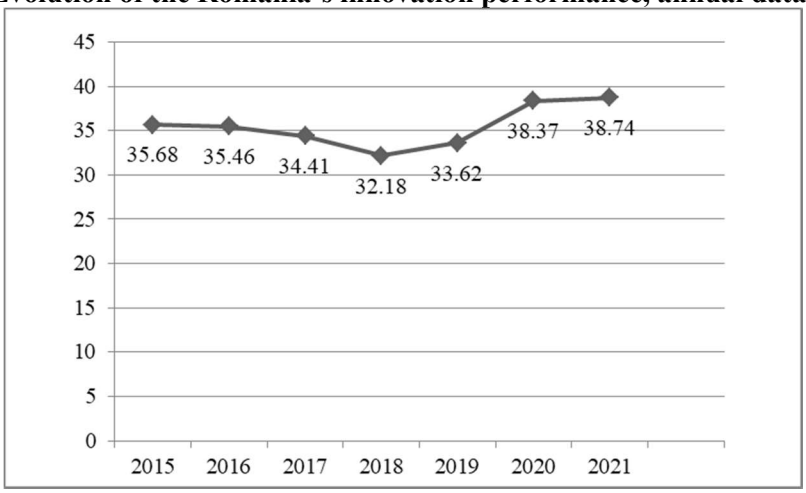
Strengths	Position in GII 2022	Weaknesses	Position in GII 2022
1.2.3 Cost of redundancy dismissal	1	1.1.2 Government effectiveness*	84
3.3.3 ISO 14001 environmental certificates	10	1.3.1 Policies for doing business	114
3.3.1 GDP/unit of energy use	19	2.2.1 Expenditure on education, % GDP	99
4.1.3Loans from microfinance institutions, % GDP	9	2.3.2 Gross expenditure on R&D, % GDP	64
4.3.1 Applied tariff rate, weighted avg., %	20	2.3.4 QS university ranking, top 3*	72
5.1.4 GERD financed by business, %	21	4.1.2 Domestic credit to private sector, % GDP	105
5.3.3 ICT services imports, % total trade	14	4.2.1 Market capitalization, % GDP	74
6.2.1 Labour productivity growth, %	4	4.2.3 Venture capital recipients, deals/bn. PPP$ GDP	81
6.2.4 ISO 9001 quality certificates/bn PPP$ GDP	17	4.2.4 Venture capital received, value, % GDP	95
6.2.5 High-tech manufacturing, %	23	5.2.1 University-industry R&D collaboration	82
6.3.4 ICT services exports, % total trade	11	5.2.4 Joint venture/strategic alliance deals/bn. PPP$ GDP	93

7.2.1 Cultural and creative services exports, % total trade	15	6.1.2 PCT patents by origin/bn. PPP$ GDP	79

Source: Own processing based on the Global Innovation Index 2022.

At the European level, according to the European Innovation Scoreboard 2021, Romania is an emerging innovator and occupies the last position in the EU in terms of innovation performance. As can be seen in Graph 1, the evolution of the global innovation index for Romania (compared to the European Union average) has not changed significantly over time. If in the period 2015-2016 the relative performance compared to the EU recorded the value of approximately 35%, in 2021 it recorded a modest progress reaching the value of 38.74%.

Graph 1: Evolution of the Romania's innovation performance, annual data 2015-2021

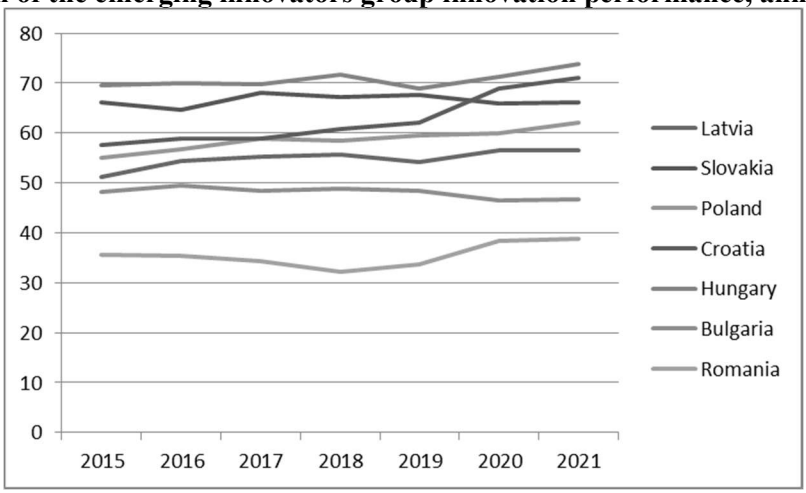


Source: Author based on data European Innovation Scoreboard (2021).

According to the latest edition of the European Innovation Scoreboard, among the top three indicators for which Romania recorded values close to or above the EU average are exports of high-tech goods, broadband internet penetration and venture capital investments. On the other hand, the list of weak points includes a much larger number of indicators, which reflects the poor level of innovation performance in Romania.

Romania has one of the lowest scores in Adjusted Research Excellence. Low integration in Space European Research Area (ERA) limits the connection to international R&D networks, with impact on the ability to attract dedicated funds from the research and innovation framework program (Horizon Europe) of the European Commission and producing results of international impact, publications and patents. The involvement of SMEs in innovation is marginal. The public-private collaboration, universities-companies is typical ad-hoc, while the scientific production resulting from these collaborations places Romania in the last places in the EU (Amcham, 2021).

Graph 2: Evolution of the emerging innovators group innovation performance, annual data 2015-2021

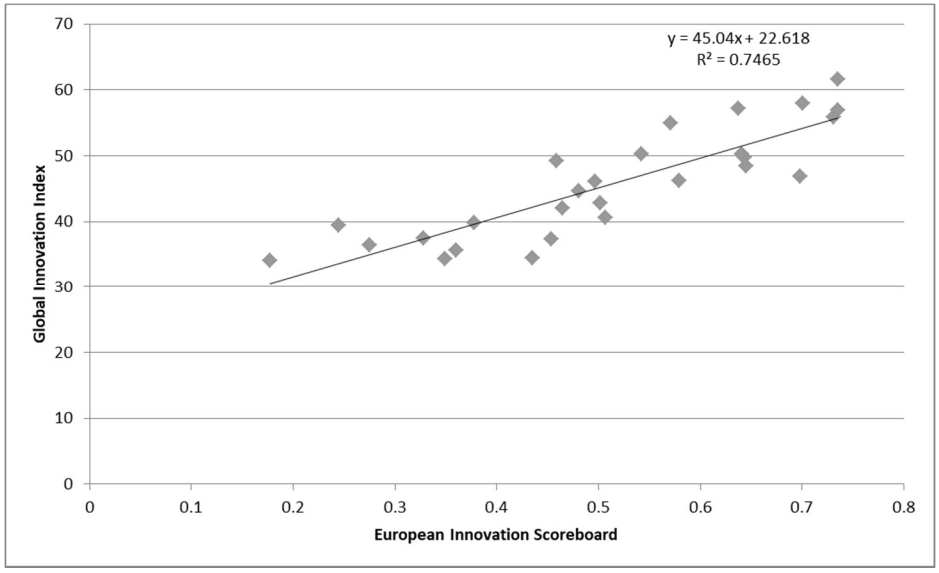


Source: Author based on data European Innovation Scoreboard (2021).

For emerging innovative countries, overall performance improved over the period 2014-2021. The leader of this group is Poland, and the last place is occupied by Romania. Three emerging innovators have registered strong increases in performance over time, Croatia, Poland and Latvia. For the rest of the countries, members of the emerging innovators group, innovation performance improved compared to 2014, but the increase was not significant. Only two states - Slovakia and Latvia - recorded decreases in performance in 2021 compared to 2020.

The positions occupied by the European countries, including Romania, at the global level in Global Innovation Index are correlated with the positions occupied at the European level in the European Innovation Scoreboard (European Commission, 2022).

Graph 3: The relationship between the European Innovation Scoreboard and Global Innovation Index 2022



Source: Author based on data Global Innovation Index and European Innovation Scoreboard 2022.

Based on the calculations, was obtained a coefficient of 0.74, which indicates a correlation between the European Innovation Scoreboard and the Global Innovation Index. This positive relationship is determined by the use of common indicators within the EIS and GII, as well as by the common purpose of the two tools to analyse innovation performance.

3. Conclusions

Romania is an emerging innovative country, with an innovation performance well below the EU average. The existing research-development-innovation system in Romania is not able to ensure overcoming the condition of a modest innovator, due to some of its weaknesses, among which the most important are: extremely low research and development expenses, under-financing, decreasing of the researchers number, the excessive priority given to fundamental research to the detriment of applied research, the lack of adequate incentives in favour of research and development, the lack of a periodic analysis of the real correlation between the needs of Romanian society and the priority programs as research direction within the national programs.

The position occupied by Romania in the Global Innovation Index is complemented by the position occupied in other world and European rankings, as follows:

- Romania ranks 19/133 in the list of the most complex countries in the world in the Economic Complexity Index ranking (Harvard, 2020).
- The 2019 Global Competitiveness Index of the World Economic Forum places Romania in 51st place out of 141 countries. The country ranks best in ICT adoption (32nd) and market size (41st), and worst in financial systems (86th), health (83rd), skills (72nd) and business dynamism (World Bank, 2020).
- Romania ranks 55th in the World Bank's Doing Business ranking, which evaluates the ease of doing business in 190 countries around the world. The country has gone through many reforms to make it easier to do business and is now closer to other EU member states in terms of scores for starting a business (EBRD, 2019).

- Romania has a below-average performance on all dimensions of the eco-innovation index (it ranks 25th out of the 27 member states). Eco-innovative outputs and activities are relatively at half of the EU average; the country is closer to the EU average in socio-economic outcomes (93%) and resource efficiency outcomes (81%) (European Commission, 2019).
- Romania ranks 26th out of 28 countries in the Digital Economy and Society Index (DESI) 2021. The country scores best in the Connectivity dimension and is well positioned in terms of ICT graduates (Human Capital), but digitization of the economy lags far behind. Regarding digital public services and the use of internet services, Romania has the worst performance in the EU (European Commission, 2021).

References:

[1] Adler,P.S., Shenbar, A.(1990). *Adapting your technological base: The organizational challenge*, Sloan Management Review,25/ 1990, pp.25-37

[2] Amcham (2021). *Priorități pentru România 2021-2024*, available at http://www.globeco.ro/wp-content/uploads/vol/split/vol_9_no_1/geo_2021_vol9_no1_art_022.pdf .

[3] Chou, Y.K. (20030. *The Australian growth experience (1960-2000), R&D based, human capital-based or just steady state growth,* Research Paper No. 855. Department of Economics, University of Melbourne, 2002

[4] Cristina, I. (2020). *Care sunt cele mai inovatoare economii și cum inovează aceste țări,* available at https://urbanizehub.ro/care-sunt-cele-mai-inovatoare-economii-si-cum-inoveaza-aceste-tari/.

[5] EBRD (2019). *Knowledge Economy Index*, available at https://www.ebrd.com/news/publications/brochures/ebrd-knowledge-economy-index.html

[6] European Commission (2019). *Eco-innovation Index, Country profiles: Romania*, available at https://ec.europa.eu/environment/ecoap/romania_en.

[7] European Commission (2021). *Indicele economiei și societății digitale (DESI) 2021* available at https://ec.europa.eu/newsroom/dae/redirection/document/80598.

[8] European Commission (2021). *PSF review of the Romanian R&I System*, available online at https://op.europa.eu/en/publication-detail/-/publication/8a4a2522-eac3-11ec-a534-01aa75ed71a1/language-en/format-PDF/source-259353375.

[9] Griliches, Z. (1995). *R&D and productivity*. In: Stoneman, P. Ed., Handbook of Industrial Innovation. Blackwell, London.

[10] Harvard's Growth Lab (2020). *Atlas of Economic Complexity. Country profile: Romania*, available at https://atlas.cid.harvard.edu/countries/185/summary.

[11] Jones, C. I., & Williams, J. C. (1995). *Measuring the social return to R&D*. The Quarterly Journal of Economics, 113(4), 1119-1135, 1995

[12] Maier, L. (2014). *The implementation of innovations in business in the Republic of Moldova,* Theoretical and scientifical journal, no.3/ 2014 , available at https://ibn.idsi.md/sites/default/files/imag_file/Implementarea%20inovatiilor%20in%20afaceri%20in%20RM.pdf.

[13] Ministerul Educației (2022). *Raport privind starea învățământului superior din România 2020- 2021* available at https://www.edu.ro/sites/default/files/_fi%C8%99iere/Minister/2021/Transparenta/Stare%20invatamant/Raport_stare_invatamant_superior_RO_2020_2021.pdf.

[14] OECD (2018). *Oslo Manual 2018- Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition* available at https://www.oecd-ilibrary.org/science-and-technology/oslo-manual-2018_9789264304604-en?itemId=/content/publication/9789264304604-en&_csp_=f0a6f52d4530c0667c4c56b36905227f&itemIGO=oecd&itemContentType=book

[15] Saharnean, L. (2019). *Imaginea inovațională: metodologii internaționale de cercetare a activității inovaționale a Republicii Moldova*. Studia Universitatis Moldaviae, no.2(122), available at https://oaji.net/articles/2019/2054-1565859504.pdf.

[16] Wang, E. (2010). *Determinants of R&D investment: The Extreme-Bounds-Analysis approach applied to 26 OECD countries*, Research Policy, 39, 2, pp.103-110.

[17] WIPO, 2022. *Global Innovation Index 2022- What is the future of innovation-driven growth,* available at https://www.globalinnovationindex.org/gii-2022-report#.

[18] World Bank (2020). *Ease of doing business in Romania*, available at https://www.doingbusiness.org/en/data/exploreeconomies/romania.

The Importance of Accounting Information Systems for Business

ANDREEA PAULA DUMITRU
Senior Lecturer Ph.D., Faculty of Economics and Business Administration
Nicolae Titulescu University
Calea Văcărești no. 185, Sector 4, Bucharest
ROMANIA
pauladumitru@univnt.ro

Abstract: Accounting information systems have an important role for the progress of a company. Accounting information systems produce financial information. Financial information is also referred to as financial statements. The accounting information system collects data in the form of transactions that occur in companies such as purchase transactions, sales transactions, cash disbursements transactions and cash receipt transactions. Information in company financial reports is needed by both internal and external parties. The financial statements must meet the requirements, that is, have quality characteristics. To run an Accounting Information System (AIS), elements are needed so that the system can run properly and correctly. namely: (1) Human resources (HR) who have been trained; (2) Financial Data Form; (3) Hardware; (4) Software; (5) Procedure; (6) communication technology network; (7) database. The quality characteristics of financial statements consist of comprehensiveness, relevance, materiality, reliability, honest presentation, substance outperforming form, neutrality, sound judgment, and completeness. The accounting information system functions to oversee all the company's financial activities and collect and store data on the company's financial activities or transaction.

Keywords: Accounting, Information, Systems, Business, Decision Making

1. Introduction

Accounting information systems have an important role for business. The accounting information system here is a computerized information system for processing financial data related to transaction data in an accounting cycle and presenting it in the form of financial reports to company management. The system is a set of elements that come together to achieve certain goals where the system has the same relationship, integration and goal and has several sub-systems in it. Companies that run a business definitely need an accounting information system to support their business performance.

The purpose of an accounting information system is to collect, process and report information relating to the financial aspects of the company's business activities. Companies that run a business need to design and run properly related to accounting information systems including subsystems by paying attention to several components of the accounting information system. Such as human resources who are able to understand accounting and financial business processes in general, financial and accounting procedures, financial data forms used to record all financial activities, accounting software, and hardware that are supported by internet networks and other equipment. So that it will be able to build company business activities that can run effectively, efficiently, and have a positive impact on the company's business development because it is able to maximize the objectives and benefits of accounting.

Accounting is an information system that provide stakeholders with reports on the economy and state of the company. Financial transaction activities in a company are processed through accounting. Accounting includes the identification process, the measurement process, and the reporting process for producing financial reports.

Accounting has benefits both for internal parties and for external parties.
Internal parties are parties that are directly related to company operations, for example, company leaders. As for external parties, namely parties that are not directly related to the company, for example, company owners, creditors, government agencies, and the community.

The government is a user of accounting information that is included in external parties. The government as an institution that manages state finances must monitor company performance. This control is mainly related to taxes and the use of labor.

Accounting information must be understandable. Therefore, the preparation of the report is adjusted to the understanding and knowledge of its users. Accounting information is said to be credible if it meets the criteria, which is testable, neutral, and presents actual data. Apart from that, the predictive value and feedback also need attention. This means that the data currently owned can be used to predict future conditions. Due to the large amount of benefits required for the benefit of various parties, the financial statements must be presented on time. Timeliness is important to avoid delay in decision making. For the government itself, the accuracy of companies in reporting finances is an assessment of whether their performance is good or bad. A good company will certainly maintain all of its activities by prioritizing quality.

The government as the decision maker of state finance must use accounting information correctly. Because all government policies will affect a country's economic growth. Prosperity can be achieved if the government takes the right policies. The role of the accounting information system for the company, in this case is clearly very important. Because accounting information systems together with other information systems provide information needed by management as a basis for decision making. For parties outside the company, the role of accounting information systems is equally important. As a producer of information in the form of financial reports that are useful as a basis for assessment and analysis of the condition of the company. From these reports, parties outside the company can make the right decisions.

The role of information systems is inseparable from the functions it performs. Not only data processing or processing, but accounting information systems also carry out functions ranging from data collection, data processing or processing, data management, data control and security, and of course the function of providing information. And the accounting information system is a structure that is one of the entities that uses hardware to convert financial /accounting transaction data into accounting information with the aim of meeting the information needs of its users. With this it can be concluded that AIS is very important for companies and organizations. AIS has many important roles in a company, such as improving quality and reducing costs in producing goods and services, improving decision making, and creating a competitive advantage.

Of the many AIS functions, there are 3 main functions established by SIA in companies, besides being used for decision making, they also consist of collecting and storing transaction data, processing data into information that can be, an controlling company assets.

There are 2 a information produced by SIA, namely Financial Accounting Information in the form of financial reports and Management Accounting Information which is used for decision making by companies. The SIA scope tracks a large amount of information regarding sales orders, sales in units and currency, cash collectors, purchase orders, receipt of goods, payments, salaries and hours worked.

2. Literature review

The purpose of an accounting information system is to present accounting information to various parties who need this information, both internal and external parties. Hall (2001, p.18), the purpose of compiling information systems is as follows: objectives of Accounting Information Systems

1) To support the management function (stewardship) of the management of an organization/company, because management is responsible for informing the organization and use of organizational resources in order to achieve the organization's goals.
2) To support management decision making, because information systems provide information needed by management to carry out decision-making responsibilities.
3) To support the day by day operations of the company. Information systems help operational personnel to work more effectively and efficiently.

The following is a description of the objectives of the accounting information system

1) Collecting and storing data about activities and transactions
2) Process data into information that can be used in the decision-making process related to business planning and control.
3) Perform proper control over company assets.
4) Cost and time efficiency on financial performance.
5) Presentation of financial data in a systematic and accurate manner in the appropriate accounting period.

