GLOBAL ECONOMIC OBSERVER

EDITORIAL BOARD

CONTENTS

The Socio-Economic Impact of Migration in the EU: In the Case of Ukraine Refugees[1]

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

VALENTIN CONSTANTIN
Ministry of Internal Affairs
ROMANIA
valentin.constantin@gmail.com

Abstract: The paper analysis the new and old challenges of the migration phenomenon in the Member States and their socio-economic impact. The authors are focused on the implications of the waves of Ukrainian refugees caused by the war in Ukraine and on EU member states' response to the crisis. A special attention is dedicated to Romania as a destination country for Ukrainian refugees. It is analysed the process of integration of refugees from Ukraine in Romania. From the quantitative analysis of the statistical data and the qualitative research of the migration policies from EU and Romania, a series of vulnerabilities are highlighted, but also possible opportunities for the Romanian labor market, which are summarized based on the SWOT analysis.

Keywords: Migration, refugees, Covid-19 pandemic, war in Ukraine, employment impact, SWOT

JEL Classification: *J16, J18, H75, I38, O52*

1. Introduction

The development of effective migration policies has been based on the successful implementation of measures to integrate migrants not only into the labour market but also into the host society. Katseli (2006) points out that managing migration has become a priority for policymakers in both developed and developing countries and is indeed a difficult challenge. Excessive immigration flows relative to the number of native populations can have a strong impact on every aspect of a society: family structures, community life, education and health systems, labour markets, security systems, governance, and public institutions. Despite the deficiencies inherent in developing migration policies, there is a growing awareness that, if the management of the system of integration improves, significant gains will take place for both migrant host countries and migrant countries of origin.

During the Covid-19 pandemic, the "essential workers" who play a key role in the continued functioning of basic services, especially health services, welfare, and food supply chains were immigrants. Existing studies highlight how the employment of migrant workers in essential services is determined by the interests of employers, sectoral policies, and national institution. Experts point out that the analyzes of how immigrants can influence systemic resilience of essential services in a pandemic or similar crisis are insufficiently in-depth, not only in policy making but also in research (Anderson & Poeschel & Ruhs,2021).

According to the same authors, regarding "shortages" of labor or skills, there is no universally accepted term as a definition and no "optimal" policy response. From the point of view of employers of migrant workers, "labor

[1] The article is based on the results of the authors research carried out as a part of the study 6.5.13 Migration waves and the COVID-19 Pandemic. Effects and challenges for the labor market in some EU Member States, coordinated by CSII Dr. Alina Ligia Dumitrescu, as part of the Research plan of the Romanian Academy / INCE - 6.5 The new conditions for European integration and globalization. Romania's economic and monetary convergence with the European Union - a necessary process, Coordinators: Acad. Mugur Isărescu, CIS Dr. Napoleon Pop, CIS Dr. Simona Moagăr Poladian.

shortage" usually refers to labor demand exceeding supply, wages, and conditions of employment on the market. Some employers may be reluctant or unable to meet demand and pay higher salaries. However, the central role of wages, employment conditions and structural constraints in stimulating employment growth must not be neglected. Such considerations probably apply in the context of essential services; for example, employment conditions can simultaneously create flexibility for employers (which could contribute to resilience), but also temporary employment of workers (which could undermine companies' resilience to asymmetric shocks).

2. The impact of migrant integration in the EU

In 2005 the European Commission adopted the Communication "A Common Agenda for Integration. Framework for the Integration of Third-Country Nationals into the European Union ", that expresses a view to establish a "coherent European integration area" based on implementing the" common basic principles ", through a series of EU support mechanisms (European Commission, 2005). In addition, on 3 March 2010, the European Commission's Communication entitled "Europe 2020, a strategy for smart, sustainable and inclusive growth", emphasized the need to set a new agenda for the integration of migrants to enable them to capitalize on their full potential.

In July 2011, the Commission proposed a "New European Agenda for the Integration of Third-Country Nationals", focusing on actions to increase the economic, social, cultural, and political participation of immigrants and on the direct actions of the local authorities. This new agenda highlights the challenges that need to be addressed if the EU wants to reap the full potential of migration and the value of cultural diversity and explores the role of countries of origin in the success of the integration process. A support working document provided by the Commission is attached to the Communication and contains a list of EU initiatives that support the integration of third-country nationals (European Commission, 2011).

On 7 June 2016, the European Commission adopted an "Action Plan on Integrating Third-Country Nationals" (European Commission, 2016). The action plan provides a comprehensive framework to support Member States' efforts to develop and strengthen their integration policies and describes the concrete measures that the Commission is implementing in this regard. Although it targets all third-country nationals in the EU, it contains specific actions to address the specific challenges facing refugees. The plan includes actions in all areas of migration policy that are essential for their integration:

- pre-departure and pre-arrival measures, including actions to prepare migrants and local communities for the integration process;
- education, including actions to promote language training, the participation of immigrant children in early childhood education and care, teacher training and civic education;
- employment and vocational training, including actions to promote early integration into the labor market and migrant entrepreneurship;
- access to basic services such as home insurance and health care;
- active involvement and social inclusion, the participation of migrants in socio-cultural life and the fight against all forms of discrimination are also tools for strengthening coordination between the various actors responsible for integration at national, regional, and local levels. For example, the European Integration Network, which promotes mutual learning between Member States and a more strategic approach to EU funding for integration, has a special role to play.

European Migration Network (2019) has pointed that the integration into the labor market of third-country nationals legally residing in EU Member must follow complex issues:

- most Member States have implemented specific integration policies targeting many of the migrant groups, including newcomers, as well as first-generation third-country nationals. These policies are usually a component of more general policies for the integration of disadvantaged groups;
- current labor market integration policies are usually driven by a lack of labor and the need to quickly support new workers to become self-employed;
- member States shall combine basic and personalized labor market integration measures. While the main integration activities contribute to ensuring equal access to general services (public employment). It is underlined that customized measures can address some of the problems faced by newcomers from the third countries compared to other groups, including lack of language skills and low level of familiarity with the new society culture;

- the most common obstacles faced by Member States in supporting third-country nationals are the accreditation of professional qualifications / skills assessment of non-EU nationals, combating discrimination in recruitment processes and ensuring the different levels of language skills required in integration activities. These difficulties are more pronounced for immigrant women or vulnerable groups, such as the elderly;
- among the most innovative measures is the development of intergenerational links, bringing together people of different ages or ethnicities, not only to facilitate the integration of immigrants into society, but also to strengthen social cohesion;
- employment agencies and non-governmental organizations appear as key partners in implementing labor market integration measures. Most of the funding is from the national and / or community level, but there are examples of private funding, including new instruments, such as social impact bonds and sponsorships;
- measures taken by the private sector are aimed at integrating workers (immigrants) into the workplace;
- The good practice examples that have been largely implemented by large companies have focused mainly on continuing education, training, professional qualification.