As for some of the objectives of the accounting information system stated by Setiawati (2011: 5), including:

1) Safeguarding company property/assets. The assets in question include the company's cash, merchandise inventory, including the company's fixed assets.
2) Produce a variety of information for decision making.
3) Produce information for external parties.
4) Produce information for employee or division performance appraisals.
5) Provide past data for audit purposes (inspection).
6) Produce information for the preparation and evaluation of company budgets.
7) Produce information needed in planning and control activities. Accounting information that is informed in the form of company financial reports is a medium of communication between the company's business activities and parties with an interest in the company's financial position and business development. Accounting information has uses that are very dependent on the user.

The following is the use of accounting information for:

1) Chairman of the company.
(a) As proof of accountability to the owner of the company for the trust given to him to manage the company;
(b) As a tool for assessing the implementation of the company's operational activities, both as a whole, in sections and individuals who are given authority and responsibility;
(c) As a tool to measure the level of costs of business activities carried out by the company;
(d) As a material for consideration in controlling company activities;
(e) As a material for consideration in preparing a program of activities in the coming period;
(f) As a consideration in making decisions; (g) This is to determine the condition of the company and the company's financial position
2) Company owner. In a company in the form of a limited liability company or a company whose leadership is transferred to someone else, financial reports are needed by the owner of the company.
Financial statements for company owners function as:
(a) An assessment tool for the results that have been achieved by the company leadership;
(b) The basis for determining the estimated future profits and the estimated development of the share price it owns; (c)Creditors and potential creditors.
3) Creditors are people or entities that provide loans in the form of money or goods to companies. For creditors and potential creditors, the financial report serves as a material for consideration and decision in granting credit, because the results of the analysis of financial statements can be seen whether the company to be given a loan can repay the loan at maturity or not. From the financial report, it can also be seen whether the loan provided is sufficiently guaranteed or not.
4) Investors and potential investors. People or entities who invest in a company are called investors. Investment can be done in two ways, namely buying a portion of the company's share capital or providing a loan to the company concerned which is supported by bonds. For investors and potential investors, financial reports are useful as a material for consideration in investing in a company. In addition, financial reports are useful for assessing the company's ability to provide profits or pay dividends to investors.
5) Government agencies. Government agencies with an interest in financial reports include:
(a) tax office. For the Tax Office, the company's financial statements serve as the basis for determining the income tax that is borne by the company;
(b) Capital Market Development Agency (Bapepam). Bapepam uses financial reports as a financial monitoring tool for companies that sell their shares through the capital market;
(c) Department of Industry and Commerce. Financial reports are used for statistical data collection purposes.
6) Employees. Employees also have an interest in financial statements, because financial statements function as follows:
(a) this is to determine the level of ability of the company in paying salaries and other social security;
(b) to assess the development and prospects of the company in determining the choice of steps that must be taken in connection with the continuity of its work;
(c) as a basis for assessing the eligibility level of the bonus it receives compared to the company's profits in the period concerned.

3. Result and Discussion

Management in a company must depend on management accounting information made in accordance with the management accountant's code of ethics. This information is obtained from data in the management information system and accounting information system in the form of notes to financial reports. If all the theories that have been studied can be implemented properly according to the provisions, a company will be able to make efficiency and gain company progress to respond to the challenges of the global world and free markets.
All of these things are of course inseparable from existing resources so that a management must be able to adjust it so that there is no waste.

The functions formed by the Accounting Information System include:

1. Collecting and storing data about activities and transactions.
2. Processing data into information that can be used in the decision making process.
3. Perform proper control over organizational assets. Various non-financial transactions that cannot be processed by an ordinary Accounting Information System are processed by the Management Information System.

The benefits of accounting information for the business:

1) Produce Flexible and Actual Information. Management provides flexible information because the management accounting information system is not bound by any formal criteria that define the nature of its processes, inputs, or outputs that are tailored to management's primary objectives. Actual or up-to-date information is better than old, complete information as long as it is in accordance with accounting principles.
2) Assisting the planning of corporate activities. The scope of management accounting provides financial information that can be used in the preparation of activity plans because this information serves as a reference for the allocation of resources owned by the company. Management accounting also provides information as feedback for management regarding the implementation of the activity plans that have been prepared. Management accounting information is also needed by management to plan company activities for the future such as the next 1 year. Planning activities consist of making decisions and selecting alternative actions from various options that may be implemented in the future. Decision-making actually includes the formulation of the problem, determining various alternatives for appropriate action to solve the problem, and analysis of the consequences of each alternative for these actions so that the best alternative choice that will be implemented in the future is the best choice.
3) Assisting Management in Decision Making. The benefits of management accounting for the company, especially for management, lie in the process of analyzing the consequences of every possible alternative action in the decision-making process. Management must make decisions to choose the best alternative action among the existing alternative actions. The decision of the best of good things must be considered in terms of various aspects including risks and other possible negatives.
4) Assisting the Management to Recognize the Ins and Outs of the Company. Management is the ranks that lead a company which is divided into several parts according to their respective competences. A good manager is a manager who knows the internal and external environment well. If the management cannot recognize or know in detail the ins and outs of the company including the document flow chart, then it can be ascertained that the performance is not optimal because it does not cover all parts.
5) Assisting Management in Performance Appraisal. Management must assess the employee so that they can provide certain compensation as a reward or punishment for their underperformance. With the type of financial report from each division, it will make it easier for management to make an assessment. If you feel that the overall performance is still lacking, it is possible that certain training should be held.

4. Conclusions

Accounting is a process of identifying, measuring, and reporting economic information, to enable clear and unequivocal judgments and decisions for those who use the information.

However, in the business world, accounting (accounting) can be defined as an information system that provides reports to stakeholders regarding economic activity and the condition of a company.

The use of information technology has enormous benefits, especially for companies.

By using information technology, companies can provide, manage, and report finances easily, quickly and accurately. These stakeholders are owners (shareholders), employes (workers), customers (customers), creditors (people who provide loans), government (government), community (community).

Accounting provides information for stakeholders in the company through the following processes:

(1) Identify stakeholders;
(2) Assess stakeholder needs;
(3) Designing accounting information systems to meet stakeholder needs;
(4) Recording economic data regarding company activities and events prepare accounting reports for stakeholders;
(5) Stakeholders use accounting reports as the main information, although they are not the only ones to make decisions, they also use other information.

References

[1] Albu N. &, Albu C., (2003) -Intrumente de management al performantei, vol.I, Ed.Economică, Bucuresti;
[2] Azhar Susanto & Meiryani., (2018).- The Quality of Accounting Information system and its impact on the quality of accounting information: user ability and top management support. Journal of Engineering and applied sciences 13(2), pp. 384-38;
[3] Maines, L. A., & McDaniel, L. S., (2000) - Effects of Comprehensive-Income Characteristics on Nonprofessional Investors. The Accounting Review, April 1, 2000, American Accounting Association;
[4] O'Byrne, S. F & Young S., D. (2001) - EVA and Value Based Management: A Practical Guide to Implementation. New York: McGraw-Hill;
[5] Epstein B., Mirza Abbas Ali, Willey (2015). IFRS 2015 – Interpretarea și aplicarea
[6] Standardelor Internationale de Contabilitate și Raportare Financiarã, Editura BMT Publishing House, București.

Economic Impact of the Coronavirus Crisis on the Construction Sector in Romania

MARIA-ZENOVIA GRIGORE
Associate professor, PhD.
Faculty of Economics and Business Administration,
„Nicolae Titulescu" University from Bucharest
ROMANIA
mgrigore@univnt.ro

CAMELIA BÎZNĂ
Postgraduate student,
Faculty of Economics and Business Administration,
„Nicolae Titulescu" University from Bucharest
ROMANIA
cameliam40393@univnt.ro

Abstract: The construction sector has been marked in recent years by unforeseen events that have changed the plans of many companies in the sector. This paper examines the evolution of this sector before, during and after the SARS-COV2 pandemic. The aim of this paper is to highlight how construction companies have managed their business with the threat of the pandemic crisis. The method used is a comparative analysis from 2015 to 2022 inclusively, so that we can observe the stage of development of firms operating in the construction sector precursor to the pandemic, and the effects it has had. For the period 2019-2022, we have also analyzed the impact of the increase in the minimum wage and of the tax facilities for construction employees on the development of the construction industry. Among the indicators analyzed are the gross value added of the construction sector, the volume of construction work by structural elements, net investment and construction cost growth. The study highlights the extent to which the construction sector has been affected by the pandemic crisis, but also the factors that could lead to the development of this sector.

Keywords: construction, pandemic, gross value added of the construction sector, net investment, tax breaks

1. Introduction

Construction is a very important technical branch in the Romanian economy, dealing with the design, execution, maintenance and operation of various structures or infrastructure works. In recent years, an impediment to the development of the economy has been the pandemic crisis. Some firms have survived by finding ways to manage their business in accordance with the regulations in force, while others have been on the verge of bankruptcy. This study aims to highlight the indispensability of this sector in the structure of the Romanian economy, through a macroeconomic analysis based on four indicators, namely the gross value added of the construction sector, the volume of construction works by structural elements, net investments and the growth of construction costs. The study is based on statistical information provided by the National Commission for Strategy and Forecasting and the National Institute of Statistics.

In this article, we have analyzed the construction sector in terms of the tax facilities it benefits from, but also in terms of how it contributes to an important macroeconomic indicator, the Gross Domestic Product, with the threat of the economic crisis due to the COVID-19 virus.

The objectives of this paper are to show to what extent the pandemic has affected the dynamics of the construction sector and which areas of the country have been most affected, as well as how net investment influences the construction sector. Thus, we divided the paper into three divisions. In the first part, we analyzed indicators specific to the construction sector in the pre-crisis period 2015-2019. In the second part of the paper, we presented the development of these indicators in the two years of the pandemic, 2020-2021, and finally we exposed the post-crisis phase, the year 2022, with the repercussions of the pandemic and the energy crisis

generated by the conflict in Ukraine. Half of the period analyzed (years 2019-2022) was influenced by the introduction of incentives for the construction sector through GEO 114/2018. The analysis carried out shows the extent to which these mitigated the negative effects of the COVID-19 pandemic.

The novelty of this paper stems from the fact that it focuses on a macroeconomic analysis differentiated over three sub-periods and aims to illustrate how construction firms operate under the impact of the pandemic crisis.

2. Literature review

The COVID-19 pandemic has had an unexpected impact on the construction sector, as during the period of restrictions the sector has seen increases for small-scale building completions, repairs, renovations and even extensions to individual buildings. Thus, in 2020 compared to 2019, construction volume increased by 16%. The top construction category was engineering construction, which increased by 18.5% compared to 2019. With an annual increase of 17.8%, residential buildings ranked second. Last but not least, non-residential construction increased by 11%[1].

In order to comply with the restrictions imposed by authorities, the real estate market had to postpone some projects and come back with a new investment strategy. With the advent of the pandemic crisis, raw material prices have risen, fuel prices have also risen substantially and these factors have led to higher prices for final projects and obviously to renegotiation of contracts.

In terms of complying with the restrictions in place, for the office area it was more challenging as employees had to keep a minimum distance of 2 meters, a limitation of a certain number of people in one room was imposed, which led to tele-communication and therefore increased costs. On the other hand, the balance was evened out by individual households, which increased the demand for building materials, for which various warehouses, logistic spaces were built to store materials until delivery to the customer. Since the workers in the households worked in small groups in the open air, they were able, with minimal protective measures, to carry out their work much better. In addition, since most companies came with the possibility to work 'from home', many people decided to build a new space in which to work, away from large human agglomerations, or to extend their existing space.

The impact of the pandemic crisis on the construction sector is analyzed in numerous articles published in specialist magazines such as *Agenda Construcțiilor & Fereastra*[2], *Arena construcțiilor*[3]. The authors explain how construction volumes evolved during the pandemic, what measures the authorities imposed and how companies managed the whole situation to comply with the restrictions but still be able to operate without endangering the lives of their employees.

The incentive measures in the field of the wage of workers in the construction sector introduced by the Romanian Government through GEO 114/2018[4] entering into force on 01.01.2019 affected half of the period analyzed (years 2019-2022) and were spread over all 3 periods concerned (pre - in - post pandemic). From 01.01.2023, GEO 168/2022[5], as can be seen in Table 1 modified some of the provisions of GEO 114/2018. The application of this government ordinance has reduced the number of those who benefit from tax facilities. One of the reasons for this is the significant reduction in the range in which the salaries that benefit from the facilities can be included. The second cause is the limitation of the tax relief to income obtained under an individual employment contract, eliminating the possibility of granting income from other contractual forms (management contracts, apprenticeships, internships, etc.).

Table 1. Tax facilities in the field of construction sector payroll

APLICATION PERIOD	01.01.2019 – 31.12.2022	01.01.2023 – 31.12.2028
CONDITIONS FOR GRANTING FACILITIES	The employer derives at least 80% of its turnover from construction activities, whose	The employer derives at least 80% of its turnover from construction activities, whose CAEN codes are listed in the Fiscal Code;

[1] https://www2.deloitte.com/ro/ro/pages/real-estate/articles/constructiile-au-sfidat-pandemia-evolutie-de-exceptie-in-2020.html, accessed on 16 March 2023
[2] https://www.agendaconstructiilor.ro/files/, accessed on 20 March 2023
[3] https://arenaconstruct.ro/, accessed 20 March 2023
[4] https://static.anaf.ro/static/10/Anaf/legislatie/OUG_114_2018.pdf, accessed on 16 March 2023
[5] https://static.anaf.ro/static/10/Anaf/legislatie/OUG_168_2022.pdf, accessed on 16 March 2023

	CAEN codes are listed in the Fiscal Code; The gross salary is between 3,000 lei and 30,000 lei per month.	The gross salary is between 4,000 lei and 10,000 lei per month; Only wages earned under an individual employment contract are covered.
TAX RELIEF		
Payroll tax	0 instead of 10%	0 instead of 10%
Employee's contribution to social health insurance	0 instead of 10%	0 instead of 10%
Employee's social security contribution	21,25% instead of 25%	21,25% instead of 25%

Source: GEO 114/2018 and GEO 168/2022

According to an article published by the Federation of Employers of Construction Companies (FPSC)[6] in *Revista Construcţiilor* no. 194/August 2022, these measures have helped to increase production and the number of new jobs. In November 2021, the FPSC conducted a survey of 293 managers of construction companies that benefited from the tax facilities introduced by GEO 114/2018. They stated that the main positive effect of GEO 114/2018 was the "stabilization" of the existing workforce and therefore a reduction in the number of departures abroad (77%), an increase in turnover (56%) and an increase in the number of employees, without affecting competitiveness (55%). Respondents considered that the elimination of tax facilities would have the following effects on companies: a reduction in the number of employees (75.3%), difficulties in continuing contracts (67.8%) and a reduction in activity (58.3%).

3. Methodology and database

The research hypotheses of this study are whether the pandemic has significantly influenced the dynamics of the construction sector and which regions have been more affected, as well as to what extent net investment stimulates the development of this sector.

The method used in the study is a macroeconomic analysis broken down into three sub-periods, based on four relevant macroeconomic indicators, namely the gross value added of the construction sector, the volume of construction works by structural elements (new construction works, capital repair works, maintenance and current repair works), net investment and construction cost growth. The period analyzed is eight years, from 2015 to 2022.

This period is divided into three frameworks, depending on the factor that led to the change in the way the business is managed, the COVID-19 pandemic. Thus, in the first part, the ante-covid period, we presented the dynamics of construction firms through their contribution to GDP in the period 2015-2019. For the years 2020 and 2021, we have analyzed the impact of the pandemic crisis on this sector, both in terms of works carried out and in terms of costs. In the last part, the post-crisis period, we have exposed the oscillations of the construction sector from the perspective of the four indicators mentioned above, as well as the solutions agreed by the Romanian state to remedy the effects left by this crisis.

The whole analysis is based on statistical information provided by the National Commission for Strategy and Forecasting and the National Institute of Statistics.

4. Economic analysis of the construction sector

4.1. Analysis of the construction sector precursor to the pandemic crisis

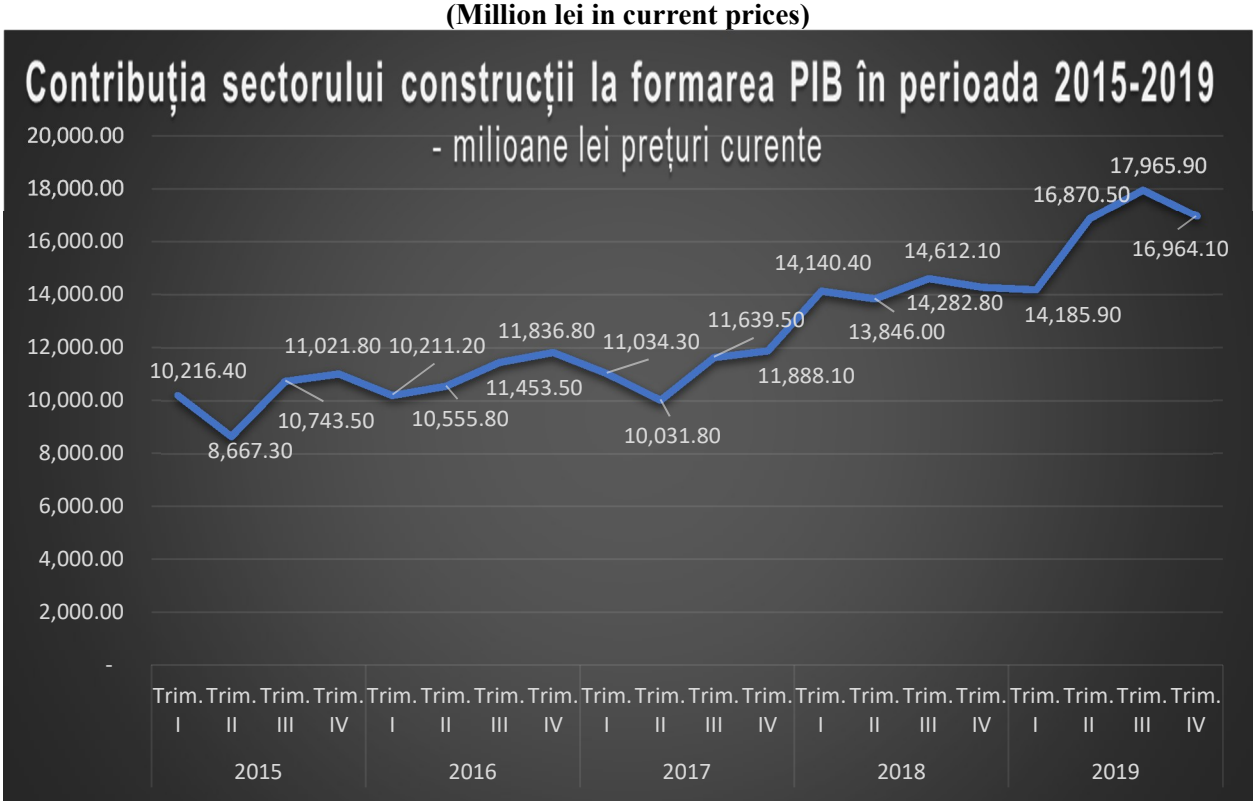
A first indicator by which we analyze the evolution of the construction sector in the pre-crisis period (2015 - 2019) is the contribution of this sector to the formation of gross domestic product (Chart 1). We have chosen for analysis the seasonally and working-day adjusted series.

As it can be seen in Chart 1, the gross value added (GVA) of the construction sector fluctuated quite a bit from quarter to quarter over the period 2015-2019. In annual values and compared to the previous year, the GVA

[6] https://www.revistaconstructiilor.eu/index.php/2022/08/01/fpsc-impactul-majorarii-salariului-minim-si-facilitatilor-fiscale-acordate-angajatilor-asupra-activitatii-din-constructii/, accessed on 20 March 2023

increased in 2016 by 8%, in 2017 by only 1%, and in the following two years the increase was spectacular (28% in 2018 and 16% in 2019).

Chart 1. Quarterly gross value added of the construction sector between 2015 and 2019 (Million lei in current prices)



Source: graphic representation of the authors, according to data on the website https://insse.ro/cms/ro/content/produsul-intern-brut, accessed on 20 March 2023

There was also an upward trend in the volume of construction works completed between 2015 and 2019 (Table 2), but this time the annual growth rates were quite close, ranging between 5.30% and 6.50%.

Table 2. Volume of construction works by structural elements - percentage changes from previous year

	2015	2016	2017	2018	2019
Construction - total	6,20%	5,30%	5,80%	6,20%	6,50%
New construction works	5,20%	5,70%	6,30%	6,80%	7,10%
Capital repair works	12,30%	5,50%	5,70%	6,00%	6,20%
Current maintenance and repair works	5,80%	4,00%	4,50%	4,70%	5,00%

Source: https://insse.ro/cms/ro/tags/comunicat-constructii-locuinte-trimestrial, accessed on 20 March 2023

Before the Covid-19 pandemic, the cost of construction had relatively low annual increases, as shown in Table 3.

Table 3. Cost increase in construction - percentage changes from previous year

Indicator	2015	2016	2017	2018	2019
The rising cost of construction	0%	1,5%	2%	2,5%	2,3%

Source: https://cnp.ro/wp-content/uploads/2021/07/prognoza_2015_2019_varianta_toamna_2015.pdf, accessed on 20 March 2023

The increase in the gross value added of the construction sector in 2016 compared to 2015 is correlated with the increase in the cost of construction (1.5%) and the increase in the number of completed works by 5.30%. In terms of structural elements, the volume of current maintenance and repair works increased the least, by only 4%, while the number of new constructions increased by 5.70%.

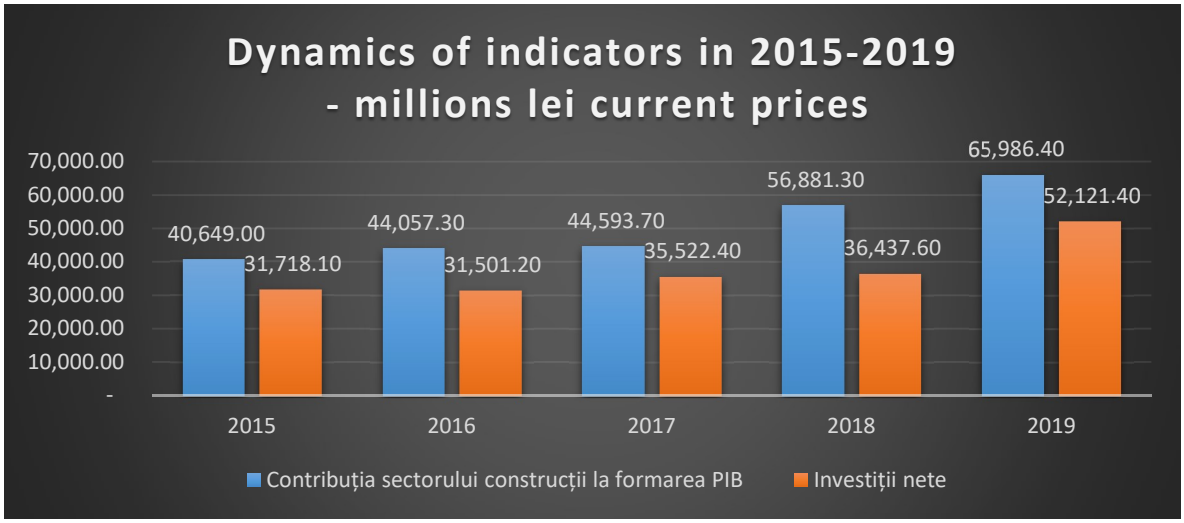
In 2017, the second quarter saw a decrease in the contribution of the construction sector to GDP formation, by around 5% compared to the same period of the previous year, with the other three quarters seeing slight increases in the indicator. The year 2017 was characterized by an increase in the volume of completed constructions, both in total and by construction category. However, the sector's contribution to GDP formation increased by only 1% compared to the 2016 level, very little if we take into account that in 2017 Romania had the highest economic growth in recent years, of 7.0%. This gap between the evolution of construction and that of the economy was due to the reduced capacity of companies in the sector to undertake works, due to the lack of financial and human resources.

In 2018, the situation started changing, with increases compared to 2017 in all the indicators analyzed. Thus, the GDP in construction increases from 44,593.70 million lei to 56,881.30 million lei, the volume of construction works increases by 6.20% and the average cost of construction by 2.5%. However, the sector is not operating at full potential.

Together with the implementation of measures in favor of employment in construction introduced by GEO 114/2018, the contribution of this sector to GDP formation is experiencing a significant increase in each quarter of 2019 compared to the similar quarter of 2018. Overall, the contribution of the construction sector to GDP formation increases in 2019 compared to 2018 by 9,105.10 million lei, representing approximately 16%. In terms of the volume of completed works by structural elements, in 2019 compared to the previous year there were 7.10% more new construction works, 6.20% more capital repair works and 5% more current works and repairs. Overall, 6.50% more construction was completed in 2019 compared to 2018. The third quarter of 2019 recorded the highest quarterly contribution to GDP in the period 2015-2019, namely 17,965.90 million lei, as can be seen in Chart number 1.

Chart 2 shows the link between the net investment allocated by the Romanian state and the contribution of the construction sector to GDP. With the exception of 2016, the increase in the contribution of construction to GDP formation is directly proportional to the net investment allocated to this sector. Thus, in 2017, 35,522.40 million lei were invested in the construction sector, 4,021.20 million lei more than the budget allocated in 2016, which also led to an increase in the number of dwellings compared to the previous year. The highest investment volume was in 2019, with an increase of 43.04% (in absolute value 15,683.80 million lei in current prices) compared to 2018.

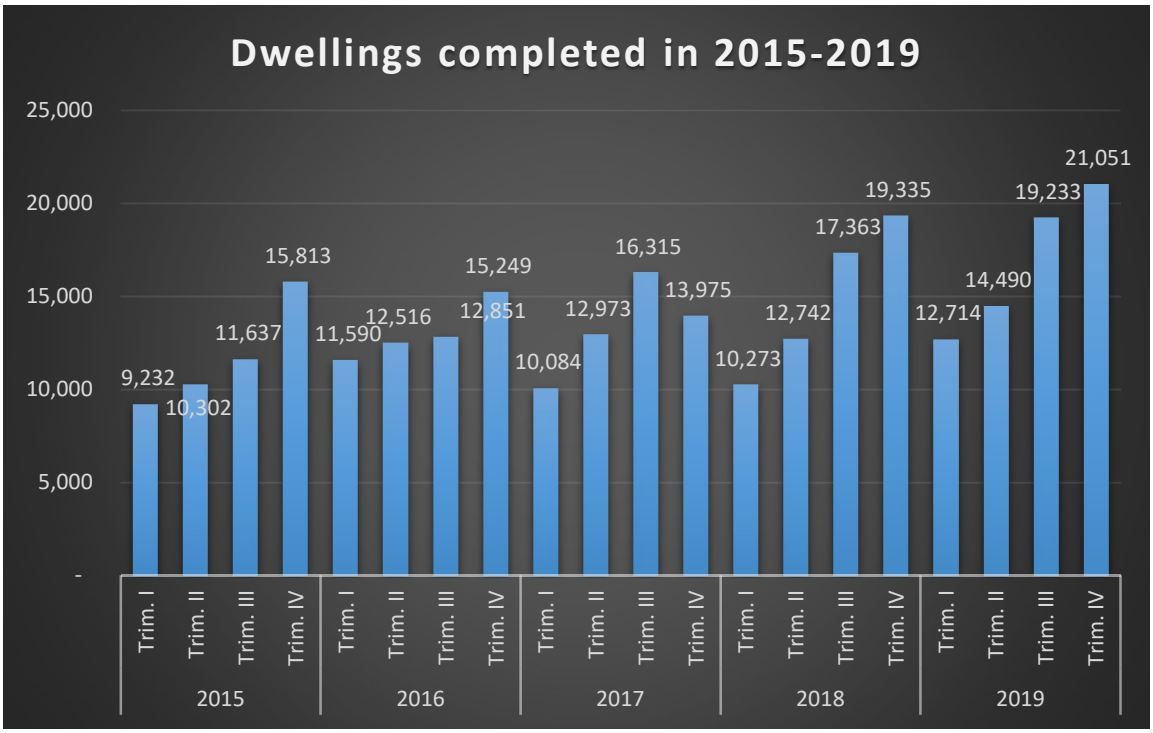
Chart 2. Relationship between net investment and gross value added of the construction sector between 2015 and 2019 (Million lei in current prices)



Source: graphic representation of the authors, according to data on the website https://insse.ro/cms/ro/tags/comunicat-investitii-economia-nationala, accessed on 20 March 2023

Chart 3 reflects the fluctuations in the volume of dwellings built in each quarter from 2015 to 2019. In 2016, the volume of dwellings completed increased compared to 2015 by 5,222. The increase in the number of dwellings occurred in all development regions, with one exception: the South-West Oltenia area, where there was a decrease of 58 dwellings.

Chart 3. Number of dwellings completed between 2015 and 2019



Source: graphic representation of the authors, according to data on the website https://cnp.ro/wp-content/uploads/2021/07/prognoza_2015_2019_varianta_toamna_2015.pdf, accessed on 20 March 2023

In 2017, the areas where fewer dwellings were completed compared to the previous period were the North-East area (down by 844), South-West Oltenia (down by 37) and the Bucharest-Ilfov part (489 fewer works were completed).

In 2018 and 2019, the number of completed dwellings increased at a faster pace than in previous years, with the peak of the period under review being reached in the fourth quarter of 2019, when 21,051 dwellings were completed, most of them in the North-West of the country and in Bucharest-Ilfov. The tax facilities that came into force from 01.01.2019 through the application of GEO no. 114/2018 had multiple positive effects on production, turnover and employment, with an impact on budget revenues, not only in the construction sector itself, but also in construction-related activities, manufacturing of building materials.

In conclusion, the pre-pandemic period predicted an upswing in this sector, as year after year the volume of construction increased, even though costs also rose, and the contribution to GDP increased directly in proportion to the volume of work completed.

4.2. Analysis of the construction sector during the pandemic period

With the arrival of the pandemic crisis, the government has imposed many restrictions, the result of which was home work, which in fact brought major costs for all companies in Romania. Since March 2020 the crisis has affected most sectors of the economy, leading to the bankruptcy of many companies.

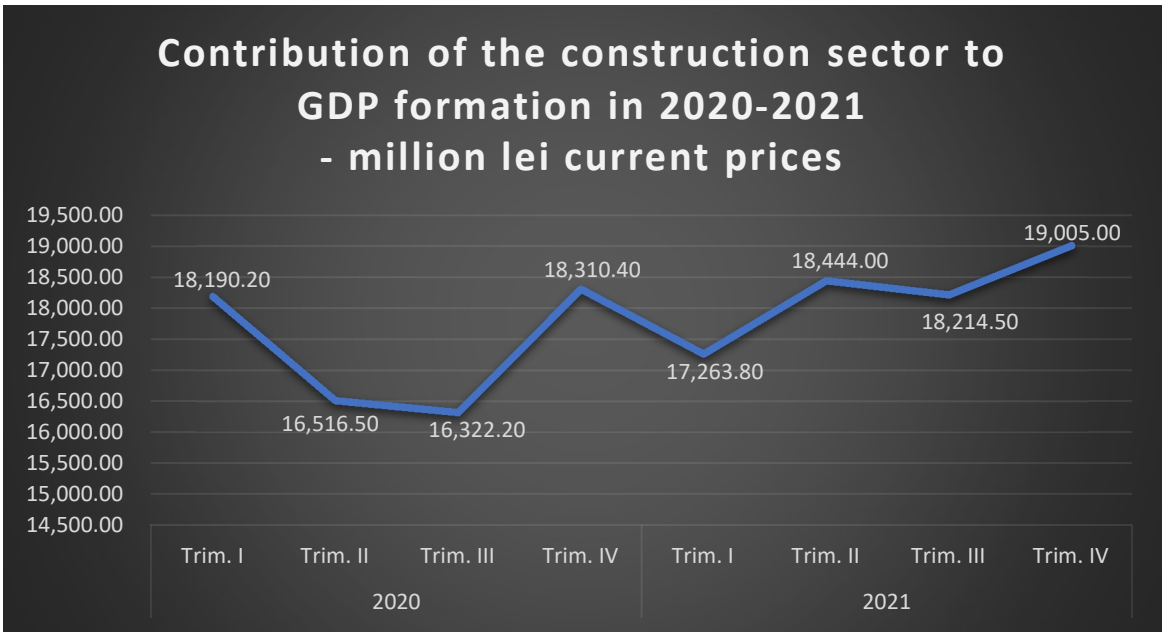
Table no. 3 shows how the volume of completed construction works evolved in the years of the Covid-19 pandemic, respectively 2020 and 2021, and Graph no. 4 shows the contribution of construction to GDP formation in the same period.

Table 3. Volume of construction works by structural elements - percentage changes from previous year

	2020	2021
Construction - total	15,90%	-0,60%
New construction works	9,30%	5,90%
Capital repair works	46%	-22,60%
Current maintenance and repair works	24,40%	-7,90%

Source: https://insse.ro/cms/ro/tags/comunicat-constructii-locuinte-trimestrial, accessed on 20 March 2023

Chart 4. Quarterly gross value added of the construction sector in 2020 and 2021 (Million lei in current prices)



Source: graphic representation of the authors, according to data on the website https://insse.ro/cms/ro/content/produsul-intern-brut, accessed on 20 March 2023

In the first quarter of 2020, construction contributed with 18,190.20 million lei to GDP formation. In the second and third quarters of 2020, the contribution of the construction sector to GDP formation decreased, due to compliance with the limits imposed by the Romanian state for the safety of employees. Compared to the same period of the previous year, the contribution of construction to GDP followed a decrease of 2.1% and 9.15% respectively in these two quarters. In the fourth quarter, the situation improves and the contribution of this sector is 7.94% higher than in the fourth quarter of the previous year. In addition, in 2020 compared to 2019 new construction work increased by 9.30%, the number of capital repair works increased by 46% and the number of maintenance and current repair works increased by 24.4%.

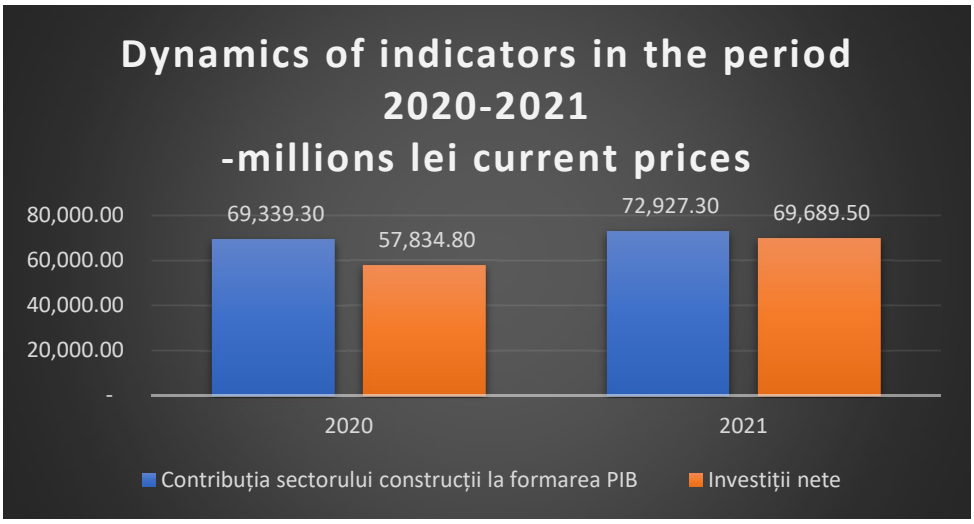
In the first quarter of 2021, a slight decrease of 5.09% in the contribution of construction to GDP is observed compared to the same period of the previous year, with the indicator showing higher values in the second, third and fourth quarters than in similar quarters of 2020.

Although the contribution of construction to GDP increased in 2021 compared to 2020 by 5.17%, the volume of completed works decreased by 0.6%. By structural elements, the decreases recorded were 22.60% for capital repair works and 7.90% for maintenance and current repair works. Only the volume of new construction works increased by 5.90% in 2021 compared to the previous year. Also worth noting is the 12.1% increase in construction cost in 2021 compared to the previous year, whereas in the period 2015-2020 annual increases in this cost ranged from 0% to 2.5%[7]. The crisis generated by the Covid-19 pandemic has led to an increase in all prices, including those for construction materials and works.

Graph no. 5 shows the link between the construction sector's contribution to GDP formation and net investment during the Covid-19 crisis.

[7] https://cnp.ro/wp-content/uploads/2021/07/Prognoza_preliminara_toamna_rectificare_bugetara_2020_2021.pdf, accessed on 20 March 2023

Chart 5. Relationship between net investments and gross value added of the construction sector in 2020 and 2021 (Million lei in current prices)

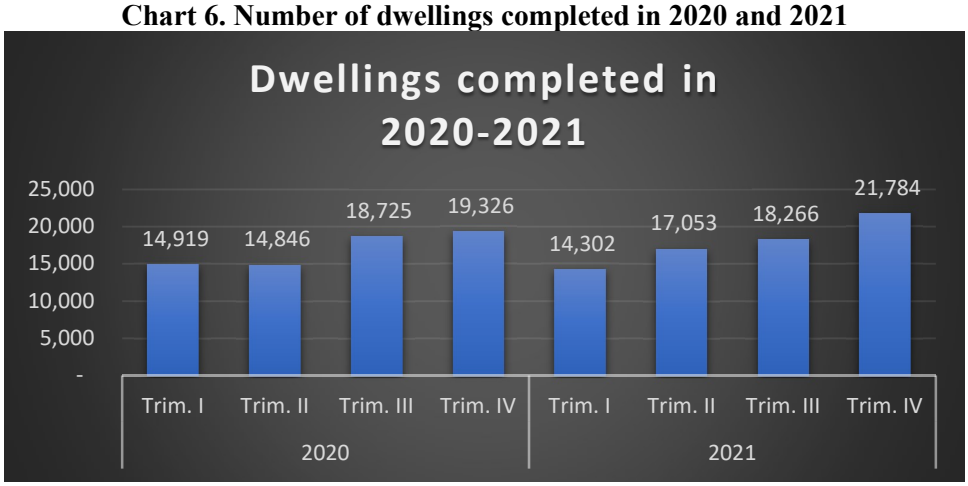


Source: graphic representation of the authors, according to data on the website https://insse.ro/cms/ro/tags/comunicat-investitii-economia-nationala, accessed on 20 March 2023

Compared to 2019, net investments in 2020 increased by about 11% reaching 57,834.80 million lei. It can be seen that the investment factor has a strong impact on the construction sector, because the more the investment budget allocated increases, the more the value of construction increases and therefore the more constructions are carried out. The increase in the volume of completed constructions in the second year of the pandemic compared to the first is due to the fact that the state made net investments in new construction works amounting to 69,689.5 million lei, 20% more than in the previous year.