Based on the progress made since 2016, the European Commission has presented a new Pact on Migration and Asylum in September 2020 (European Commission, 2020a). It aimed to provide new tools for faster and more integrated procedures, better management of the Schengen area and borders, as well as flexibility and resilience to any crisis. The new Pact on Migration and Asylum sets out a fairer and more coordinated approach to managing migration and asylum. It aims to implement a comprehensive and sustainable policy, providing an effective long-term response to the current challenges of illegal migration, the development of legal migration routes, better integration of refugees and other newcomers and the deepening of migration partnerships with countries of origin and transit for mutual benefit. A new "good governance" mechanism will ensure a more equitable sharing of responsibilities and effective solidarity between Member States, with national migration management systems increasingly integrated into a common Community space.

An Action Plan on Integration and Inclusion 2021-2027 (European Commission, 2020b) was adopted in November 2020, emphasizing that the digitalization of governments at all levels can facilitate access to digital public services. However, if not used in an inclusive way and not accessible, digitization of services may extend inequalities instead of narrowing them down. The Covid-19 crisis has revealed the potential for digitization of services in areas such as continuing education and language courses. Many Member States have had to adapt their services for integrating immigrants into socially remote conditions by providing online training courses. In any case, this change has also highlighted that immigrants and EU citizens from outside the EU often face obstacles in accessing digital courses and services due to lack of infrastructure, language barriers, lack of electronic identification and reliable digital services (such as electronic signature) or lack of digital skills to use these services. Online services can also be particularly effective in the pre-departure phase to help immigrants learn the language and acquire skills that can accelerate their integration upon arrival and connect them more easily with institutions in the host communities (European Commission, 2020).

3. The implications of the waves of Ukrainian refugees caused by the war in Ukraine over European Union

According with the European Economic Forecast Spring 2022, because of the war in Ukraine the outlook in the EU is now for lower growth and higher inflation, especially for 2022. “Real GDP growth in both the EU and the euro area is now expected at 2.7% in 2022 and 2.3% in 2023, down from 4.0% and 2.8% (2.7% in the euro area), respectively, in the Winter 2022 interim forecast …In turn, the projection for inflation has been revised up significantly. In the EU, HICP inflation is now expected to average an all-time high of 6.8% in 2022, before declining to 3.2% in 2023. In the euro area, inflation is projected at 6.1% in 2022 and 2.7% in 2023. This compares with 3.5% and 1.7%, respectively, in the Winter 2022 interim forecast” (European Commission, 2022a).

3.1. Synthesis of relevant statistical data

According with European Commission - Directorate General for Migration and Home Affairs- Directorate for Migration & Asylum, around 5.45 million people arrived at the EU from Ukraine through Poland, Slovakia, Hungary, Romania border crossing points (Graph 1). One of which on 5 May around 41,298 arrived, 2% less than on the previous day (41 960) (European Commission, 2022). The United Nations High Commissioner for

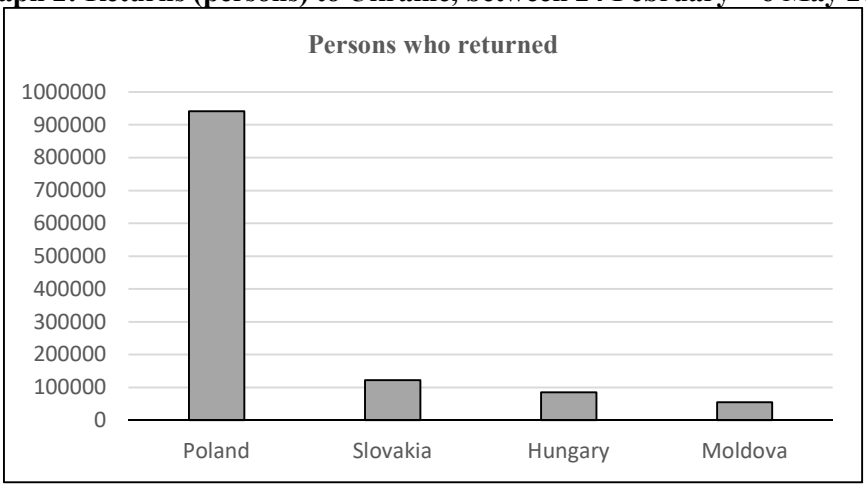
Refugees data show that on 23 May 2022, the number of refugees amounted about 5.6 million people (UNHCR, 2022).

Graph 1: Arrivals (persons) to Ukraine Neighbouring Countries, between 24 February – 6 May 2022

Source: Authors based on data published by the European Commission (2022).

The State Border Guard Service (SBGS) of Ukraine reports that there are people who return to Ukraine. This would bring the total, as of 5 May, to almost 1.5 million citizens returned to Ukraine since the beginning of Russia's military invasion on 24 February (European Commission, 2022b)

Graph 2: Returns (persons) to Ukraine, between 24 February – 6 May 2022



Source: Authors based on data published by the European Commission (2022).

According with the European Commission, as reported in the context of the Solidarity Platform with the Ukrainian citizen , as of 6 May, the below represents the current status regarding reception capacities in the EU Member States and Schengen Associated CountriesOut of 17 Member States and 3 Schengen Associated Country reporting: 12 Member States (report occupancy rates between 70 and 100%. 4 Member States (Hungary, France, Romania, and Bulgaria) have 100% occupancy. And 16 Member States and 2 Schengen Associated Country report the possibility to upscale reception capacity. France reports to be capable of increasing their reception places up to 200 000, while Romania up to 500 000 places.

3.2. The EU's response to the refugee crisis in Ukraine

On 2 March 2022, the European Commission proposed granting temporary protection for up to three years to people fleeing the war in Ukraine, which includes a residence permit and access to employment and social assistance. On 3 March, the proposal was approved by EU interior ministers, with a majority of at least 15 Member States. The Dublin Convention, which requires the first country of entry to assess the asylum applications of immigrants has been abolished.

The protection measure includes access to housing and medical care and will be provided to war refugees without them having to go through lengthy asylum procedures. Protection status can last up to three years and can be extended for another year unless the situation in Ukraine stabilizes faster and enough for people to return home.

There were also about 75,000 foreign students in Ukraine (many studying medicine, engineering, and military affairs), and nearly a quarter of them were Africans from Morocco, Egypt, Nigeria, and Ghana (Notes from Poland, 2022). They also left Ukraine, but many of them, unlike Ukrainians, were restricted from entering the EU.

Member States will focus their efforts on integrating refugees into society and the labor market. According to migration experts Sandilya and Deleva (2022), an influx of human capital could be extremely beneficial for many EU economies, provided that the relocation process is properly managed. First, they point out that, unlike Western European countries, the new EU Member States still have very little experience with large-scale immigration. Secondly, the influx of Ukrainians into these countries was largely made up of women and children, as men of fighting age keep behind, and therefore inclusion mechanisms will have to take gender and age into account.

In addition to providing housing, education and financial support, governments will also need to facilitate the entry of Ukrainian women into EU labor markets. In addition to providing training on skills and entrepreneurship, EU governments should focus on eliminating bureaucracy that prevents refugees who are able and willing to work. The European Ministries of Labor should work closely with companies, recruiters, and job search services to ensure that skilled workers find jobs quickly. Translation based on artificial intelligence can help in the process of recognizing diplomas and technical qualifications. Similarly, the universities and the technical training institutions will need to be flexible to facilitate access to education without the necessary documents, and courses can be presented in several languages. This will help refugee women gain the knowledge and experience they need to get jobs. Finally, refugees who want to become entrepreneurs will need sustained technical support, access to finance and - perhaps most importantly - mentors to guide them through the process of starting a business (Sandilya and Deleva, 2022).

4. Romania as a destination country for Ukrainian refugees

To counteract the negative impact on the Ukrainian refugees, has been launched a Regional Plan for Refugees for the situation in Ukraine, for the period March-August 2022, implying the participation of 12 partners (including the UN Non-Governmental Organization, international and civil society), for six months working with refugee host governments. According to this plan, the preliminary sum of 550.6 million dollars is allocated for the countries of the EU are on the border with the Czech Republic, Poland, Slovakia, and Hungary (in the West) and Romania (South-West). destination destinations for reimbursements in Ukraine.

4.1. Analysis on border transit - Ukrainian citizens

From the beginning of the conflict on February 24 until May 7, 919,217 inflows of Ukrainian citizens and 830,915 outflows were registered at the Romanian border crossing points. Currently, 88,302 Ukrainian citizens remained in Romania (9.61%) of which 4,345 applied for asylum, and for 17,779 temporary residence permits were issued (Ministry of Interior Affairs, 2022a).

According to statistical statistics, the daily average inflows and outflows of Ukrainian citizens are as follows (Table 1):

Table 1: The daily average inflows and outflows of Ukrainian citizens between 24 February-7 May 2022 (persons)

DATE	INFLOWS	OUTFLOW	ASYLUM APPLICATIONS	RESIDENCE PERMITS
28.02.2022	23.514	13.785	225	
01.03.2022	22.596	15.877	321	
02.03.2022	23.862	17.783	289	
03.03.2022	25.294	19.575	387	
04.03.2022	28.563	22.011	409	
05.03.2022	28.235	22.813	489	
06.03.2022	31.628	23.180	472	
07.03.2022	33.969	26.632	463	

08.03.2022	29.636	26.551	228	
09.03.2022	28.888	25.506	60	
10.03.2022	23.546	24.475	53	
11.03.2022	21.003	23.653	51	
12.03.2022	16.348	21.659	67	
13.03.2022	16.676	16.858	65	
14.03.2022	14.475	14.954	52	
15.03.2022	13.769	13.425	97	
16.03.2022	15.212	13.350	69	
17.03.2022	15.286	13.176	45	
18.03.2022	13.000	13.206	40	x
19.03.2022	11.182	11.779	64	
20.03.2022	10.699	10.704	57	
21.03.2022	9.582	10.576	28	
22.03.2022	8.601	9.366	46	
23.03.2022	9.295	8.453	17	14
24.03.2022	8.910	8.916	11	113
25.03.2022	9.995	9.349	25	152
26.03.2022	8.975	8.670	15	165
27.03.2022	8.943	9.144	-	74
28.03.2022	7.776	8.367	1	24
29.03.2022	7.625	7.647	2	331
30.03.2022	8.261	8.241	6	390
31.03.2022	8.650	8.380	-	316
01.04.2022	8.277	8.813	-	459
02.04.2022	7.365	7.772	4	445
03.04.2022	7.820	8.104	-	38
04.04.2022	6.729	6.955	-	15
05.04.2022	7.189	6.639	1	449
06.04.2022	7.524	7.205	9	479
07.04.2022	8.894	7.436	3	468
08.04.2022	9.165	9.198	-	471
09.04.2022	8.623	8.323	4	454
10.04.2022	10.025	8.631	-	26
11.04.2022	7.915	8.226	-	10
12.04.2022	8.350	8.293	1	507
13.04.2022	9.429	8.012	-	490
14.04.2022	9.385	9.035	-	585
15.04.2022	10.092	9.703	1	555
16.04.2022	7.691	7.971	-	537
17.04.2022	8.648	8.509	-	67
18.04.2022	6.750	6.779	-	15
19.04.2022	6.602	6.246	-	543
20.04.2022	7.349	7.302	-	362
21.04.2022	7.704	7.695	-	362
22.04.2022	7.608	8.165	-	455
23.04.2022	6.743	7.226	-	56
24.04.2022	5.130	5.869	-	37
25.04.2022	3.189	3.636	-	4
26.04.2022	4.412	3.722	-	25
27.04.2022	6.629	5.141	-	576
28.04.2022	8.635	7.340	1	706
29.04.2022	8.590	8.224	-	732
30.04.2022	8.364	7.857	-	826
01.05.2022	10.569	9.486	-	327
02.05.2022	7.648	8.453	-	44
03.05.2022	6.747	7.103	2	814
04.05.2022	7.767	7.104	-	814

05.05.2022	8.148	7.885	-	927
06.05.2022	7.733	8.256	-	881
07.05.2022	8.072	7.143	-	889
07.05.2022	9.065	8.067	-	314

[1] Sources: Ministry of Interior Affairs (2022a) Note: * Last available data.

For the effectively management and coordination of the massive influx of refugees displaced by the Russian-Ukrainian military conflict, The General Inspectorate for Emergency Situations has operationalized 15 Centers of Temporary Transit (12 assets, 2 suspended and 1 in administration of the local public authorities) in counties on the border with the Republic of Moldova and Ukraine, with a capacity of 2,943 accommodation places of which, , 65 were occupied, and from the moment of operationalization, which have been assisted 694,435 people, in the date under analysis between 24 February-17 May.