As can be seen in Chart no. 6, 2020 comes with a substantial increase in the number of completed housing units compared to the previous year, namely by 15.90%. In 2020, the most dwellings were built in Bucharest-Ilfov, with 5,941 more than the previous year. The least were built in the North-West region of the country, where 2,983 fewer constructions were completed than in the previous year.

Chart 6. Number of dwellings completed in 2020 and 2021



Source: graphic representation of the authors, according to data on the website https://cnp.ro/wp-content/uploads/2021/07/Prognoza_preliminara_toamna_rectificare_bugetara_2020_2021.pdf, accessed on 20 March 2023

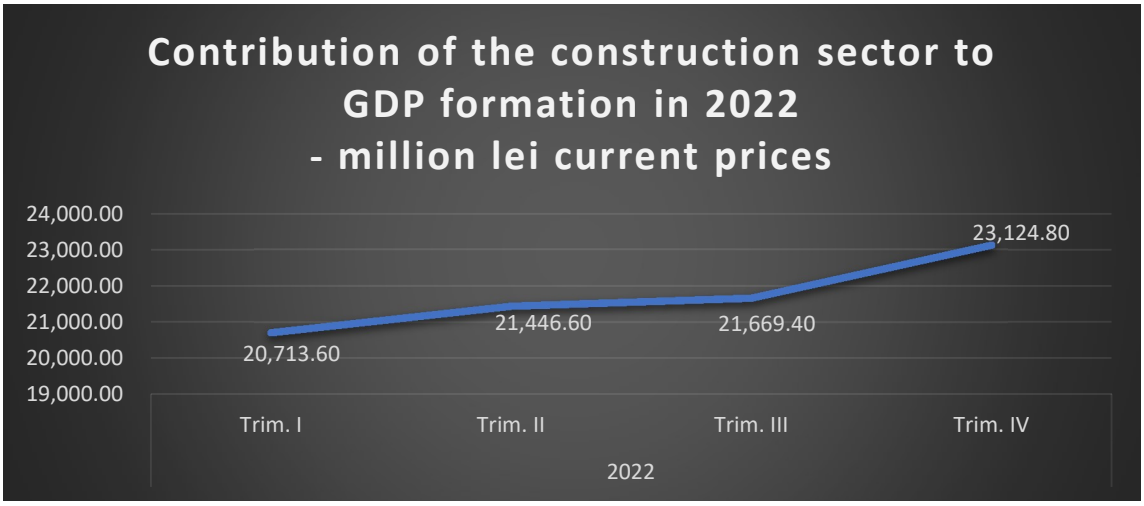
The lowest number of dwellings completed during the pandemic period was recorded in the first quarter of 2021, after that the indicator followed an upward trend. In 2021, the total volume of dwellings recorded an increase of 3,589 dwellings compared to the previous year, with most completed in the Bucharest-Ilfov region (22,010) and the fewest in the center of the country, where only 8,431 dwellings were completed. In the pandemic period, it can be seen that most completed dwellings were completed in the fourth quarter of 2021, and as regions,

most buildings were completed in Bucharest-Ilfov (7,549) and the fewest in the North-East region of the country (2,299).

4.3. Analysis of the construction sector in the post-covid period

The last part of this study concerns the analysis of the construction sector after the pandemic crisis period, namely 2022. Thus, in Chart no. 7 we have shown the contribution the sector has made to GDP formation for each quarter of this year.

Chart 7. Quarterly gross value added of the construction sector in 2022 (Million lei in current prices)

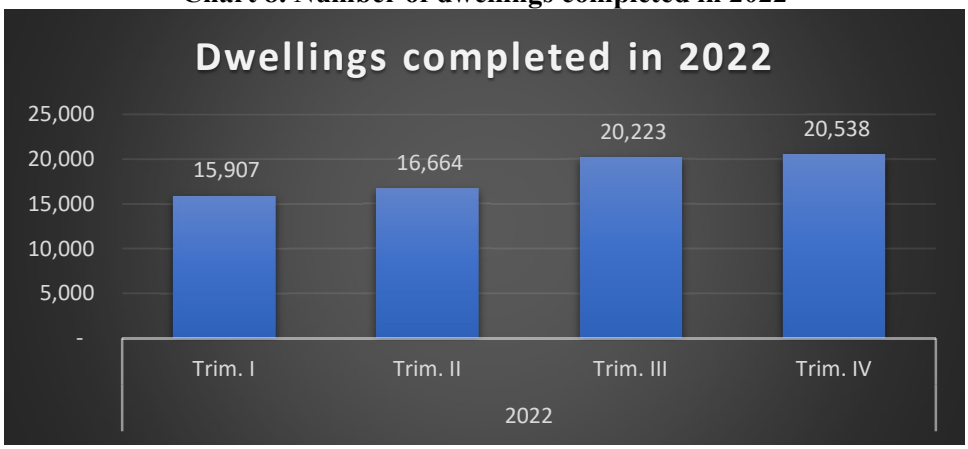


Source: graphic representation of the authors, according to data on the website https://insse.ro/cms/ro/content/produsul-intern-brut, accessed on 20 March 2023

The year 2022 announces a favorable period for the construction sector, as already in the first quarter this sector's contribution to GDP was higher than the fourth quarter of the previous year by about 9%. In 2022, construction contributed to GDP formation with the amount of 86,954.40 million lei, up by 19.23% compared to the previous year, with the largest increase recorded in the fourth quarter, namely 21.68% compared to the same period of the previous year. Due to the pandemic and the war in Ukraine, the price of fuel increased, which led to higher construction spending. Thus, the annual average cost increase in construction was 20.2% (8.1 p.p. higher than in 2021) at a leu/euro exchange rate of 4.94.

In 2022, the number of completed dwellings (73,332) followed an upward trend, with most buildings completed in the fourth quarter (Chart 8). Compared to the previous year, there was an increase both in total (7.40%) and by structural elements: new construction work increased by 3.20%, capital repair work by 20% and maintenance and current repair work by 15.30%. This year, 1,927 more dwellings were built than in the previous year, most of them in the Bucharest-Ilfov area (21,328) and the fewest in the South-West Oltenia region (only 3,724).

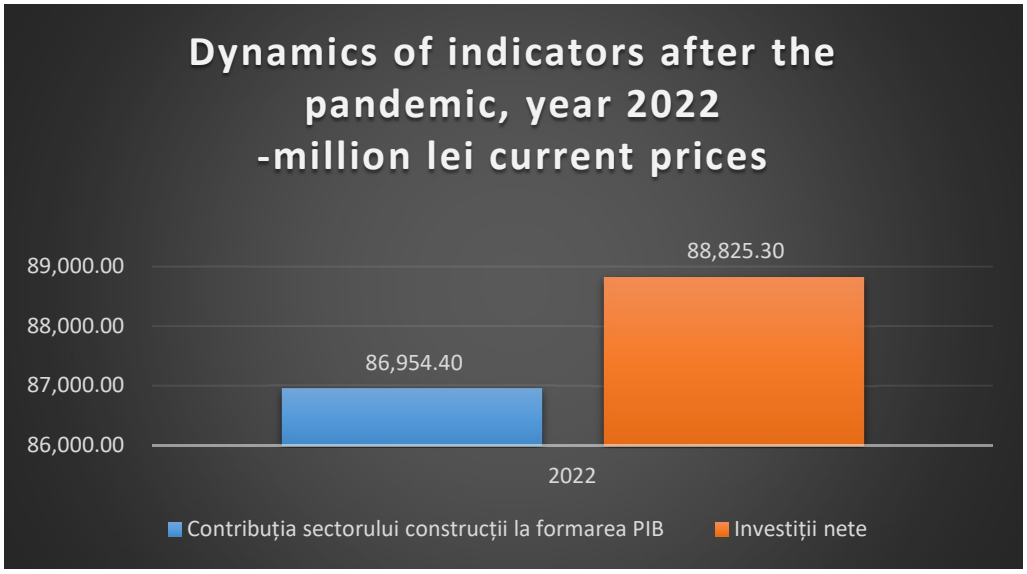
Chart 8. Number of dwellings completed in 2022



Source: graphic representation of the authors, according to data on the website https://cnp.ro/wp-content/uploads/2022/10/Prognoza-de-TOAMNA-2022-2026.pdf, accessed on 20 March 2023

Chart 9 shows that in 2022, the Romanian state invested 88,825.30 million lei in construction, 27.46% more than in 2021. The year 2022 is the only year in the entire period analyzed when the value of net investments exceeded the value added in construction.

Chart 9. The relationship between net investment and gross value added of the construction sector in 2022 (Million lei in current prices)



Source: graphic representation of the authors, according to data on the website https://insse.ro/cms/ro/tags/comunicat-investitii-economia-nationala, accessed on 20 March 2023

5. Conclusions and recommendations

This case study has answered two working hypotheses: whether the pandemic has significantly influenced the dynamics of the construction sector and which regions have been more affected, but also to what extent net investments stimulate the development of this sector.

In response to the first hypothesis, we observed that the construction sector was not as strongly impacted as other sectors; on the contrary, it managed to align itself with the imposed restrictions and to grow by constructing more buildings compared to the 2015-2019 period. In the period preceding the pandemic, most new construction works were carried out in Bucharest-Ilfov (56,741 works), the North-West area (48,173 works) and the North-East area (40,144 works) of the country, predominantly in 2019, the first year of the application of the tax facilities on construction workers' salaries. The least developed area was the South-West Oltenia area, with the fewest works being built in 2017. During the pandemic period, the situation was similar, with most new construction works in Bucharest-Ilfov (42,483 works) and the fewest in the South-West Oltenia area (only 6,224 works). During the pandemic, the construction sector was among the few that recorded an increase in gross value added. As for the post-pandemic period, in 2022 Bucharest-Ilfov remained the area with the most works, although their volume decreased by 3.1% compared to 2021. The South-West Oltenia area still has the fewest works (3,724), but their number increased by 14.23% compared to the previous year. According to the data published by INS, in January 2023 compared to January 2022, the volume of construction works increased, as a working-day and seasonally adjusted series, by 7.2%[8]. It remains to be seen what will happen for the rest of the year and what influence the decrease of the applicability of the tax facilities provided for by GEO 168/2022 and applied from 01.01.2023 will have. In order to answer the second hypothesis, we have analyzed the correlation between the contribution of construction to GDP formation and net state investment in this sector by means of graphs. We found that the two indicators oscillate directly proportionally (if investment increases, the number of buildings-built increases, and if investment decreases, construction decreases or stagnates). In all three periods analyzed, the investment budget allocated to construction increased, with the largest volume being allocated in 2022, namely 88,825.30 million lei at current prices. In conclusion, the volume of investments is an important and indispensable factor for the development of this sector.

[8] https://insse.ro/cms/sites/default/files/com_presa/com_pdf/indici_constr1r23.pdf, accessed on 20 March 2023

Therefore, the study shows that the construction sector had an increasing trend throughout the period under analysis, with a faster growth rate at the end of the period. Although it was hampered by the pandemic crisis with all the measures that were imposed, this sector managed to develop and contribute with an increasing share from year to year to the formation of GDP. We consider that an important role in this regard had the tax facilities and the increased minimum wage introduced by GEO 114/2018 for employees in the construction sector. After 2019, construction was one of the few sectors where the average number of employees increased, even during the pandemic. In 2019, the average number of employees in construction increased by 5.5% (compared to an increase of 1.9% in the economy as a whole), and in 2020 it increased by 2.9% (compared to a decrease of 1.9% in the economy as a whole).

According to Eurostat, in 2021, Romania was the country with the second highest share of gross value added (GVA) generated by the construction sector in total GVA (7.3%), after Finland (7.7%), well above the EU average of between 5% and 6% over the period 2010-2021.[9] Based on this observation, we will complement the research carried out in this paper with an analysis of the economic impact of the pandemic on the construction sector at European level, in order to see whether the growth trend in Romania was also recorded in the other Member States and what the pace of this growth has been. The study will also highlight the measures taken by other governments to develop the construction sector and their impact.

References:

[1] https://www2.deloitte.com/ro/ro/pages/real-estate/articles/constructiile-au-sfidat-pandemia-evolutie-de-exceptie-in-2020.html
[2] https://www.agendaconstructiilor.ro/files/
[3] https://arenaconstruct.ro/
[4] https://static.anaf.ro/static/10/Anaf/legislatie/OUG_114_2018.pdf
[5] https://static.anaf.ro/static/10/Anaf/legislatie/OUG_168_2022.pdf
[6] https://www.revistaconstructiilor.eu/index.php/2022/08/01/fpsc-impactul-majorarii-salariului-minim-si-facilitatilor-fiscale-acordate-angajatilor-asupra-activitatii-din-constructii/
[7] https://insse.ro/cms/ro/content/produsul-intern-brut
[8] https://insse.ro/cms/ro/tags/comunicat-constructii-locuinte-trimestrial
[9] https://cnp.ro/wp-content/uploads/2021/07/prognoza_2015_2019_varianta_toamna_2015.pdf
[10] https://cnp.ro/wp-content/uploads/2021/07/Prognoza_preliminara_toamna_rectificare_bugetara_2020_2021.pdf
[11] https://cnp.ro/wp-content/uploads/2022/10/Prognoza-de-TOAMNA-2022-2026.pdf
[12] https://insse.ro/cms/ro/tags/comunicat-investitii-economia-nationala
[13] https://insse.ro/cms/sites/default/files/com_presa/com_pdf/indici_constr1r23.pdf
[14] https://ec.europa.eu/eurostat/cache/digpub/housing/bloc-3a.html?lang=en

[9] https://ec.europa.eu/eurostat/cache/digpub/housing/bloc-3a.html?lang=en, accessed on 20 March 2023

Evaluation of Banking Performance Based on the Rate of Return on Equity and the Total Capital Ratio

MĂDĂLINA RĂDOI
Associate Professor, PhD, Faculty of Economics and Business Administration,
"Nicolae Titulescu" University, Bucharest
ROMANIA
radoimadalina@univnt.ro

NICOLETA PANAIT
Lecturer, PhD candidate, Faculty of Economics and Business Administration
"Nicolae Titulescu" University, Bucharest
ROMANIA
npanait@univnt.ro

Abstract: In the financial-banking field, rational behavior is explained by maximizing return at an assumed level of risk or vice versa, maximizing risk at an expected return in order to maximize the value of the economic entity. The performance of a credit institution is no longer defined by the traditional profit, but by the profit that shows a real increase in the value of the economic entity, of the shareholders' equity. Peter Drucker[1] says that "Management gives up its traditional master - profit, it now engages, more and more meaningfully, in the service of value". We agree with this opinion, demonstrating that a credit institution can obtain this profit by properly managing their banking assets and liabilities from a temporal, value and financial standpoint, as well as by keeping track of the bank's liquidity and solvency at the microeconomic level. Performance and risk are two essential components of the management of credit institutions. Starting from the fact that in recent years the economic crises have generated the emergence of new risks and vulnerabilities, we utilized the regression method to better analyze the financial performance based on banking performance ratios, and thereby revealed the correlations between return on equity and risk, as well as the form and strength of the correlation.

Keywords: banking performance; return on equity, capital risk; regression equation; total capital ratio

1. Introduction

Financial theory is built around a fundamental concept: maximizing the value of the economic entity. The banking performance is aimed first of all at determining the bank's soundness, the degree of its exposure to the various categories of risk and then its level of efficiency. For these reasons, the financial diagnosis of banking activity has two components: the diagnosis of profitability (return on own capital, economic profitability); risk diagnosis (operating risk, financial risk, bankruptcy risk).

Hughes & Mester[2] identify two broad approaches in measuring the performance of banks i.e. non-structural and structural approaches. Non-structural approaches use different performance measures (e.g. ROE, ROA, net interest margins, Tobin's q-ratio among others) while structural approaches are based on theoretical models of banking behavior such as efficient and profit frontiers.

In terms of non-structural approaches, performance can be quantified through indicators, namely rate of return on assets (ROA) which is obtained by reporting net income by total assets reflects the profitability of the entire capital invested in the bank, while the rate of return on equity (ROE) reflects the fruit yield of the equity of the bank and measure reporting net profit to equity. In literature this indicator is met as the financial return that measures the return on investment made by shareholders. The Modigliani-Miller model[3] represents the first

[1] P. Drucker "Managing the Non-Profit Organization" Butterworth – Heinmann, 1990
[2] Hughes, J., & Mester, L. (2015). Measuring the performance of banks: theory, practice, evidence and policy implications. In The Oxford Handbook of Banking (Second ed., pp. 247-270). Oxford University Press.
[3] F.Modigliani, M.Miller "The Cost of the Capital Corporation Finance and the Theory of Investment", American economic Review, XLVIII, No. 3, June 1958

substantiation of the rate of return on equity expected by the shareholders, under the given conditions of the taxation rate. In addition to the return on the economic assets of the company, the shareholders request to be remunerated with a risk premium for holding shares of the indebted company. The risk premium is based on the difference between the rate of return on assets and the market interest rate and based on the level of indebtedness of the company (leverage). Shareholders of a credit institution are focused on increasing the return on their shares, the return on equity, but a high debt ratio puts pressure on the bank's capital, i.e. it decreases it. The result of an excessive indebtedness is a higher return to shareholders, however, this also leads to a decrease in the bank's capital and a decrease in profit. By limiting those investments, shareholders can achieve a higher rate of return on investment, allowing them to generate the same amount of net profit while investing less per unit, thus increasing the income per investment unit.

This article follows the analysis of the economic dependence of bank profitability on the level of the main risk factors, especially on capital risk through the analytical model of unifactorial regression.

2. Models for evaluating banking performance

There are a variety of primary and secondary, essential and non-essential factors that influence social-economic phenomena, and they are all interconnected. Using statistical and economic mathematics, different techniques and approaches can be applied to analyze the tangible links between different elements, quantify them, and determine the strength of the correlations.

It is essential to utilize these analysis methods for economic research, as when dealing with mass economic matters such as those in the banking industry, not all correlations are expressed with the same strength, in the same direction and free of any influence from each other.

The increasing intricacy of the elements that constitute banking operations enlarges the count of variables that cannot be observed directly or can only be estimated through specific statistical conventions. There can be functional or statistical correlations between economic phenomena and processes.

The first category corresponds to causal correlations, i.e. one of the phenomena uniquely determines the change of the other.

The functional correlation between the cause-characteristic string and the effect-characteristic string is such that a single value from the former is associated with a single value from the latter, and any change in the quantity of the first characteristic will be accompanied by a similarly-measured change of the same type in the second.

This mathematical function can be used to model such correlations:

$Y_i = f(x_1 , x_2 , ...x_p)$

Where $x_1 , x_2 , ...x_p$ are the factors that act together on the result variable "y" and which also include a random component.