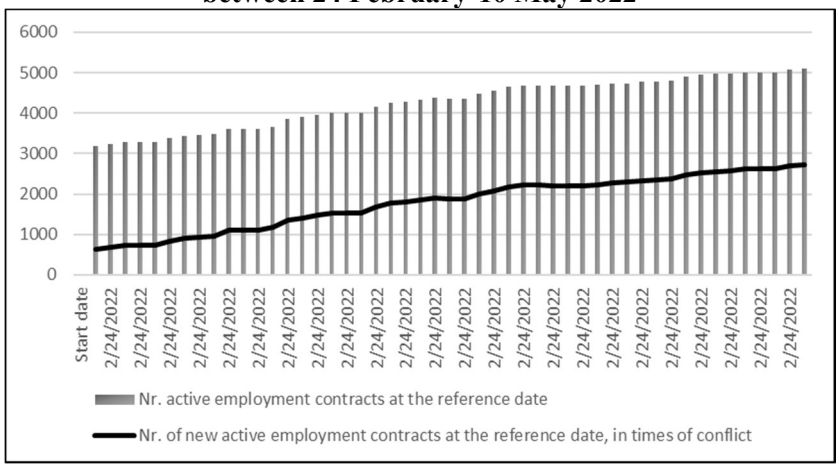
According with the General Inspectorate for Emergency Situations and National Intervention Coordination and Management Centre (2022), the costs for the civil protection in the context of the Russian-Ukrainian conflict have been 6,869,510 RON (1,387,779 EUR), of which 1,699,430 RON (343,319 EUR) for accommodation and 5,170,080 RON for food (1,044,460 EUR) (Ministry of Internal Affairs, 2022b).

4.2. The process of integration of refugees from Ukraine in Romania

Romania, measures have been taken to integrate Ukrainian refugees into the labor market. According to the Minister of Labor, the legislation has been amended so that all Ukrainian citizens who enter Romania and wish to be employed can do so without any notice or restriction but based on a statement on their own responsibility. Through this statement, they assume that they meet the conditions of professional training and experience necessary for the position they are to be employed and that they do not have a criminal record incompatible with the activity they are to carry out in Romania. Also, citizens from Ukraine will have the opportunity to work without having to obtain a residence visa for work from Romania's diplomatic missions in Ukraine.

According with the Ministry of Labour and Social Protection data, on 10 May 2022, several 5,101 active contracts of Ukrainian citizens are registered, out of which 2,731 are contracts that have a start date after the beginning of the conflict. So, the number of active contracts that started on February 24, has increased by thirty-eight persons compared to 10 May 2022 (Graph 3, Table 2).

Graph 3: The evolution of the working contracts of Ukrainian citizens, between 24 February-10 May 2022



Source: Authors based on data published by Ministry of Labour and Social Protection - *National Employment Agency* (ANOFM 2022).

Table 2: Information for the Interinstitutional Working Committee on Ukraine

Period	No. of companies that have declared vacancies available for Ukrainian citizens	Number of places declared vacant	Number of Ukrainian job seekers in Romania registered with AJOFM / ANOFM	Number of jobs held by Ukrainian citizens in Romania	New contracts registered in REVISAL of Ukrainian citizens

24.02.2022-10.05.2022	270	4075	756	451	2731

Source: Ministry of Labour and Social Protection - *National Employment Agency*. (ANOFM 2022).

Occupations of employed Ukrainian citizens are: car wiring manufacturers, car industry specialists, textile industry workers, construction workers, violinist, driver, workers in hotels and restaurants, sales representatives, fishermen, confectioner, pedagogue, car mechanics, IT, pastry chefs, packers, chefs, data processing operators, hairdressers, manicurists, beauticians, green space caretakers, cargo handlers, food industry workers, unskilled in the field of electricity, unskilled road maintenance, textile chemist, car sales worker, car operator, social worker, translators, workers in aircraft industry, dental technician, engineer, architect manager, design engineer, unskilled worker in non-ferrous metal casting, ship engineer, sales manager, quality controller, plastics operators.

Between 24.02.2022 and 05.05.2022, 250,790 minor Ukrainian citizens entered through the border crossing points and 211,940 minor Ukrainian citizens left. Currently, in Romania, there are 38,850 minor Ukrainian citizens left, of which 33,087 are under 14 years old, 24,107 are under 10 years old, and 11,380 are under 5 years old.

Because of the large number of children among refugees, there were taken a set of measures Ukrainian children protection. All Ukrainian children who are on Romanian territory, including those who do not apply for protection, according to the Asylum Law, will benefit from the right to free education in Romania, as well as Romanian students. Refugee children in Ukraine will be entitled to free accommodation in boarding schools, food allowance, supplies and textbooks.

From the study of the statistical data and of the migration policies from EU and Romania, a series of vulnerabilities are highlighted, but also possible opportunities of the Romanian labor market, which are summarized based on the SWOT analysis in the following table:

Table 3: The impact of migration in the EU: A SWOT analysis

STRENGTHS	**WEAKNESSES**
- Member States have implemented specific integration policies targeting many of the migrant groups in general and in special of the Ukraine. - A well organised system for coordination and management of refugees' crisis at national and local level.	- An inadequate supply of migrant labour, due to lack of qualifications or inadequate training for the host country's labour market demand. - Arduous process of accreditation of professional qualifications / skills assessment of non-EU nationals.
OPPORTUNITIES	**THREATS**
- Immigrants could play an important role in the continued functioning of basic services, especially health services, welfare, and food supply chains. - Increasing labour supply and employment in the host countries.	- An increased social spends in host countries. - The risk elevated level of unemployment between the immigrant population, due to the imbalance between demand and supply of skills.

Source: Authors

Of the estimated about 6 million refugees expected to arrive in EU countries following the war in Ukraine, some will decide to stay in the host countries. In this context, the capacity of host states to integrate refugees and build social cohesion with them is a win-win process: the immigrants will have better opportunities to work and live and the in EU will increase the employment, that will contribute to the economic growth and economic development of the Member States.

5. Conclusion

In the years before the Russian-Ukrainian conflict, the Member States of Central and Eastern Europe were facing a labor shortage due to the free movement of labor from these states to more economically developed countries. A major challenge is the integration of immigrants into the host countries labor market. The European Union encourages the integration of immigrants into the Member States through a series of programs to facilitate

their access to the labor market, programs to learn the language of the host country and retraining and continuous education to make the demand match the supply of labor. The latest challenge is the refugee crisis in Ukraine. The first phase requires humanitarian aid, livelihood assistance and second phase, and the integration of children into the education systems of the host Member States and adults into the labor market.

The liability of Ukrainian migratory phenomenon is that most refugees are women and minor children, because the men stayed in Ukraine to fight on the front. So social integration will have to focus mainly on these two vulnerable categories. The legislative framework and the Community and international institutions support the process of strengthening the resilience of host communities and social cohesion with refugees.

References:

[1] Anderson, B., Poeschel, F. and Ruhs, M (2021). *Rethinking labour migration: Covid-19, essential work, and systemic resilience*". Comparative Migration Studies, forthcoming. https://comparativemigrationstudies.springeropen.com/articles/10.1186/s40878-021-00252-

[2] Eueopean Commision (2022 a). Spring 2022 Economic Forecat Rusian invation tets EU economic resilience. https://ec.europa.eu/info/business-economy-euro/economic-performance-and-forecasts/economic-forecasts/spring-2022-economic-forecast_en

[3] European Commission. (2022 b). *Blueprint daily report on migratory implications of the Russian invasion on Ukraine and EU Member States preparedness and contingency planning.* Directorate-general for migration and home affairs, Directorate C – Migration & Asylum.

[4] European Commission (2020a). *The new migration pact*. https://ec.europa.eu/commission/presscorner/detail/ro/ip_20_1706

[5] European Commission (2020b*). Action plan on Integration and Inclusion 2021-2027* {SWD (2020) 290 final}. https://ec.europa.eu/home-affairs/system/files_en?file=2020-11/action_plan_on_integration_and_inclusion_2021-2027.pdf

[6] European Commission (2016). *Action plan on the integration of third-country nationals*.7.6.2016 COM (2016) 377 final. https://eur-lex.europa.eu/legal-content/RO/TXT/PDF/?uri=CELEX:52016DC0377&from=RO

[7] European Commission (2011). *European Agenda for the Integration of Third-Country Nationals.* Commission Staff Working Paper. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011SC0957&rid=3

[8] European Commission (2005). *A Common Agenda for Integration Framework for the Integration of Third-Country Nationals in the European Union*. 1.9.2005 COM (2005) 389 final. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0389:FIN:en:PDF.

[9] European Migration Network (2021). *The impact of the Covid-19 in the migration area in the EU and the OECD countries*.: https://www.oecd.org/migration/mig/00-eu-emn-covid19-umbrella-inform-en.pdf,

[10] European Migration Network (2019). *Labour market integration of third-country nationals in EU Member States – Synthesis Report.* Brussels: European Migration Network. https://ec.europa.eu/home-affairs/system/files/2021-05/00_eu_labour_market_integration_final_en.pdf.

[11] Global Migration Data Portal (2022). *Migration data in Europe*. https://www.migrationdataportal.org/regional-data-overview/europe.

[12] Katseli, T.L. (2006). *Policies for Migration and Development: A European Perspective.* Disponibil la: https://www.academia.edu/53260428/Policies_for_Migration_and_Development_A_European_Perspective

[13] Ministry of Internal Affairs (2022a). Border traffic analysis. Internal document.

[14] Ministry of Internal Affairs (2022b *Information note on events of interest in the field of civil protection in the context of the Russian-Ukrainian conflict.*). The General Inspectorate for Emergency Situations National Intervention, Coordination and Management Centre.

[15] Minister of Labour and Social Protection - *National Employment Agency.* (ANOFM 2022). *Information for the Interinstitutional Working Committee on Ukraine.*

[16] Notes from Poland (2022). *We can't take any more refugees": Polish cities call on government to seek EU and UN help.*https://notesfrompoland.com/2022/03/11/we-cant-take-any-more-refugees-polish-cities-call-on-government-to-seek-eu-and-un-help/

[17] OECD (2021). *International Migration Outlook 2021*. OECD Publishing, Paris, https://www.oecd.org/migration/international-migration-outlook-1999124x.htm.

[18] Ruhs, M., Vargas-Silva, C. (2017). *Briefing the labour market effects of immigration*. http://www.migrationobservatory.ox.ac.uk/resources/briefings/the-labour-market-effects-of-immigration/.

[19] Sandilya, H., Deleva, Z. (2022). How Europe can include Ukrainian refugees in society. *Social Europe.* https://socialeurope.eu/how-europe-can-include-ukrainian-refugees-in-society.

[20] UNHCR (2022). *Ukraine Refugees Situation*. https://data2.unhcr.org/en/situations/ukraine

The War in Ukraine and the Overhaul of EU Energy Security

PETRE PRISECARU
European Studies Center, Institute for World Economy
Romanian Academy
ROMANIA
petreprisecaru@gmail.com

Abstract: In the last years EU energy policy was strongly affected by a mix of challenges starting with the Paris Agreement and the European Green Deal ambitious targets, followed by the outburst of COVID-19 pandemic and lastly by the war in Ukraine. An European Energy Security Strategy was adopted din 2014 based on eight key pillars, followed by Energy Union strategy, adopted in February 2015, built on five closely related and mutually reinforcing dimensions, the first one being energy security, solidarity and trust. Over the past years Energy Union was the subject of six regular progress reports, the last two ones in October 2020 and October 2021, where more attention was paid to energy safety and to the fourth dimension-decarbonising the economy. Due to the energy market liberalization, to energy transition and also to the impact of COVID-19 pandemic an energy crisis burst in EU in 2021, affecting mainly the natural gas and electricity prices and markets. Russia's invasion in Ukraine led to skyrocketed prices of oil and natural gas while revealing the high dependence of EU on fossil fuels imports from Russia. Our paper aims to investigate if the rounds of sanctions can reduce this dependency while finding new sources of supply - a task that is very difficult since the global supply of LNG, coal and oil is quite limited or insufficient. Our research also highlight that there is an urgent need for a new strategic vision at EU and national level to ensure energy security and protect the environment.

Key Words: energy security, solidarity, fossil fuels dependence, transition, renewables, energy strategy

JEL Classification: F15, Q 28, Q 35, Q 42, Q 48, Q 54

1. Introduction

Although it has long been a major and important concern of EU energy policy, as evidenced by the strategy launched in 2014 and other important initiatives such as the Energy Union, energy security has been a rather neglected topic in recent years in favour of green policies and combating greenhouse effects. With the recent war in Ukraine, the EU's major vulnerability in the field of energy security stood out due to its heavy dependence on imports of hydrocarbons from a single source, Russia, a supplier that has been subject to major sanctions affecting its energy supplies to many Member States, forcing them to quickly look for alternative import sources while resorting again to polluting fossil fuels, as coal. In this complicated and difficult context, the implementation of the European Green Deal and the achievement of its ambitious environmental goals remain difficult to attain, and energy security should become the number one priority for EU energy policy.

2. European Energy Security Strategy

European Energy Security Strategy was adopted in 2014 as a Communication from the Commission to the European Parliament and the Council (COM/2014/0330 final) under the influence of the 2006 and 2009 gas supply crises triggered by Russia-Ukraine disputes over transit of natural gas to Central and Western Europe.