Statistical correlations between stochastic, or uncertain, phenomena are often observed in economic processes. These links are usually associated with the uncertainties that impact banking operations and outcomes. The defining feature of this correlation is that a factor "x" (independent, exogenous or cause) impacts another factor "y" (dependent, endogenous or effect), often referred to as the factorial characteristic and resulting characteristic, respectively.

In statistical correlations, a certain value of "x" corresponds to a distribution of values for the resulting characteristic "y". This is because "y", the dependent characteristic, is also affected by other factors which, in what regards the correlation between "x" and "y", are deemed random.

The degree to which the values of the result characteristic vary in comparison to the changes of the factorial characteristic will depend on the conditions in which the causal relationships are expressed.

Statistical correlations, specific to banking processes, can be classified according to the following criteria:

a) based on the number of characteristics being studied:
   - simple correlations: when it is considered that there is a single essential factor feature that determines a result feature, and the other factors are constant, interpreted as residual factors. example: the relationship between the number of profit centers and the banking assets value
   - multiple correlations: when more than two factor features are taken into account and interpreted. example: e.g. the influence of “n” risks on banking profitability

b) based on the direction of the correlations or variations determined:

- direct correlations: when the variation of the result feature has the same direction (either increases or decreases) with the modification of the factor feature values.
- inverse correlations: when an increase in the values of one factor feature corresponds to a decrease in the other feature.

c) based on the analytical expression of the correlations:
- linear correlations: synthetically expressed by the equation of the straight line
- nonlinear or curvilinear correlations: expressed by equations of the curve (parabola, hyperbola, exponential function, etc.).

2.1 Regressive analysis method for researching banking performance

A qualitative approach is used first to analyze the correlations between economic (banking) phenomena, followed by the use of quantitative methods that are tailored to the statistical approach, in order to identify the factors, assess the shape and strength of the correlation.

Of these, we used the regression analysis method to research banking performance.

Regression analysis is a statistical technique that is used to examine the correlation between two or more variables by fitting a function (called a regression function) to the observed data.

Where "y" is the dependent variable and "x_1 , x_2 , …….x_n" are the independent variables, the regression equation can be expressed as:

$Y_i = f(x_1 , x_2 , …….x_n)$

Because of the unpredictable nature of financial-banking operations, the theoretical model mentioned above has been replaced by a statistical dependence model:

$Y_i = f(x_1 , x_2 , …….x_n) + \varepsilon$

Where ε represents a random error (a residual variable) with constant dispersion and a mean of zero.
Depending on the number of factors ($x_1 , x_2 , …….x_n$) that influence the resulting feature (Y), we could use:
- Unifactorial or simple regression, if the function includes one factor;
- Multifactorial or multiple regression, if the function includes several factors.

One of the most well-known single-factor regression models is the linear model according to which, if it is deemed that the correlation between "y" and "x" is linear, then:

$y = \alpha + \beta x + \varepsilon$

We define the single-factor regression model through a mathematical relationship that assumes that the variable Y is the result of two categories of factors:
- an essential factor, X
- several non-essential factors, specified by a random disturbance variable ε

This theoretical model is estimated by an average trend equation that can be written as follows:

$y = \alpha + \beta x_i + \varepsilon$

The linear dependence between "y" and "x" is considered a stochastic dependence in which several "y" values can correspond to one "x_i" value.
There is a function *f* such that the variable *X* explains the variable *Y* through the function *f*, $Y = f(X)$, a linear function $f(x) = \alpha + \beta \cdot x$.

The linear regression model is $Y = \alpha + \beta X + \varepsilon$.
The variables X and Y are observable variables, that is, their values can be measured.

The variable ε is called random error or error term or disturbance variable and represents the effect of all factors, except factor X, which affect Y and which are considered unobservable. The variable ε captures the measurement errors of the variable values and the random nature of human behavior. The error term ε represents that part of the value of the Y variable that cannot be measured through a systematic relationship with the X variable.

The coefficients of the simple linear regression model

For each of the three years, the values of the two variables, *X* and *Y*, were noted, thus obtaining the data series $\{(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)\}$ or $\{(x_i, y_i), i = \overline{1,n}\}$. Based on this sample we will determine the estimators *a* and *b* of the parameters α and respectively, β of the regression model. Estimators *a* and *b* represent the solution of the system **of normal equations**:

$$\begin{cases} na + b\sum_{i=1}^{n} x_i = \sum_{i=1}^{n} y_i \\ a\sum_{i=1}^{n} x_i + b\sum_{i=1}^{n} x_i^2 = \sum_{i=1}^{n} x_i y_i \end{cases}$$

Solving the system using the method of determinants: $a = \frac{\Delta_a}{\Delta}$ and $b = \frac{\Delta_b}{\Delta}$,

where $\Delta = \begin{vmatrix} n & \sum_{i=1}^{n} x_i \\ \sum_{i=1}^{n} x_i & \sum_{i=1}^{n} x_i^2 \end{vmatrix}$ is the determinant of the matrix of the system of equations,

and $\Delta_a = \begin{vmatrix} \sum_{i=1}^{n} y_i & \sum_{i=1}^{n} x_i \\ \sum_{i=1}^{n} x_i y_i & \sum_{i=1}^{n} x_i^2 \end{vmatrix}$, $\Delta_b = \begin{vmatrix} n & \sum_{i=1}^{n} y_i \\ \sum_{i=1}^{n} x_i & \sum_{i=1}^{n} x_i y_i \end{vmatrix}$ are the minors corresponding to the two unknowns.

$$\begin{cases} a = \frac{\Delta_a}{\Delta} = \frac{(\sum_{i=1}^{n} y_i) \cdot (\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i) \cdot (\sum_{i=1}^{n} x_i y_i)}{n \cdot (\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2} \\ b = \frac{\Delta_b}{\Delta} = \frac{n \cdot (\sum_{i=1}^{n} x_i y_i) - (\sum_{i=1}^{n} x_i) \cdot (\sum_{i=1}^{n} y_i)}{n \cdot (\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2} \end{cases}$$

$a = \frac{\sum y - b \sum x}{n}$

The coefficient "a", which can take both positive and negative values, represents the coordinate at the origin, respectively it is the value of "y" when "x" is equal to zero.

Coefficient "b", called regression coefficient, shows the extent to which the dependent characteristic changes if the independent characteristic changes by one unit.

Depending on the sign of the regression coefficient, we can appreciate the type of correlation:

- in the case of direct correlation, the coefficient has a positive value;
- in the case of inverse correlation, the value of the regression coefficient is negative;
- if b = 0, it is deemed that the two variables ("x" and "y") are independent.

The value of the regression equation is computed for every size of the characteristic "x" using the parameters "a" and "b". The regression equations' values are regarded as the theoretical values for the characteristic "y" based on "x". The process of substituting the actual terms of "y" with the theoretical values is known as "adjustment"[4].

2.1.1 Applying the performance evaluation model at the level of the banking system

The objective of analyzing the economic dependence of banking profitability on the primary risk factors, particularly the capital risk, prompted us to employ the unifactorial regression analytical model to express these correlations. It adjusts the variable effect-rate of return on equity based on the independent variable – the total capital ratio (the former solvency ratio). Following the prudential framework in effect at the EU level, which is directly applicable at the national level, credit institutions are required to fulfill the subsequent minimum capital requirements at all times: 8 percent for the total capital ratio, 6 percent for tier 1 capital ratio and 4.5 percent for the common equity tier 1 capital ratio.

Regression analysis is frequently employed to determine how changes in the independent variable impact the dependent variable, which is one of the most common use cases.

Next, we will evaluate the model using data pertaining to the banking industry in Romania between 2019 and 2021. Due to objective reasons, the entire banking system was considered as a whole, rather than a specific bank being taken into account. This approach does not change the results obtained, in principle.

Item no.	Ratios	2019	2020	2021
1.	Net profit	RON 6.4 billion	RON 5.02 billion	RON 8.27 billion

[4] T Baron, E.Biji et al."Statistica teoretica si economica" Didactica si Pedagogica Publishing House,| 1996, ISBN:| 973-30-4025-8 p.168

2.	Total capital ratio (the former solvency ratio)	22%	25.1%	23.3%
3.	ROE (Annualized net profit / Average equity)	12.2%	8.7%	13.3%
4.	ROA (Annualized net profit / Average total assets)	1.3%	1%	1.4%
5.	The leverage effect	10.2	10.3	8.6

As the complexity of the phenomena inherent in banking activities grows, the number of factors involved increases, making it more challenging to identify and measure causal relationships.

Initially, assuming that other factors (risk categories) exert a constant and negligible impact on the rate of return on equity (ROE), we examine the effect of capital risk, measured by the total equity ratio, on ROE using the unifactorial regression method.

In our study, the variables are:

X – total capital ratio (the former solvency ratio)

Y – ROE

To determine the regression equation based on banking performance ratios, we calculate the regression coefficient "b". The evolution and adjustment of the ROE ratio depending on the total capital ratio is presented in the table below.

The calculations are presented in the table below:

Adjusted values Linear model y= - 6.66 + 30x	**Period**	**x_i values of variable *X***	**y_i values of variable *Y***	x_i	$(y_i)^2$	$x_i \cdot y_i$
-0.06	*2019*	x_1=0.22	y_1=0.122	$(x_1)^2$=0.0484	$(y_1)^2$=0.0148	$x_1 \cdot y_1$=0.0268
0.87	*2020*	x_2=0.251	y_2=0.87	$(x_2)^2$=0.0630	$(y_2)^2$=0.7569	$x_2 \cdot y_2$=0.2183
0.33	*2021*	x_3=0.233	y_3=0.133	$(x_3)^2$=0.0542	$(y_3)^2$=0.0176	$x_3 \cdot y_3$=0.0309
		$\sum_{i=1}^{3} x_i = 0.704$	$\sum_{i=1}^{3} y_i = 1.125$	$\sum_{i=1}^{3} x_i^2 = 0.1656$	$\sum_{i=1}^{3} y_i^2 = 0.7893$	$\sum_{i=1}^{3} x_i\ y_i = 0.276$

We obtain: $a = \frac{\Delta a}{\Delta} = \frac{1.125 \cdot 0.1656 - 0.704 \cdot 0.276}{3 \cdot 0.1656 - 0.704^2} = -6.66$

$b = \frac{\Delta b}{\Delta} = \frac{3 \cdot 0.276 - 0.704 \cdot 1.125}{3 \times 0.1656 - 0.704^2} = 30$

The value of the regression equation was computed for every size of the characteristic "x" using the parameters "a" and "b".

Therefore, the regression line is the equation $y = a + bx$ = - 6.66 + 30x.

It follows that the equation of the linear model is $Y_i = \alpha + \beta X + \varepsilon$ = - 6.66 + 30x + ε, i = $\overline{1.3}$

and the adjusted values of the observations $Y_i = \overline{1.3}$ by regression are

$Y_i = a + bx$ = - 6.66 + 30 x_i, i = $\overline{1.3}$

After drawing up the correlation table, we observe an uneven change in the dependent variable (ROE) under the influence of the change in the independent variable (total capital ratio).

Moreover, the value of the regression coefficient b is positive (b = 30) and indicates an increasing regression.

The estimated regression equation (- 6.66 + 30x) shows that the correlation between the two ratios is direct.

Estimation by confidence interval for the error variant[5]

$S_e^2 = \frac{\sum_i \varepsilon_i^2}{n-2} = \frac{\sum_i (Y_i - a - bx_i)^2}{n-2}$

Error calculation

Y_i	Y_{xi}	ε_i	ε_i^2
0.122	-0.06	0.182	0.033
0.87	0.87	0	0
0.133	0.33	0.97	0.940
			0.973

$\varepsilon_i = Y_i - Y_{xi}$

Estimation of the error variant

$S_e^2 = \frac{\sum_i \varepsilon_i^2}{n-2} = \frac{0.973}{3-2} = 0.973$

The level of the rate of return on equity depends on the size of the risks (in our case the capital risk) that the banking system is willing to manage.

Bank profitability increases by assuming high risks, but decision-makers within credit institutions seek to obtain increased returns for certain assumed risks.

3. Conclusions

The rate of return on equity represents the most important ratio of bank profitability, because it is influenced by the bank's performance in relation to each profit category (depending on the source or specific activity), as well as due to the fact that it indicates the bank's ability to compete for private sources of capital from the national economy.

The existence of equity and its adequate sizing (in relation to risk-weighted assets) represent the third line of defense for banks after profits and provisions.

An excessive capitalization is generally associated with economic inefficiency for shareholders, a too high capital adequacy index contributing to the reduction of dividends. It is true that the banks establish the size of capital according to the regulations in force domestically and internationally and in accordance with the requirements of economic efficiency. However, regulatory constraints often conflict with shareholders' wishes for greater capital leverage and higher revenues.

If we were to assess the trend based on the evolution of the ratios from the last three years, with the exception of 2020, we notice that, in the case of ROE, the trend is increasing. The decrease in the ROE level for 2020 is mainly due to a lower level of net profit. The net profit of the banking system decreased in 2020 by RON 1.2 billion (19.5%) compared to the previous year, due to provisions for potential non-performing loans caused by the coronavirus crisis, according to statistical data provided by the National Bank of Romania (NBR). The decrease in profit was caused by the increase by RON 680 million (8.7%) of provisions for potential losses from non-performing loans (adjustments for expected losses, according to the rules of the European Banking Authority (EBA), up to almost RON 8.5 billion.

The provisions were of a preventive type, for the period after the expiry of the moratoriums on deferring loan installments, given that the rate of non-performing loans fell to 3.83% in 2020, from 4.06% in 2019.

If in industrial enterprises the ROA must be higher than the inflation rate in order for it to maintain its economic substance, in a banking unit, this is the result of the rotation of banking assets and of the unit's net profit obtained from the entirety of collected revenues. At the end of 2020, the assets of the banking system increased by about RON 65 billion (+13%) compared to December 2019, reaching a new record level of RON 560 billion, while the rate of return on assets (ROA) decreased to 1% in the context of reporting a lower profit during the Coronavirus pandemic. In this situation, the evolution of this ratio is the result of the forecast dynamics

[5] Analiza de Regresie Simpla | PDF (scribd.com)

of the profit ratio (with an increasing trend) and less of the forecast dynamics of asset turnover. As in the case of ROE, ROA recorded an upward evolution in 2021 compared to 2019.

The level of the total capital ratio recorded in the period under review had a slight decrease in 2021. On December 31, 2021, the total capital of credit institutions, Romanian legal entities, reached a level of RON 57,895.2 million, down 1.0 percent compared to the end of the previous year, while the total value of the exposure at risk increased by 6.7 percent, up to a level of RON 248,280.0 million. This decrease is due not only to the increase in the total value of the risk exposure at a rate higher than that recorded by the capital, but also due to the incorporation of part of the profit related to the year 2021 and the decision of the credit institutions to distribute dividends from the reserves constituted from the profits of the previous years (2019 and 2020), according to the decision of the General Council of the National Committee for Macroprudential Supervision (CNSM) not to extend the period of application of Recommendation no. R/2/2021 after September 30, 2021. Although the capital requirements based on the value of risk exposure are required for the correct sizing of capital in relation to unexpected losses, they are not sufficient to ensure a prudential behavior on the part of credit institutions, which may be tempted to assume excessive and unsustainable risks through an excessive level of indebtedness. Thus, the set of capital adequacy assessment ratios, calculated based on the total value of risk exposure, was completed by the leverage effect ratio. "Starting with June 28, 2021, the requirement regarding the leverage effect ratio, of at least 3 percent, entered into force, according to the provisions of Regulation (EU) no. 876/2019 amending Regulation (EU) no. 575/2013. On December 31, 2021, the leverage effect for credit institutions in Romania was 8.6 percent, according to the transitional definition, and 8.1 percent, according to the full definition, being below the level recorded in December 2020, of approximately 10.3 percent, in the case of the transitional definition and 10.0 percent in the case of the full definition"[6].

According to NBR data for the first three quarters of 2022[7], the net profit of the entire banking industry was RON 7.6 billion, fueled by the accelerated dynamics of lending in 2022 and the increase in net interest income. Regarding performance ratios, in September 2022, ROE reaches the level of 16.6 percent and ROA of 1.5 percent.

We tested the model on the aggregated data related to the banking industry in Romania. The results we obtained showed that the increase in ROE implies the assumption of a greater capital risk.

Considering that the analyzed ratios have a favorable trend, the application of the linear model is questionable. If the evolution had been unfavorable, according to the linear model we could have said that one or several banks within the banking system may face insolvency. However, we must not omit the fact that at the level of the banking system there are a number of vulnerabilities, among which the possible increase in the risk of non-payment of loans granted to the manufacturing industry in the context of deteriorating macroeconomic conditions, uncertainties regarding future developments, but also an increase in debt service through the increase interest rates.

In conditions of uncertainty at the macroeconomic level, the market value of banks is dependent on variables that they cannot control (the interest rate on the money market, the price of assets), thus making it difficult to distinguish insolvent banks from solvent ones[8].

The analysis and study of the performance ratios, their evolution over time, as well as the correlations between the ratios, contribute to the improvement of the activity and the achievement of an improved level of banking efficiency.

References:

[1] P. Drucker "Managing Non Profit Organization" Butterworth – Heinmann, 1990

[2] F. Modigliani, M. Miller "The Cost of the Capital Corporation Finance and the Theory of Investment", American economic Review, XLVIII, No. 3, June 1958

[3] T Baron, E. Biji et al."Statistica teoretica si economica" Didactica si Pedagogica Publishing House,| 1996, ISBN:| 973-30-4025-8 p.168

[4] Analiza de Regresie Simpla | PDF (scribd.com) RAPORT ANUAL 2021 (3).pdf

[5] Hughes, J., & Mester, L. (2015). Measuring the performance of banks: theory, practice, evidence and policy implications. In The Oxford Handbook of Banking (Second ed., pp. 247-270). Oxford University Press.

[6] RSF decembrie 2022.pdf

[6] RAPORT ANUAL 2021 (3).pdf

[7] RSF decembrie 2022.pdf

[8] Schüler, M. (2003). How Do Banking Supervisors Deal with Europe-wide Systemic Risk? Centre for European Economic Research, Mannheim.

[7] Schüler, M. (2003). How Do Banking Supervisors Deal with Europe-wide Systemic Risk? Centre for European Economic Research, Mannheim.

Innovative Financing Mechanisms to Leverage Ecosystem Based Adaptation (EbA) Finance for Vulnerable Communities

NAMITA VIKAS
Founder and Managing Director
auctusESG LLP
1008, Kohinoor Square, Shivaji Park, Dadar, Mumbai
INDIA
namita.vikas@auctusesg.com, https://auctusesg.com/

SMITHA HARI
President (India)
auctusESG LLP
1008, Kohinoor Square, Shivaji Park, Dadar, Mumbai
INDIA
smitha.hari@auctusesg.com, https://auctusesg.com/

Abstract: Climate change accelerates economic loss and results in negative GDP growth. Vulnerable geographies and communities are the most affected by climate change, but they lack the capacity (financial and technical) to withstand and adapt to its effects. In addition to this, the mismanagement of environmental resources for economic development has reduced the natural capacity of the ecosystem to adapt to climate change. In this regard ecosystem-based adaptation (EbA) measures can play a crucial role in building resilience to climate change in vulnerable communities. However, despite its importance, there is a significant shortfall of capital flows to adaptation, and specifically to EbA initiatives. There is a critical need to develop financing strategies which address challenges of traditional means of financing. This paper explores various innovative financing mechanisms and models to leverage adaptation finance and implement EbA measures for vulnerable communities through global case studies. In addition, the study seeks to provide pathways for adaptation finance that can be tailored to the priorities of local communities.