The European Energy Security Strategy was thought as an integral part of the 2030 policy framework on climate and energy, in order to be fully consistent with EU competitiveness and industrial policy objectives. It was also important that decisions to be taken on that framework as soon as possible, as indicated by the European Council, and that Member States to gear up collectively to elaborate and implement long-term plans for competitive, secure and sustainable energy. Tackling energy security in a fast-changing environment would require flexibility, capacity to adapt and change and the strategy would need to evolve due to changing circumstances.

The Strategy set out areas where decisions need to be taken or concrete actions implemented in the short, medium and longer term to respond to energy security concerns. It was based on eight key pillars that together promote closer cooperation beneficial for all Member States while respecting national energy choices, and were underpinned by the principle of solidarity (European Commission, a, 2014).

1. ***Immediate actions aimed at increasing the EU's capacity to overcome a major disruption during the winter 2014/2015.*** As enough EU Member States were very dependent on one single gas supplier, Russia, the Commission intended to work together with Member States, regulators, Transmission Systems Operators and operators to improve the Union's immediate preparedness in respect of possible disruptions. Particular attention was going to be paid to vulnerable areas, to enhancing storage capacity, to developing reverse flows, to developing security of supply plans at regional level and to exploiting more the potential of LNG. As key actions undertaken by the Commission and Member States one could mention: intensifying cooperation within the Gas Coordination Group and notably continue monitoring natural gas flows and the level of gas storage and coordinating at EU and/or regional level national risk assessments and contingency plans; updating the risk assessments and the Preventive Action Plans and Emergency Plans, as provided for by the Regulation 994/2010; launching energy security stress tests in light of the supply disruption risks in the next winter, and developing back-up mechanisms if necessary, such as increasing gas stocks, developing emergency infrastructures and reverse flows and reducing energy demand or switching to alternative fuels in the very short term; developing further cooperation with gas suppliers and transmission system operators to identify possible sources for short-term additional supplies, notably LNG.

2. ***Strengthening emergency/solidarity mechanisms including coordination of risk assessments and contingency plans; and protecting strategic infrastructure***. One important priority was defined as ensuring the best possible preparation and planning for improving resilience to sudden disruptions in energy supplies, protecting strategic infrastructures and supporting collectively the most vulnerable Member States. ***Oil stocks*** representing about 120 days of consumption and there value along with with the oil stockholding obligation developed under the International Energy Agency (IEA) were considered important instruments for preventing any physical shortage of supply and for tempering market price fluctuations in the case of a crisis. EU had to promote further international cooperation and transparency concerning oil stocks and oil markets. ***Preventing and mitigating gas supply disruption risks*** by strengthening EU coordination capabilities, imposing EU rules for protecting customers in severe conditions, drawing up by MS of Emergency Preparedness Plans and Emergency Response Plans, fully implying Gas Coordination Group, involving Member States, regulators and all stakeholders, as an effective EU-wide platform to exchange information between experts and coordinate action, developing risk assessments (stress tests) and security of supply plans at regional and EU levels, were viewed as key elements for developing a regulatory framework for gas storages that recognises their strategic importance for supply security.

Protection of critical infrastructure against threats, hazards, IT attacks, control exerted by non-EU entities, acquisitions made by non-EU companies, and a stricter application of EU internal market rules, notably as regards public procurement is also considered a key input for EU energy security. ***Solidarity mechanisms among Member States*** by using proper contingency planning, based on stress tests of the energy systems and discussions with national authorities and industry, guaranteeing minimum levels of intra-EU deliveries of alternative fuel supplies to complement emergency stocks, reviewing existing mechanisms to safeguard security of energy supply, were essentials tools for proposing to Member States and industry new contingency coordination mechanisms and plans to deliver energy to countries in times of need, based on risk assessments (energy security stress tests).

3. Moderating energy demand. At that time it was important to attain EU energy efficiency target of 20% in 2020 resulting in 371 Mtoe primary energy savings compared to projections with the support of the Energy Efficiency Directive ("EED") and the Energy Performance of Buildings Directive ("EPBD"). So the focus was put on achieving significant energy savings, especially in the building sector, responsible for about 40% of energy consumption in the EU and a third of natural gas use, that could be cut by up to three quarters if the renovation of buildings was going to accelerate and improvements were made in district heating and cooling. In the field of industry which consumed around one quarter of gas used in the EU there was a significant potential for energy efficiency gains driven by Emissions Trading System proposed by the Commission as part of the 2030 climate and energy framework. Investments from the private sector had a key role to play but also European Structural and Innovation Funds, from which €27 billion had been allocated specifically for low carbon economy investments, including energy efficiency, but the amount of these investments would have increased to over €36

billion. Other key actions aimed at energy efficiency were planned to be carried out by the Member States and the European Commission.

4. Building a well-functioning and fully integrated internal market. A European internal market for energy was defined as a key factor for both energy security and government interventions affecting this market framework, such as national decisions related to renewable energy or efficiency targets, while being essential for supporting investment in nuclear generation and other key infrastructure projects that had to be discussed at European and/or regional level to ensure that decisions in one Member State did not undermine security of supply in another Member State. Various tools existed at EU level for implementing such projects in respect of the acquis and in a coordinated manner (internal market legislation, TEN-E Guidelines, State-Aid control) and enforcement tools had to be preceded by a strategic discussion at EU level, not just at national level. ***The first measure was to make the internal market for electricity and gas work better*** through liberalization packages, more regional market integration, more free competition, well-developed trading mechanisms and liquid spot markets along with the full coupling of some regional electricity and gas markets. ***The second measure was to accelerate the construction of key interconnectors,*** meaning a significant development of energy transport infrastructure, in particular cross-border interconnections between Member States, which would involve €200 billion up to 2020 in this respect. The Regulation on the Guidelines for trans-European energy networks together with the Connecting Europe Facility (CEF) were designed to identify and ensure the timely implementation of the key projects Europe needs along 12 priority corridors and areas. ***The third measure targeted European oil market*** which was heavily dependent on crude oil and diesel oil imports from Russia. In this respect EU intended to closely monitor issues requiring a more strategic coordination of the EU's oil policy: the dependence of the EU's refinery industry on Russian crude oil, the increased concentration in the Russian oil industry, and the increased ownership of EU refinery capacity by Russian oil companies, the refined products consumed in transport. It was deemed to be important maintaining competitive refining capacities in Europe to avoid overdependence on imported refined petroleum products and being able to process crude oil stocks with sufficient flexibility. Other key actions aimed at building an integrated internal market were planned to be carried out by the Member States and the European Commission.

5. Increasing energy production in the European Union aimed at reducing its dependency on particular suppliers and fuels, while also maximising its use of indigenous sources of energy. Due to the fact that indigenous energy production in the European Union had steadily declined for about 20 years it was necessary to increase the use of renewable energy, nuclear energy, as well as sustainable production of competitive fossil fuels. For renewable energy it was set the objective of 20% share in the final energy consumption for 2020. Resources like hydrocarbons and clean coal were also taken into account by exploitation of conventional oil and gas deposits in Europe, both in traditional production areas like the North Sea and in newly discovered areas like Eastern Mediterranean and Black Sea. Coal and lignite having a significant share in electricity generation in several Member States would have a long-term future in the EU if using Carbon Capture and Storage (CCS). Other key actions aimed at increasing internal energy production were planned to be carried out by the Member States and the European Commission.

6. Further developing energy technologies. The reduction of EU energy dependence required substantial changes to the energy system and also the development of new energy technologies for cutting primary energy demand, diversifying and consolidating supply options (both external and indigenous), while optimising energy network infrastructure to fully benefit from this diversification. New technologies were meant to improve the efficiency of buildings and local heating systems, to provide new energy storage solutions and optimise the management of grids. But significant investments from the EU and Member States in energy research and innovation were required based on the priorities set in the Horizon 2020 and also on the Integrated Roadmap of the Strategic Energy Technology Plan.

7. Diversifying external supplies and related infrastructure for Natural Gas

In 2013, 39% of EU gas imports by volume came from Russia, 33% from Norway and 22% from North Africa (Algeria and Libya), other sources counting for just 4%. Also at that time LNG imports from some countries like Qatar, Nigeria increased and peaked at about 20%. More diversified natural gas resources was considered a priority mainly based on new LNG supplies from Northern America, Australia, Qatar and new discoveries in East-Africa. Gas resources from the Caspian region and Central Asia (from Turkmenistan, Iraq and Iran) could also significantly contribute to the enlargement of the Southern Gas Corridor. ***Uranium and nuclear fuel*** were very important for nuclear power plants producing electricity at a low cost. The worldwide uranium supply market was stable and well-diversified but the EU was completely dependent on external supplies. At that time Russia was a key competitor in nuclear fuel production and was making investments in the

whole nuclear chain in Europe. But at EU level it was taken into account the possibility of fuel supply diversification as a condition for any new investment, to be ensured by the Euratom Supply Agency. Some key actions aimed at diversifying external energy supplies were established to be carried out by the Member States and the European Commission.

8. Improving coordination of national energy policies and speaking with one voice in external energy policy. Member States had to coordinate better important energy policy decisions, while decisions on energy mix being a national prerogative, the progressive integration of energy infrastructure and markets, the common reliance on external suppliers, the need to ensure solidarity in times of crisis, were considered fundamental political decisions on energy and they needed be discussed with neighbouring countries. The external dimension of EU energy policy was also a matter of common decisions of Member States. The European Commission supported several important objectives such as: the idea of an Energy Union, the international energy markets which are stable, transparent, liquid, rule based, the coordinated promotion of sustainable energy technologies across the globe, but particularly among emerging economies, engaging all neighbouring partners at all levels in order to enable their close integration into the EU energy market, also by means of Energy Community, the role played by summits with strategic partners, energy dialogues with major supplier countries, agreements with third countries in the field of energy, fully compliant with EU legislation.

The European External Action Service had an important role to play in integrating energy considerations into EU foreign policy and coordinating with Member State's foreign affairs ministries. Other key actions aimed at improving coordination of national energy policies and speaking with one voice in external energy policy were planned to be carried out by the Member States and the European Commission.

3. Energy Union and energy security

The energy union strategy (COM/2015/080), published on 25 February 2015, aims at building an energy union that gives EU consumers - households and businesses - secure, sustainable, competitive and affordable energy. Energy union is also one of the pillars or components of EU Economic Union, besides Banking Union, Capital Market Union, and Fiscal Union. Since its launch in 2015, the European Commission has published several packages of measures and regular progress reports (6), which monitor the implementation of this key priority, to ensure that the energy union strategy is achieved.

The energy union builds five closely related and mutually reinforcing dimensions: ***Security, solidarity and trust*** - diversifying Europe's sources of energy and ensuring energy security through solidarity and cooperation between EU countries, ***A fully integrated internal energy market-*** enabling the free flow of energy through the EU through adequate infrastructure and without technical or regulatory barriers, ***Energy efficiency*** - improved energy efficiency will reduce dependence on energy imports, lower emissions, and drive jobs and growth, ***Climate action, decarbonising the economy*** - the EU is committed to a quick ratification of the Paris Agreement and to retaining its leadership in the area of renewable energy, ***Research, innovation and competitiveness*** - supporting breakthroughs in low-carbon and clean energy technologies by prioritising research and innovation to drive the energy transition and improve competitiveness (European Commission b, 2015)

The last two reports evaluating the progress of Energy Union were launched in October 2020 and October 2021 and in the following sections of our paper we will show their conclusions on EU energy security.

3.1. Fifth report on the state of the energy union-energy security

The COVID-19 crisis has exerted a considerable stress on energy demand affecting its volume and also consumption patterns, but Member States' preparedness had proved robust and ensured continuity of essential operations. The Energy Union legislative framework on energy security – in particular, the Regulation on Risk Preparedness in the electricity sector and the Regulation on Gas Security of Supply – had an important contribution in managing the impacts of the crisis in the energy sector. In June 2020 the Commission published good practices and lessons learned for the energy sector. The expert groups created by EU legislation played a key role in facilitating cross-border coordination alongside with the extensive cooperation and information sharing between the Member States, system operators and relevant agents in the energy sector. The Commission was assessing potential vulnerabilities and options for improving the resilience of critical supply chains for energy technologies. Strengthening the resilience and cybersecurity of critical energy infrastructure had been highlighted by the pandemic and the European Commission had started to work on a network code to ensure the cybersecurity of cross-border electricity flows.

The Risk Preparedness Regulation in the electricity sector ensured bilateral cooperation between Member States in order to prevent, prepare for and mitigate electricity crises. Two new methodologies have allowed the European Network of Transmission System Operators for Electricity (ENTSO-E) to identify the most relevant regional electricity crisis scenarios and carry out the first seasonal adequacy assessment for the summer 2020 based on a new methodological approach (the Summer Outlook 2020) and this was intended to serve as a basis for preparing national scenarios and Member States' risks preparedness plans. The Commission adopted a recommendation on fair compensation for Member States when they provide each other with assistance to prevent and manage crises (European Commission c, 2020).

Figure no. 1: Energy Union is based on 5 dimensions

Source: Author's own contribution based on EC Communication.