Keywords: Climate change, vulnerable communities, ecosystem-based adaptation, EbA, adaptation finance, climate finance

JEL Classification: G20, Q54, Q56, Q57

1. Introduction

Vulnerable communities across the globe face the biggest burden of climate change. The latest Intergovernmental Panel on Climate Change (IPCC) report concludes that the poor are disproportionately harmed by the impacts of climate change, including decreased agricultural productivity, effects on human health and food security, destruction of houses and enterprises, and loss of livelihoods (Birkmann, Liwenga, & Pandey, 2022). Further, multi-hazard risks arising from climate change have the potential to push the poor into persistent poverty traps, engendering recurring modalities of poverty, reducing productivity, and heightening income losses. The situation is further exacerbated by the lack of technical or financial capabilities of such vulnerable communities, which is evident from the multiple accounts of devastating impacts of climate change witnessed around the world.

This context triggered the need for the implementation of strong climate adaptation measures to build resilience in vulnerable communities. Stronger housing, the introduction of drought-resistant crops in cropping cycles, diversification of income sources, and improving social safety nets are some examples in the context of building adaptive capacities. Strategies for adaptation require focused capital flows for effective implementation, and to achieve the desired impact. Adaptation finance - one stream of climate finance - aims to help communities reduce the risks they face and the harm they suffer due to climate hazards. Ecosystem based Adaptation (EbA)

finance is a sub-class of adaptation finance aimed at financing measures that harness nature based solutions (NbS) and ecosystem services.

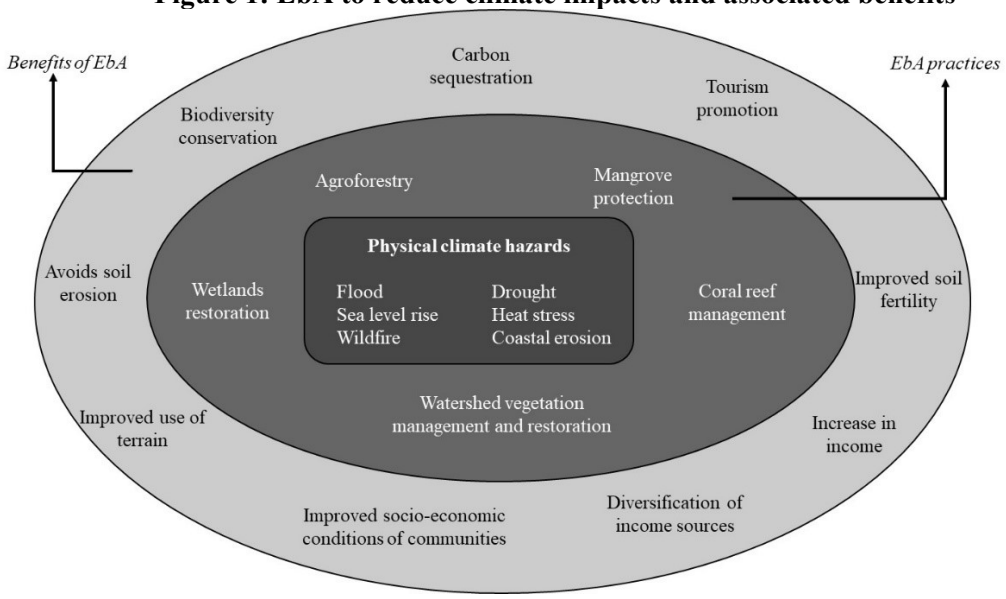
2. Climate adaptation – techniques and challenges in financing

Climate adaptation may be initiatives relating to infrastructural and technological initiatives (such as building defenses or early warning systems), institutional initiatives (such as regulations or new insurance schemes), behavioral actions (such as a change in livelihood strategies or migration) and nature related initiatives (such as nature-based solutions or ecosystem-based adaptation). This paper specifically discusses Ecosystem-based Adaptation (EbA) - an inclusive and long-term solution to build climate resilience within vulnerable communities.

2.1. Overview of Ecosystem-based Adaptation

Ecosystem-based adaptation or ecosystem-based solutions (EbS) focuses on harnessing the potential of natural systems to adapt to the impacts of climate change. A well-designed EbA has an overarching impact to address a range of challenges, apart from creating diverse adaptation benefits. The strategy, predominantly based on harnessing nature-based solutions and ecosystem services, in contrast to hard-infrastructural solutions, creates opportunities for vulnerable communities to adapt to climate change. For instance, communities sustainably leveraging ecosystem services, such as hydrological regulation, soil retention, climate regulation, and the provision of food, building materials, or medicinal plants would generate benefits for themselves and the planet. Every US $1 invested in EbA initiatives has the potential to provide a 34x return on investment, thereby being an effective mechanism to innovative approaches with cross- cutting benefits (UNEP, FAO, 2021). This is particularly effective in emerging economies that require cost-effective approaches to build climate resilience, which can translate to multiple benefits. EbA solutions have a range of benefits (direct and indirect), which not only address the immediate impacts of climate change, but also offer long-term solutions for conserving and restoring nature and improving health, education and livelihoods of the communities (Figure 1).

Figure 1: EbA to reduce climate impacts and associated benefits



Source: Authors' representation based on literature review.

Majority of communities in the Global South have co-existed with nature and ecosystems for millennia. The dependency on local ecosystems for livelihoods is also much larger in these communities due to the absence of technological or financial breakthroughs, which increases the relevance of EbS for these groups. Mirroring this relevance, a recent study revealed that based on the Nationally Determined Contributions (NDCs) submitted to the UNFCCC, there is a disproportionately higher inclusion of EbA in the adaption plans of the lower income countries (Seddon, et al., 2020). From an economic standpoint, EbA and other adaptation solutions have the potential to reduce the intensity of climate hazards by 26%, representing an economic cost of US $104 billion by 2030, to significantly cut climate costs in vulnerable countries (IFRC, WWF, 2022). This strengthens the case

for EbA, highlighting the need to introduce, replicate and multiply approaches to integrate ecosystem considerations in project planning and delivery.

In practice, it is important to make promising approaches for sustainable EbA through stakeholder engagement with local communities, integration of long-term considerations in planning, and aligning practices with local tradition and indigenous knowledge during the design stage. Building these key elements into adaptation projects would ensure effective implementation and monitoring of outcomes for the local community and for the system at large.

2.2. Challenges for EbA financing within vulnerable communities

The disproportionate concentration of climate risks in the poorest countries and communities, coupled with the lack of capital and institutional capabilities in these geographies, places ample emphasis on the need for effective capital mobilization at scale. At the same time, mobilizing capital for poor and vulnerable communities is riddled with unique challenges (OECD, 2015), as given below:

- Relevant information on climate information, forecasting data, and socio-economic policies are often inadequately available for vulnerable communities.
- Insufficient stakeholder engagement and limited collaborative efforts result in siloed approaches to adaptation, which limit the scalability and sustainability of interventions.
- Failure to design EbA initiatives and adaptation financing mechanisms based on the local context particularities, with buy-in from affected vulnerable communities results in unsustainable projects.
- A lack of awareness among local communities, of the funding resources and availability is a barrier to raising adaptation finance.
- Good governance in the form of robust policies, legal and regulatory frameworks are essential elements of successful adaptation projects. A limited coherence on these aspects obstructs the finance flows for adaptation activities.
- The inability of vulnerable communities in developing countries to meet safeguards and standards of multilateral funds (including appropriate risk management, monitoring, and evaluation capabilities) hinders attracting adaptation finance.

2.3. The current state of EbA financing

For the past decade, there has been an uptake in the adoption of ecosystem-based approaches. UNEP alone is supporting over 45 EbA projects that aim to restore around 113,000 hectares of ecosystems and benefit 2.5 million people (UNEP, 2022). Despite this uptake, a significant funding gap remains. Finance flows to EbA projects at global level are currently US $154 billion annually, falling short by over US $230 billion of the investment required by 2025. Participation from the private sector is also low, with only a small share of 17 percent of the current financing coming from private sources (UNEP, ELD, 2022). Further, there is a vast difference between global adaptation finance flows and capital directed toward climate mitigation initiatives.

Going forward, it is expected that the existing financing gap will widen, given the intensifying climate impacts. Moreover, vulnerable communities face a range of barriers and challenges in accessing adaptation finance, as discussed earlier, including the long tenor of such projects, inadequate attention to local contexts (resulting in the exclusion of vulnerable communities), and the lack of technical capability to monitor and evaluate projects, since private investments are based on project efficiency, risk management, and internal returns. Therefore, there is an urgent need to develop financing strategies that can upscale the quantum of adaptation finance to support vulnerable communities.

3. Financial innovations for EbA

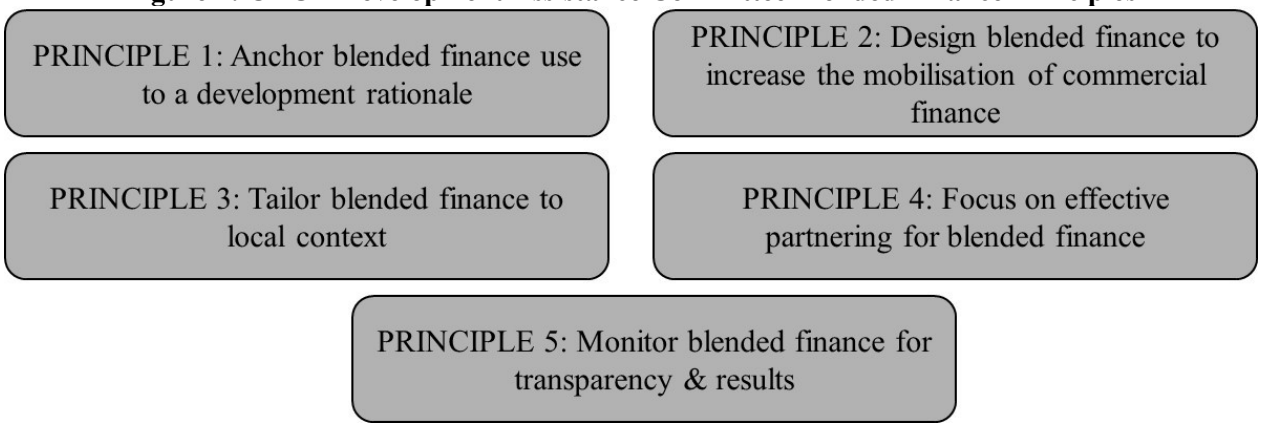
Financing approaches for EbA projects vary through the different phases of the initiatives and are usually covered by public finance from domestic or international sources. Public sources such as national funds can be utilized to maintain consistency in project implementation but are usually insufficient to cover the total costs of the project. Rising pressure on the private sector to be more responsible for its business actions has emerged as an opportunity to diversify both the financing sources as well as the nature of projects for EbA initiatives. While there is a lack of many institutionalized examples for such interventions, especially across different scales, ecosystems, finance volumes, implementation stages, and timescales, the following innovative financing mechanisms have been identified as having the potential to be deployed at different stages and/or levels.

3.1 Blended Finance

Blended finance is strategically using development finance and philanthropic funds to mobilize private capital in emerging markets. Blended finance is a structuring approach that applies risk-tolerant capital from public and philanthropic sources for de-risking and attracting additional private capital. Its long-term nature and high risk-bearing capacity, which are essential for EbA initiatives, render it a useful financing mechanism for adaptation projects. However, sustainable forest management, agroforestry, agriculture, and sustainable management of coastal and marine ecosystems currently account for just over 5% of the global blended finance transactions – this indicates the elevated need and opportunity to apply blended finance solutions for EbA (GEF, 2023).

The OECD's Blended Finance Principles (Figure 2) elucidates the core elements of a blended finance transaction (OECD, 2017). The structure is required to target a developmental need, with one or more sustainable development goals which are contextual to the communities in a particular region. There is a catalytic nature of public or philanthropic capital to raise multiples of private sector capital, which also helps in bringing down the blended cost, given its concessional nature. This makes it more affordable for target beneficiaries. Principle 3 of the OECD Blended Finance Principles specifically addresses the need to tailor transactions to the local context, which is a core tenet of EbA projects.

Figure 2: OECD Development Assistance Committee Blended Finance Principles



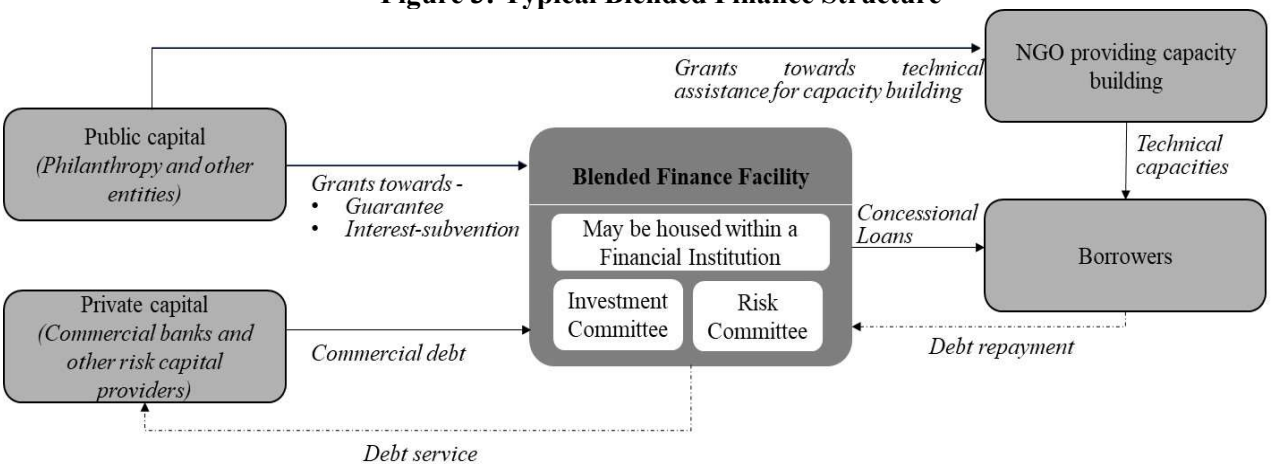
Source: OECD DAC Blended Finance Principles (2017).

Blended finance transactions typically cover the following components which may be tailored depending on the needs of the EbA project:

- Design and preparation of funds: The public/grant funding is utilized for the design and preparation of the transaction, supporting proof of the concept, establishing the baseline and monitoring process, and providing the pre-commercial funding required in the initial stages of the investment thesis. This enhances the bankability of the project or enterprise, therefore, attracting more private capital.
- Technical assistance funds: A critical challenge in mobilizing private finance for EbA for vulnerable communities is the lack of technical capabilities to deliver on the project mandates. A component of the grant funding usually focuses on technical assistance strategies for key stakeholders such as the local communities. This becomes crucial to the successful implementation and commercial viability of the project.
- Guarantees: To de-risk EbA projects, it becomes important for investors to receive a risk guarantee which covers potential losses in full or in part. Typical forms of guarantee include a pari-passu guarantee, a first loss default guarantee, or a fixed percentage of losses that may be covered by the public capital component. This guarantee component is critical to reduce the overall risk of the project and thereby attract more private capital.
- Concessional finance: In this strategy, debt or equity is provided at lower than market rates, lowering the overall cost of capital. The interest sub-vented may be covered by philanthropic funds or public capital. In some cases, concessions may be structured based on the achievement of a pre-agreed set of results (results-based financing), which gives assurance to the investors that the intended impacts would be delivered.

Figure 3 demonstrates a simple blended finance structure with various components of public and private capital.

Figure 3: Typical Blended Finance Structure



Source: Authors' representation.

Additional layers such as off-takers (to demonstrate market linkages), monitoring and evaluation of ecosystem services, and differentiated guarantee providers may be introduced and tailored based on the individual requirements.

3.2 GSS Bonds

Bonds, also referred to as fixed-income instruments, are used by governments, financial institutions, and companies to raise money in the form of borrowings. Bonds modified to serve the purpose of climate action, such as climate bonds, green bonds, blue bonds, sustainability bonds, and sustainability-linked bonds, can be utilized to fund EbA initiatives. Green bonds have thus far predominantly focused on greenhouse gas mitigation, rather than build adaptive capacities or resilience. However, given the increasing relevance of building resilience, the GSS (Green, Social, and Sustainability) bond markets are well placed to focus on issuances financing adaptation. Such bonds can be issued by any type of institution such as banks, corporates, governments, or international organizations. Similar to the 'green' certification of these bonds being done by independent verifiers such as the Climate Bonds Initiative, it is important to establish robust resilience criteria across sectors, basis which such bonds may be issued to fund adaptation and EbA projects.

To leverage bonds for financing EbA projects, a suitable framework needs to be developed, which may be based on the following International Capital Market Association (ICMA) principles (ICMA, 2021):

- Use of proceeds: This identifies the list of projects which are eligible to be financed through the issuance of a green bond. In the case of EbA projects, the umbrella criteria will need to be climate change adaptation initiatives, with specifications related to ecosystem-based activities and approaches.
- Process for project evaluation and selection: The issuer needs to communicate the adaptation objectives of the projects, the process for determining the eligibility of the projects, and the process for evaluating the environmental and social risks of the projects.
- Management of proceeds: The net proceeds of the bond need to be tracked by the issuer in a formal internal process linked to the issuer's lending and investment operations for eligible EbA projects. Additionally, during the tenor of the bond, it is recommended that the net proceeds are periodically adjusted to reflect the allocations made to eligible EbA projects.
- Reporting: The information about the use of proceeds needs to be updated at regular intervals. The annual disclosures would include information about the selected EbA projects, allotted funds, and expected impact. The periodic iterations of the disclosure reports need to include the progress on each of these components.

In addition, specifically for adaptation purposes, catastrophe bonds are also gaining popularity. Catastrophe bonds are high-yield bonds that aim to provide financial protection against climate and disaster risks. The substantial capability of EbA approaches to reduce climate risks makes it a compelling case for insurance schemes to provide a convincing link for investment into EbA.

3.3 Carbon credits

With the increasing scrutiny of the carbon footprints of enterprises, offsetting emissions has become a popular strategy to comply with global standards and expectations. EbA approaches can capitalize on this market by the sale of carbon credits, as many prominent EbA mechanisms such as reforestation, sustainable forest management, and sustainable agriculture are inherently carbon friendly. In the long term, these solutions serve as carbon sinks and can be effectively tapped as a means of financing.

A carbon credit is a tradable certificate or permit that represents one tonne of CO2-equivalent emission reduced, avoided, or sequestered through technology and nature-based solutions (Belianska, et al., 2022). The proceeds from these sales can be channelled back to the EbA projects for upscaling and broad-scaling. However, this is applicable only after the project is well underway, and therefore, alternative financing mechanisms need to be used during the project development and implementation phase. While the Clean Development Mechanism (CDM) by the UNFCCC provides an opportunity for developing countries to earn certified emission reduction (CER) credits for their emission-reduction projects, which can then be sold to industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol (UNFCCC, 2022), the development of volunatry carbon markets has helped in decentralized mechanisms to buy and sell carbon credits.

The Taskforce on Scaling the Voluntary Carbon Market is led by the private sector and aims to scale voluntary carbon markets. In its report released in January 2021, the Taskforce has suggested that up to two-thirds of the carbon markets could be made up of NbS (Nature based Solutions) by 2030 (TSVCM, 2021). This opens up a substantive funding avenue for NbS. However, the report warns that carbon markets should only support ecologically and socially responsible nature-based interventions and not be used as a replacement for decarbonisation pathways. Further, enhancing reporting requirements and regulatory reforms to address the demand-side constraints are imperative to enhance this market and make carbon credits a more viable financing solution.

3.4 Payments for ecosystem services (PES)

Ecosystem services are defined as “the direct and indirect contributions of ecosystems to human well-being” (Earthwise Aware, 2023). Water purification, regulation of water cycling, biodiversity, maintenance of soil fertility, and the regulation of the local climate are categorised as ecosystem services, while food, fuel, and fibre are considered to be ecosystem goods (Wamsler, et al., 2016). These goods and services are often by-products of EbA projects and can be leveraged to raise financing for project operations. PES programs are increasingly popular, especially in developing countries, as they are voluntary and incentive based, rather than being coercive.

Similar to other incentive-based mechanisms, Payment for Ecosystem Services (PES) compensate individuals or communities for undertaking actions that increase the provision of ecosystem services, with users paying for the services. This mechanism is therefore based on the ‘user pays’ concept. Various factors influence the structure of PES schemes, including the form of incentive or payment; the services provided; the providers, the implementers, and the intermediaries; whether incentives are provided for individuals or communities; eligibility criteria for participation; and the method of funding payments (Jack, Kousky, & Sims, 2008). Challenges for successful implementation include insecure land tenures and the often-high project transaction costs associated with PES schemes.

The following steps are crucial to implementing a successful PES strategy (Forest Trends, The Katoomba Group, and UNEP, 2008):

- Identifying ecosystem service prospects and potential buyers: This includes defining and measuring the ecosystem services and identifying the marketable value of the service. The step is followed by the identification of the potential buyers and the determination of the sales strategy (individual/community).
- Assessing institutional and technical capacity: The legal, policy, and land ownership context of the ecosystem services need to be assessed along with the market regulations, landscape, and gaps for PES. In addition to this, complementary and support services and organizations also need to be identified.
- Structuring agreements: The business plan for the PES model is designed with a focus on reducing transaction costs. Payment and contract types can then be made context specific to the EbA project.
- Implementing PES agreement: The PES management, evaluation and monitoring plans are crucial to ensure that a successful agreement can continue to be carried out successfully.

3.5 Microfinance

Microfinance encompasses financial services offered to individuals from lower socio-economic backgrounds, which range from savings accounts, checking accounts and fund transfers to microinsurance and microcredit. Microfinance institutions (MFIs) cater to some of the most vulnerable communities (Bhavsar, 2022) and are a good entry point to promote EbA approaches in vulnerable communities. Capacity building and product development for EbA are some of the areas where MFIs can facilitate to promote the uptake of EbA practices. In addition to providing access to vulnerable communities through their service offerings, MFIs have the know-how and information networks required to track a large number of small transactions. This is especially pertinent in the context of EbA, which requires the financing of multiple interventions that involve the modification or adjustment of existing practices. Inadequate screening, monitoring and enforcement capacities of poor communities make access to formal finance a challenge. Microfinance circumvents this challenge through innovations such as group lending, smaller loan ticket sizes, frequent repayments, the establishment of compulsory savings accounts by borrowers, and takes advantage of peer monitoring and joint liability, which makes the model a success (Agrawala & Carraro, 2010).

While contextualizing microfinance for adaptation, it is essential to consider the additional stress and risks imposed by climate change on the livelihoods of the poor, especially physical climate hazards. Therefore, structuring repayment schedules to account for the reliance on seasonal occupations and the uncertainties introduced by climate change is imperative, which can include facilities for flexible repayments or reduced interest rates. These adjustments would enable microfinance to be a powerful tool for EbA financing.

4. Case Studies

This section enumerates select case studies which have demonstrated use of innovative financing mechanisms to fund successful and impactful EbA projects. The case studies chosen in this paper focus on different geographies and financing instruments to highlight the context and relevance of these mechanisms.

4.1. Case Study 1: Microfinance to finance EbA in Columbia and Peru

Context: The South American countries Columbia and Peru are agrarian economies, which are also biodiversity hotspots. Climate change has resulted in an increased frequency of extreme weather events in the region, resulting in a decline in agricultural yield and impacting the livelihood of vulnerable populations in both countries. As microfinance had proven to be an efficient instrument in improving the living standards of marginalized communities and promoting financial inclusion of the poor in these countries, in 2012, The International Climate Initiative's Microfinance for Ecosystem-based Adaptation (MEbA) project was implemented by UNEP and the project was funded by BMU (GIZ, 2018). The project was not only aimed to address the climate related challenges, but also do so in line with EbA approaches, to develop and democratize EbA for the local communities.

Objective: The objectives of the project included increasing awareness regarding the impacts of climate change and the opportunities presented by EbA; training the staff on climate change and conservation; managing climate-related agricultural risks; developing micro-loans and services for EbA; and fostering technical partnerships to enhance EbA capabilities.

Target group: The farmers targeted in this project were characterized by high vulnerability to climate change due to low income (approximately US $500/year), inadequate access to social or financial services, lack of access to diversified income sources, low technical capabilities, and small holdings (between 1 and 10 hectares).

Financing mechanism: The approach of the project involved integrating climate risk considerations in credit methodologies for MFIs. In addition to this, farmers were also presented with options to reduce climate risks, improve income diversification and undertake an ecosystem-centric approach to farming. As MFIs were already offering products to the agriculture sector, MEbA products were embedded within existing product lines of the MFIs, as given below:

- Working capital loans: These were used to finance working capital needs such as seeds and fertilizers amongst others. The repayment schedule for these loans was scheduled based on the harvesting season. Under this scheme, the measures contributing to EbA included organic fertilizers, crops diversification, and integrated pest and nutrition management.
- Fixed asset loans (medium-term): These were utilized to finance fixed assets such as equipment and machinery. The loans were provided based on varied economic activities and thus their repayment

schedules were spread across several seasons. EbA measures included in this mechanism were rainwater reservoirs, aquaculture, solar dehydrators, and sustainable management of nutrients, soils, and pests.

- Community loans (short-medium term): These loans were used for community investments such as seed banks, terraces, fog catchers, and sustainable forest management.

Impact: 20 EbA products were offered by MFIs, resulting in the disbursement of over 11,000 EbA-specified micro-loans, amounting to approximately US $15 million of private investment towards sustainable adaptation alternatives. In addition, 7,000 small farmers received training on EbA practices under the program.

4.2. Case study 2: Blended Funding to finance EbA by The HAF Tree Nursery, Morocco

Context: Erratic weather conditions and unsustainable agricultural practices have a significant impact on rural Moroccan communities. Climate change impacts in the region include rising sea levels, storm surges, reduced precipitation, an increase in drought, and coastal flooding. Considering that 42 percent of the population of the country resides in rural areas with a high dependency on the agriculture and fisheries sector, the need for adaptation is urgent (IFAD, 2008). Given the livelihood reliance on ecosystem services, the US-Moroccan NGO, the High Atlas Foundation (HAF) has implemented the tree nursery projects that align with EbA, as a suitable adaptation approach (GIZ, 2018).

Target group: The project targeted the agrarian rural communities of Morocco most affected by climate change. It also focused on indigenous communities to ensure inclusion and provide them with the necessary capacities to secure their livelihoods.

Objective: The community-based projects aimed to plant fruit-bearing trees in order to reduce deforestation, diversify land use, generate income for communities, and support the inclusion of vulnerable groups in society.

Financing mechanism: The financing route for this project was a blend of public-private partnerships (PPP), ecosystem services, and carbon markets. The NGO received funding from governmental organizations, donors, and crowdfunding routes. In addition to this, there was income generated by carbon credits, by partnering with those who required these credits to offset their climate impacts.

- PPP: The upfront capital needed for the projects was obtained through public sources such as grants from governments and inter-governmental organizations. This was used for initial project plans and investment in machinery. The public capital was supported by philanthropic capital in the form of donations and crowd-funding activities to support ongoing operations. The most prominent private player in this financing mechanism was Ecosia, a Germany-based social business, aiming to plant 1 billion trees. The revenue for this business (a search engine) is generated via advertisements, and close to 80 percent of the surplus income from ad revenues was used to support reforestation projects.
- Ecosystem services: To enhance the complete value chain, HAF utilized the grant funds to create an organic agriculture system and to acquire the necessary biological certifications for its products. The increasing demand for organic goods globally was mirrored in Morocco thus creating a market for the ecosystem goods produced in the nursery projects. The profits from the sale of the ecosystem services were utilized by the community at their discretion either for general development purposes or reinvested in the nurseries.
- Carbon markets: The nurseries developed through the EbA project serve as carbon sinks. Though the process of acquiring the certification for carbon credits and tracking and monitoring the system is challenging, HAF has secured a potential buyer for its first batch of carbon credits. Upon successful implementation of the carbon credit system, an ongoing stable source of finance will be established to sustain the project.

Impact: Since the start of its implementation in 2006 the HAF project has grown to now manage 11 organic fruit tree nurseries in 7 provinces in Morocco with a total capacity of 2.44 million seeds. The program has had significant impacts across its individual nursery initiatives. The projects are community-based, targeting vulnerable populations and providing them with livelihood sources and meaningful work. The programs have cross-cutting impacts across agriculture, youth, women's empowerment, water, culture and capacity building, keeping inclusivity and participatory approaches at the center of interventions. On the financing side, the blended approach to raising capital has proved to be apt for EbA approaches used by HAF, addressing the requirements of investment and operational costs being complemented by each funding source.

4.3. Case study 3: Sovereign blue bond to support EbA, Seychelles

Context: Similar to other small islands, Seychelles faces climate change hazards such as erratic rainfall patterns leading to flooding and landslides; increase in sea temperature; changes in the acidity of the ocean, increase in the frequency and intensity of storms and suchlike. The vulnerability of the communities in the country is exacerbated by the heavy dependence on fisheries and the tourism sectors for livelihoods (The World Bank, 2022). However, transitioning to sustainable fisheries can be a significant cost for a small island state like Seychelles. Given the decline in marine resources and the vulnerability of local communities, the Republic of Seychelles launched an innovative instrument - a sovereign blue bond with the World Bank and Global Environment Facility in 2018.

Target group: The main beneficiaries of the project were community members whose livelihoods depend on marine resources and the ocean. Among them are artisanal and semi-industrial fishermen, operators in the tourism and seafood value chain, including aquaculture, and national and local institutions engaged in the management of marine resources, including fishermen's associations and government agencies.

Objective: The bond sought to increase Seychelles' resistance to climate change and conserve marine resources by promoting sustainable fisheries through proper control and management. The primary approach for the projects financed involved wetland and forest restoration.

Financing mechanism: The blue bond which aimed to improve the management and conservation of marine areas and strengthen the seafood value chains in Seychelles, has the following structure:

- The ceiling value for the bond is US $15 million with a maturity period of 10 years. A partial guarantee is provided by the World Bank amounting to US $5 million. A concessional loan worth US $5 million is provided by the Global Environment Facility which will partially subsidize the payment of the bond coupons. These instruments also serve as an example of blended finance, where international public finance serves as the credit enhancement instrument. This allows for a reduction in the price of the bond by partially de-risking the investment of private investors, as well as reducing the effective interest rates by subsidizing the coupon.
- Given the considerably small volume of the bond it was placed with three international impact investors - Calvert Impact Capital, Nuveen, and Prudential.
- The funds raised by the blue bond were used to capitalize the Blue Grants Fund (US $3 million) and the Blue Investment Fund (US $12 million), which provide financing for relevant projects in marine and ocean-related activities, including EbA projects. The Seychelles Conservation and Climate Adaptation Trust (SeyCCAT) and the Development Bank of Seychelles (DBS) administer funds from the Blue Grants Fund and the Blue Investment Fund respectively.

Impact: The blue bond raised US $15 million from international investors. This highlighted the potential for developing countries to mobilize private capital for adaptation activities. Specifically on adaptation, the bond aimed to strengthen the country's resilience to climate change impacts by expanding marine protected areas to 30% of their Exclusive Economic Zone and promoting sustainable fisheries using an ecosystem-based approach.

5. Conclusion

The scoping review in this paper presents key insights and best practices regarding EbA financing mechanisms that have been successful in other geographies. It is critical to tailor the interventions and the related financing to suit the local context, for the success of such adaptation projects. Designing and/or implementing EbA projects in silos is not sustainable, much less up scaled. A value chain approach that builds on the network of businesses and donors willing to invest, is the way forward. This can create an extensive network of potential funding sources that can be capitalized to scale projects and interventions. MFIs, technical partners, and government outreach programs need to work together to develop technical capacity, including the ability to view adaptation as a long-term process, requiring several planned EbA investments.

Reconciling public and private finance is therefore important to achieve the varied needs, investments, and operation costs of EbA projects. While public funding may be adequate during the project's conception and execution phases, in the long run, attracting private sector capital is essential to ensure sustainability. Governments, DFIs, or multilateral agencies committing to the availability of financing, both towards de-risking, as well as providing concessional capital can be an effective means to give private investors the confidence and comfort to invest in long-gestation adaptation sectors. In essence, as traditional forms of financing may not necessarily work due to the unique characteristics of EbA projects, innovating financial products and structures,

having a collaborative approach, and involving various stakeholders like Governments, DFIs, and financial institutions are crucial to enhance capital flows to long-term adaptation initiatives.

References:

[1] Agrawala, S., & Carraro, M. (2010). *Assessing the role of microfinance in fostering adaptation to climate change.* OECD.

[2] Jack, B.K., Kousky, C., & Sims, K.R. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *Economic Sciences*, 9465-9470.

[3] Belianska, A., Bohme, N., Cai, K., Diallo, Y., Jain, S., Melina, G., …Zebro, S.(2022). *Climate Change and Select Financial Instruments - An Overview of Opportunities and Challenges for Sub-Saharan Africa.* Washington, DC.: International Monetary Fund.

[4] Bhavsar, P. (2022). *How Can The Microfinance Industry Support Vulnerable Communities In The Fight Against Climate Change?* Retrieved from Outlook: https://www.outlookindia.com/outlook-spotlight/how-can-the-microfinance-industry-support-vulnerable-communities-in-the-fight-against-climate-change--news-229621

[5] Birkmann, J., Liwenga, E., & Pandey, R. (2022). *Poverty, Livelihoods and Sustainable Development. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge: Cambridge University Press.

[6] Earthwise Aware. (2023). *What are Ecosystem Services?* Retrieved from EwA: https://www.earthwiseaware.org/what-are-ecosystem-services/

[7] Forest Trends., The Katoomba Group., & UNEP. (2008). *Payments for Ecosystem Services: Getting Started, A Primer.* Washington, DC: UNEP.

[8] GIZ. (2018). *Finance options and instruments for Ecosystem-based Adaptation. Overview and compilation of ten examples*. Retrieved from https://www.greengrowthknowledge.org/sites/default/files/downloads/resource/Finance_options_and_instruemnt_for_EbA_GIZ.pdf

[9] GEF. (2023). *Blended Finance*. Retrieved from gef: https://www.thegef.org/what-we-do/topics/blended-finance

[10] High Atlas Foundation. (2021). *Fruit tree planting*. Retrieved from High Atlas Foundation: https://highatlasfoundation.org/project/organic-agriculture/

[11] ICMA. (2021). *The Green Bonds Principles.* ICMA.

[12] IFAD. (2008). *Kingdom of Morocco - Country strategic opportunities programme* . IFAD.

[13] IFRC, WWF. (2022). *Working with Nature to Protect People: How Nature based Solutions Reduce Climate Change and Weather Related Disasters.* Retrieved from https://www.ifrc.org/document/working-nature-protect-people

[14] OECD. (2015). *Toolkit to enhance access to adaptation finance* .

[15] OECD. (2017). *OECD DAC Blended Finance Principles for unlocking commercial finance for the Sustainable Development Goals*. Retrieved from https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/OECD-Blended-Finance-Principles.pdf

[16] Seddon, N., Chausson, A., Berry, P., A.J, C., Girardin, Smith, A., & Turner, B.(2020). Understanding the value and limits of nature-based solutions to climate change and other global challenges. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 375.

[17] The World Bank. (2022). *The World Bank in Seychelles*. Retrieved from The World Bank: https://www.worldbank.org/en/country/seychelles/overview#:~:text=Fisheries%20remain%20the%20largest%20sector,(as%20tourism%20has%20recovered)

[18] TSVCM. (2021). Taskforce on Scaling Voluntary Carbon Markets: https://www.iif.com/tsvcm

[19] UNEP., FAO. (2021). *Becoming #GenerationRestoration: Ecosystem Restoration for People, Nature and Climate.*

[20] UNEP. (2022). *Ecosystem-based Adaptation*. Retrieved from UNEP Climate Adaptation: https://www.unep.org/explore-topics/climate-action/what-we-do/climate-adaptation/ecosystem-based-adaptation

[21] UNEP., ELD. (2022). *State of Finance for Nature.* Nairobi: UNEP.

[22] UNFCCC. (2022, December). *Clean Development Mechanism*. Retrieved from UNFCCC: https://cdm.unfccc.int/about/index.html

[23] Wamsler, C., Niven L., H.Beery, T., Bramryd, T., Ekelund, N., Jonsson, I., …Stalhammar, S.(2016). Operationalizing ecosystem-based adaptation: harnessing ecosystem services to buffer communities against climate change. *Ecology and Society*. doi:http://dx.doi.org/10.5751/ES-08266-210131

Placement of the Professional Judgment in the Current Remote Working Environment

VIORICA MIRELA STEFAN-DUICU
Lecturer, Faculty of Economics and Business Administration,
„Nicolae Titulescu" University
185 Calea Văcărești, 4th District, Bucharest
ROMÂNIA
chirita.mirela@gmail.com

MIHAELA SUDACEVSCHI
Associate Professor PhD, Faculty of Economics and Business Administration,
„Nicolae Titulescu" University
185 Calea Văcărești, 4th District, Bucharest
ROMÂNIA
msudacevschi@univnt.ro

Abstract: Current global pandemic changes imposed a new decisional process that drags the reshaping of the professional judgment in the current environment. This reshape is an effect of the pandemic and it is highly correlated to the adaptability of the companies to the new technological path.
The continuity of the activity at an organizational level has as base the rethinking of the structure of the professional judgment within remote work conditions.
This paper aims to highlight the change of the professional judgment in the new format by explaining the influence and generating factors and, more accurate, the benefits and the drawbacks of the remote work.

Keywords: professional judgment, pandemic, remote work, global changes, decisions, development.

1 Introduction

Professional judgment has been in our field of research for over 10 years. This indissoluble concept regarding the activity at the organizational level has undergone changes on perception and on the entire process of formation and substantiation of this type of judgment.

Below we will present results of our past research in the professional judgment definition area.

Based on the research conducted so far, we have outlined several definitions of the professional judgment starting from the basic notions and then continuing at a particular level.

All the definitions regarding the professional judgment used in the qualitative and quantitative research we have conducted so far represent accepted general notions that have proven authenticity and carry the label that they are valid.

These definitions are:

-„the construction „professional judgment" indicates a cognitive demarche based on factors that support the creation of a correct decisional structure" (Stefan-Duicu & Stefan-Duicu, 2014);

-„the professional judgment is a set of logical judgments linked together in order to obtain concluded results for the activity carried taking into consideration certain circumstances, knowledge, evidences, methods, criteria and proper regulation;

-the professional judgment is the mechanism that forms an opinion and decision making taking into consideration the interaction between the accumulated experience in the domain, the assimilated knowledge;

-the professional judgment is a process that intervenes when the domain's legislation does not cover all the situations encountered in the activity carried and as a cognitive process that takes into consideration ethical codes, knowledge, circumstances but also by the employee's behavioral structures." (Stefan-Duicu & Stefan-Duicu, 2018).

In conducting qualitative and quantitative research on aspects of working in remote conditions we found the following results:

• remote work had already been implemented for some time in large companies and in companies that did not require a specific work infrastructure and it ensured higher productivity under these conditions;

• remote work has been seen by employees as beneficial especially during the pandemic period, giving an idea of security and protection;

• there has been cooperation between both state institutions and the private sector on the development and speed of the logistics needed to carry out the activity;

• remote work can be seen as a proof of adaptation to the global environment- economical, financial, and even social;

• remote work led to the extension or modifications in the employees' work tasks to keep the job if working remotely was not possible.

2 Placement of the professional judgment in the actual remote working conditions

Currently, a fact that interests us in this situation is the current pandemic status.

According to the definitions offered by the dictionary, pandemic means:

„an outbreak of a disease that occurs over a wide geographic area (such as multiple countries or continents) and typically affects a significant proportion of the population: a pandemic outbreak of a disease a global pandemic or an outbreak or product of sudden rapid spread, growth, or development" (Dictionary by Merriam Webster).

The coronavirus that causes COVID-19 is a contemporary example of a pandemic, representing a worldwide spread of a new disease.

At an official level, The World Health Organization (WHO) is the institution responsible for declaring and announcing a globally extended pandemic. This organization monitors the outbreaks of a disease and evaluates situations created with the help of health experts and specialists in various fields (Healthdirect Australia).

All countries have been affected by the pandemic through different implications such as:

• the health system has been overwhelmed by the medical crisis and also by the insufficient and unprepared staff in this specific situation;

• the fact that the virus is highly contagious and develops multiple variants quickly has blocked economic activity and activities in optimal conditions;

• the education system was also affected by the pandemic, fact that required the adaptation to the new environment via implementing online learning tools and policies.

„Public authorities must ensure, at the same time, a real competition on the markets and the suppliance of public services, such as education, health etc., for a proper functioning of the economy" (Stoica & Sudacevschi, 2019).

It was necessary to reengineer all work processes for each sector of activity. Digitalization and the use of technology are key elements of business continuity in all domains.

The pandemic status has imposed changes at all levels in companies and has led to work processes being conducted under conditions that comply with the recommendations of the relevant authorities, at the level of the health system and in other areas.

There has been the need to modify the tasks and workload, to increase awareness of the pandemic situation.

The professional judgment of the employees has shown greater attention to detail and has required continuous collaboration between colleagues and beyond. The transition period between working under normal conditions and the type of work mentioned above has consisted in the employee adaptation to all aspects regarding the global changes that have been predetermined. This adaptation followed both the integration of the personal and family plan in the work in remote conditions and the implementation of modern technologies that would allow the company's activity to take place in any location and context.

As a first reaction, many companies have restricted their activity but later they have returned to the market with solutions that ensured the continuity of its activity and keep employees in their jobs. Managers' professional judgment took unpredictable trajectories in the early days when uncertainty was high in the global economic and financial landscape. The pandemic was the main cause that both imposed and extended home-based remote work and extended the periods to indefinitely. The fact that companies have found a solution for working at home versus working in the office has led to support for the health system in the first place.

„Remote work, also called distance working, telework, teleworking, working from home (WFH), mobile work, remote job, and work from anywhere (WFA) (United States Office of Personnel Management) is an employment arrangement in which employees do not commute to a central place of work, such as an office building, warehouse, or retail store. It is facilitated by technology such as collaborative software, local area networks, virtual private networks, conference calling, videotelephony, internet access, cloud computing, voice over IP (VoIP), mobile telecommunications technology. It can be efficient and useful for companies since it allows workers to communicate over long distances, saving significant amounts of travel time and cost. Common software used for remote work are Zoom, Cisco Webex, Microsoft Teams, Google Meet, Slack, and WhatsApp" (Wikipedia - the free encyclopedia).

2.1 Potential benefits and drawbacks of the remote working

This type of work has led to distinct types of potential benefits and drawbacks.

From the category of potential benefits, we name:

• the reduction of costs for companies to conduct their activity in the previous conditions because teleworking does not require an actual space to be provided to the employee or to control the work climate, electricity costs, building maintenance, etc.

• it has been pointed out that the environmental aspect is an important one because remote working has led to a reduction in traffic and to lower emissions of pollutants and general pollution;

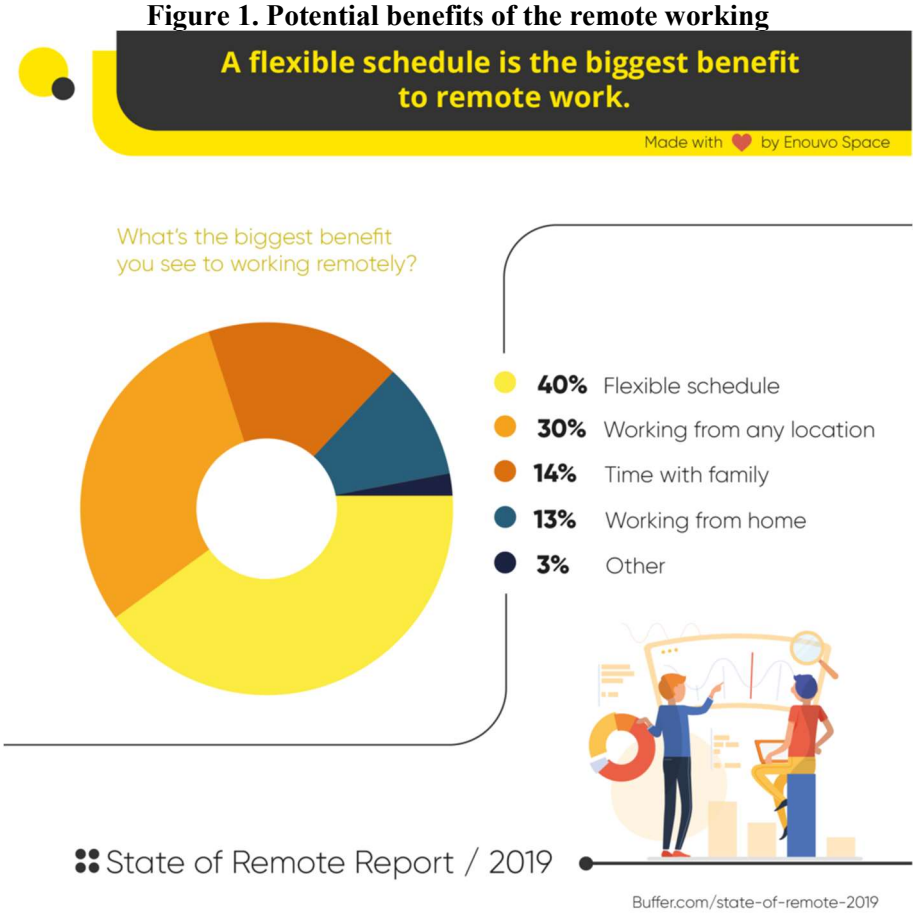
• the improvement of workers` quality of life by reducing the time spent in traffic and organizing the remaining activities;

• a highlighted advantage of remote work is that it creates a climate that encourages family life by ensuring a significant physical presence of people at home;

• schedule flexibility allows the employee to plan and decide when to complete the tasks;

• remote work is already considered an employee privilege in some companies.

Figure 1. Potential benefits of the remote working



Source: Report by Buffer State of Remote Work available at: https://buffer.com/state-of-remote-work/2019

The general drawbacks of remote work are:

• establishing logistics that cover 100% of the means of conducting the work in favorable conditions

• the lack of face-to-face interaction can lead to miscommunication and feedback often provided by personalized communication through gestures, voice, tone, facial expressions, and body posture (Daft & Lengel, 1986);

• the existence of employee's work-life balance concerns, the increase of efficiency related to the new working conditions, the need to adapt to new technologies and tools, maintaining work control and also the existence of home office constraints;

• distractions in remote work environment such as members of the family or neighbors;

• the occurrence of tensions between those who work from home and those who still work from the offices;

• the constant need of training for employees both in technology and how to work in new conditions and logistics;

• the exposure of companies to IT breaches and data theft;

• the pressure of working from home to show worth for the employees;

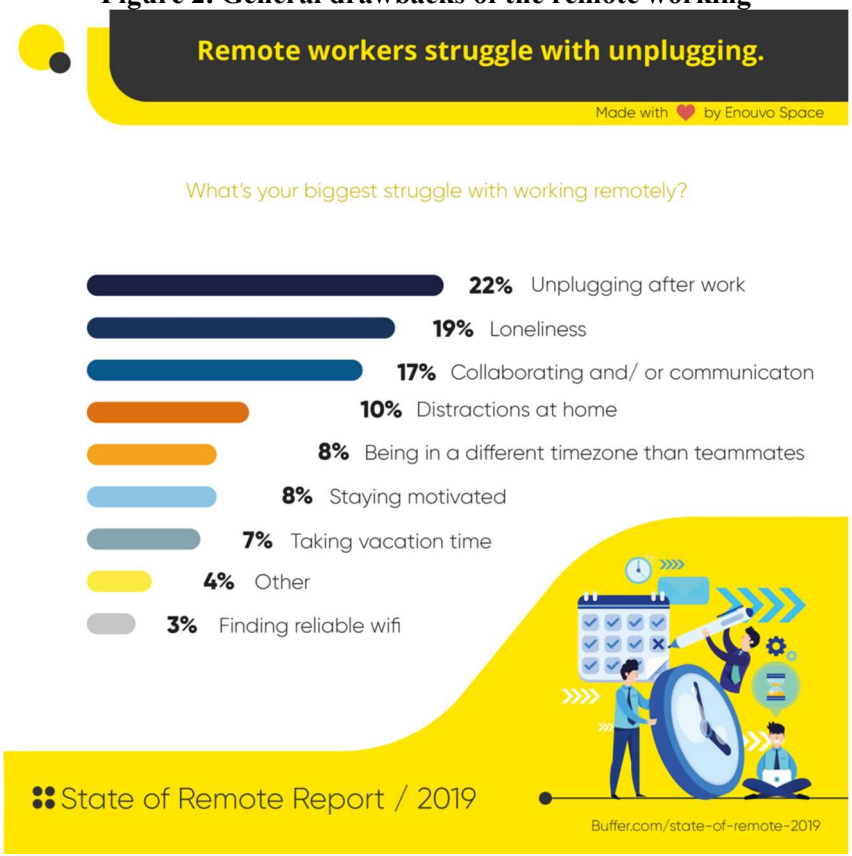
• continuous use of laptops, phones and tablets can lead to burnout and health issues among employees;

• during the adaptation process „people cannot solve problems perfectly, costless and instantaneously" (Grigore, 2009);

• employee's behaviors and attitudes change in remote working conditions because a different degree of autonomy is taken into consideration and the employee's experiences a greater focus on personal growth opportunities.

This fact goes both ways - it can increase the employee's work productivity or distract them from the main responsibilities they have because of the independence, freedom provided or the flexibility of schedule. „However, studies also show that autonomy must be balanced with high levels of discipline if a healthy work/leisure balance is to be maintained" (Cook, 2020).

Figure 2. General drawbacks of the remote working



Source: Report by Buffer State of Remote Work available at: https://buffer.com/state-of-remote-work/2019

2.2 The professional judgment during the remote working

The part that interests us the most and that we want to emphasize in this paper is that professional judgment also undergoes different changes.

If so far we were used to a fast-decision-making process at the workplace, now we had to adapt this process through the tools made available by the employer. It has been observed that the speed of decision making has decreased because the employees are withheld in group meetings, leading to longer times to be needed in this process.

This is a consequence of adaptation to the new technological path, and beyond.

The professional judgment has been affected by the lack of traditional face-2-face communication and has been, at least at the beginning of the pandemic, hampered by the adaptation time and flexibility of each employee in manifesting communication and decision making in the new work conditions (Akkirman, 2005).

Each employee and each manager had to get used to the new working climate and adapt to the new processes. Because the main goal is to ensure the continuity of the company's business at a general level and to maintain the workplace in normal parameters or with increased efficiency at an individual level all efforts have been directed towards this aspect.

Discussions no longer took place face-to-face at the office, meetings migrated online and therefore each employee had to push their limits and develop online communication skills.

The clarity of the professional judgment consisted in a comprehensive approach on all the factors influencing the company's activity and the adaptation to the new conditions imposed by the remote work.

Managers, seen as „supporters of innovation find the principles and the conventions of any kind, in a way not only to adapt better to the reality, but also to anticipate developments" (Cristea, 2015).

There has been a need for a separation between work and personal life and a need to establish a schedule to accomplish tasks in optimal conditions. Managers and stakeholders initially suspected that employees were not using the time allocated to their work in the best of their ability, but over time this suspicion disappeared as verifications occurred in the performance of tasks, activity reports or other types of reporting imposed into each company.

The remote work process has been developed against the current pandemic, but it will continue in companies even after the danger of contagion has disappeared.

3. Conclusion

Companies have adapted its activities and remote working schedule and have achieved various advantages and will continue to maintain certain remote working periods in accordance with internal policies.

Figure 3. Remote working in images

Source: photos published on unsplash.com

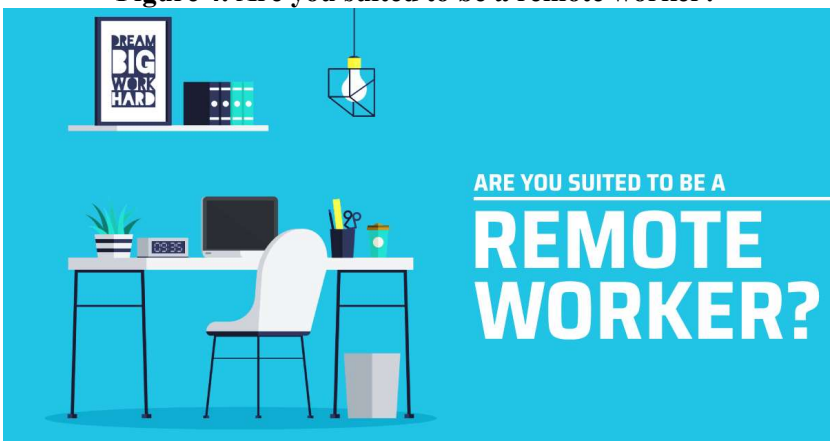
Tribute to photographers: Helena Lopes (photo 1.), Clark Tibbs (photo 2.), Manny Pantoja (photo 3.), Nelly Antoniadou (photo 4.); Andreas Klassen (photo 5.), Charles Deluvio (photo 6.), Chris Montgomery (photo 7.).

Professional judgment is based on a well-defined framework. During the transition to remote work the fact that every member of the company, whether employee or manager, had established job tasks and draft documents needed to conduct the work, led to an intrinsic decision-making process.

Initially, the difficulty arose from the concerns of transposing all the means of working from the office at home. All these elements shaped the professional judgement both through behavioral factors that influenced remote work and the employee themselves, as well as environmental factors. These environmental factors have transformed the professional judgement in remote work environment from an uncommon issue into a paradigm of the present time.

The professional judgment has seen variations in the way of being applied in areas where it initially seemed harder to work from home. Managers often decided to expand or change employees' duties and tasks in these situations.

Figure 4. Are you suited to be a remote worker?



Source: Picture used on Research by TalentLMS available at: https://www.talentlms.com/blog/remote-work-statistics-survey-2019/

In fact, looking at the whole situation, there has been a beneficial extension of professional training through the emergence of new remote working environment and processes.

Remote work will become a viable choice for companies from now on, as all the logistical and technical bases are already in place, given the historical precedent that has been set.

References:

[1] Stefan-Duicu, V. M., & Stefan-Duicu, A. (2014). Professional judgment of the financial analyst in the context of normative and positive theories of accounting directed by the economic resilience. *From Person to Society Journal*, 1003.

[2] Stefan-Duicu, V. M., & Stefan-Duicu, A. (2018). Professional Exo-Judgment Perception–A Quantitative Research Based on an Innovative Conceptual Structure. *Global Economic Observer*, 6(2), 17-25.

[3] Dictionary by Merriam Webster, *An Encyclopædia Britannica Company*, available at: https://www.merriam-webster.com/dictionary/pandemic#examples

[4] Healthdirect Australia - the national virtual public health information service, available at: https://www.healthdirect.gov.au/what-is-a-pandemic

[5] Stoica, E. C., & Sudacevschi, M. (2019). Economic policies instruments used by developed and emerging states in the conjuncture of our days. *Challenges of the Knowledge Society*, 1109-1118.

[6] What is telework? *United States Office of Personnel Management*, available at: https://en.wikipedia.org/wiki/United_States_Office_of_Personnel_Management

[7] Report by Buffer State of Remote Work – „How remote workers from around the world feel about remote work, the benefits and struggles that come along with it, and what it's like to be a remote worker in 2019", available at: https://buffer.com/state-of-remote-work/2019

[8] Daft, Richard L., Lengel, Robert H. (1986). "Organizational information requirements, media richness and structural design". *Management Science*. 32 (5): 554–571. doi:10.1287/mnsc.32.5.554. JSTOR 2631846.

[9] Wikipedia - the free encyclopedia, available at: https://en.wikipedia.org/wiki/Remote_work

[10] Grigore, M. Z. (2009). Information economics, instrument of analysis in new microeconomics. *Lex ET Scientia International Journal (LESIJ)*, 16(2), pp. 362.354-364.

[11] Cook, Dave (March 12, 2020). "The freedom trap: digital nomads and the use of disciplining practices to manage work/leisure boundaries". *Information Technology & Tourism*. 22 (3): 355–390. doi:10.1007/s40558-020-00172-4.
[12] Akkirman, A.; Harris, D. L. (June 2005). "Organizational communication satisfaction in the virtual workplace". *Journal of Management Development*. 24 (5): 397–409. doi:10.1108/02621710510598427.
[13] Cristea, V. G. (2015). The necessity to introduce the accounting rules and fair value in the conceptual framework. *Procedia economics and finance*, 515-521.
[14] Cristea, V. G. (2019). Asset pricing in a capital market. *Challenges of the Knowledge Society*, 1010-1016.
[15] Research by TalentLMS, available at: https://www.talentlms.com/blog/remote-work-statistics-survey-2019/