Infrastructure is the key for a market to function properly and efficiently and the EU had set electricity interconnection capacity targets but eight Member States had not met the 10% interconnection target for 2020. Interconnection projects were meant to support Member States' decarbonisation efforts and lay the foundation for hydrogen lead markets in Europe, based also on financial contribution from the Connecting Europe Facility and actions in the framework of the Recovery and Resilience Facility aiming at integrating clean technologies and renewables through modernised networks and enhanced interconnectivity. Efforts were made to ensure full use of existing interconnectors and operational digital platforms. Implementing the provisions related to internal electricity market design and, in particular, the rollout of market coupling had seen a large increase in the efficiency of electricity trading in Europe

On the security of gas supply, Member States have prepared preventive action and emergency plans, containing measures for mitigating the impact of a gas supply disruption and risks identified at national and regional level. The Commission continued to help Member States implement the solidarity principle for ensuring uninterrupted gas supplies to the most vulnerable consumers even in severe gas crisis situations. The Commission had assessed experiences with current legislation on the safety of offshore oil and gas operations and intended to submit its report to the European Parliament and Council during autumn 2020. On nuclear safety and security, the EU has a comprehensive framework that covers the full nuclear life cycle, including the safe and responsible management of spent fuel and radioactive and European Commission continued to carefully monitor the implementation of this framework in Member States. The EU had also continued to promote high levels of nuclear safety outside the EU, particularly in neighbouring countries that operated or planned to build nuclear power plants by supporting them in conducting stress tests and following up to promote proper and transparent implementation of recommendations.

3.2. Sixth report on the state of the energy union- enhancing energy security and safety

A continued high reliance on imports of fossil fuels exposed the Union's economy to global price fluctuations hence improving its resilience required enhancing energy security and safety while phasing out fossil

fuels and integrating more decentralised renewable energy. The EC Communication "Tackling rising energy prices: a toolbox for action and support" provided mid- and long-term measures to ensure this. In 2021, two large-scale technical incidents were resolved within one hour, proving the resilience of the EU's energy system despite the persistence of COVID-19 pandemic and this demonstrated that the effective preparedness for possible shocks was an ongoing need at Member State and EU level. The increased net energy import dependency, which reached 60.6 % in 2019, the highest level for the last 30 years was explained by the combination of a slight increase in energy demand and reduced domestic production of fossil fuels and the relatively reduced level of domestic renewable capacities.

The sectorial European coordination groups (for electricity, gas and oil) played an important role in 2020 and 2021, in monitoring security of supply, and especially the impact of delays in the maintenance of power plants due to COVID-19 related measures and discussing possible reactions to extreme weather events. In the electricity sector, the implementation of the risk preparedness regulation was in the run-up to the first set of national risk-preparedness plans containing Member States' measures to prevent, prepare for, and mitigate potential electricity crises in mutual cooperation, taking account of increasing electrification. In the context of the latest security of supply rules for gas, all but two Member States had put in place national plans to prevent or mitigate the impact of gas supply disruptions. Member States made progress in concluding bilateral solidarity arrangements aimed at securing cross-border supply to vulnerable customers in the event of severe crisis. The Commission planned a revision of the gas security of supply regulation in December 2021, for facilitating access to storage capacity across borders, including for renewable and low carbon gases. Gas storage levels and the proper functioning of the gas market were monitored ahead of the winter season. Continued improvements in electricity and gas interconnectivity had also enhanced regional cooperation and reinforced the security of supply at EU, Member States and regional level (European Commission d, 2021).

The EU was prepared for potential temporary disruptions in oil supply. In order to ensure the safe operations of the existing EU offshore oil and gas installations, the Commission and the Member States have cooperated closely to update external emergency plans. Cybersecurity threats and vulnerabilities may affect the energy system and European Commission had started work on a network code to ensure the cybersecurity of cross border electricity flows and planned to adopt the code by end of 2022. In December 2020 the European Commission proposed two new directives related to EU Security Union Strategy to improve the resilience of the energy sector focused on the resilience of critical entities and on the security of network and information systems. Thematic Network on Critical Energy Infrastructure Protection is a forum re-launched by EC for regular discussions among operators and owners of critical energy infrastructures. EC updated the Industrial Strategy in May 2021, in order to accelerate the green and digital transitions and also for strengthening the EU's resilience and strategic capacities. Industrial alliances were seen as an instrument for facilitating stronger cooperation and joint action between all interested partners in sectors of strategic importance. EC published a study in October 2021 for identifying potential bottlenecks in the raw materials supply chains for energy technologies that are critical for energy security and the clean energy transition.

In the nuclear sector, EC was working closely with Member States' nuclear safety regulators to monitor potential impacts of the pandemic on the safety of nuclear installations and found no adverse impacts on their safety or reliability. EC was funding a study to review how the sector managed the pandemic, and ensured its resilience under such severe conditions. There were potential risks relating to extreme natural hazards, like those from flooding or severe weather, but EU nuclear power plants proved to be very robust against external events, as was revealed by the post-Fukushima stress tests conducted in cooperation with the Commission. The Nuclear Safety Directive required licence holders to conduct periodic safety reviews with a view to identifying further safety improvements, taking account of operating experience.

4. European countries need to overhaul their energy security strategies

After the adoption of Energy Security Strategy and the creation of Energy Union, the EU had increased its ambition to become the world's first net-zero emission region and built up massive amounts of renewable energy, undertook huge investments in green hydrogen, and had been adopting a new energy policy to discourage the consumption of fossil fuels and finally in December 2019 launched the European Green Deal (Irina Slav, 2022). While the focus in EU energy policy has shifted from ensuring security of supply, the first dimension of Energy Union, to climate action and decarbonising the economy, the fourth dimension of Energy Union, two powerful shocks hit the global economy since 2020, the first that of the COVID-19 pandemic, the second was the war in Ukraine.

The process of energy market liberalization and transition within EU, based on five legislative packages, the fifth in 2019 (Clean Energy Package), overlapped with two major issues: energy security and climate change, both involving public interventionist policies. The collapse of hydrocarbon demand and prices in spring 2020 was followed by a relatively quick recovery of global economy in the second half of 2020 and in 2021, which produced a supply shock and an energy crisis in Europe, where the prices of natural gas and electricity exploded. But not only the gap between demand and supply led to this phenomenon but also the speculative nature of liberalized markets, due to their excessive financing, and the green energy transition from pollution sources based on fossil fuels to renewable sources (Mocearov, 2021).

After Paris Agreement had been concluded with the objective of reducing the rise in global average temperatures by 1.5 or 2 degrees Celsius from pre-industrial levels, a frantic race started in well developed economies for installing more wind turbines, more solar panels, and more storage capacities, and produce more electric cars, all requiring huge funds and investments. China became the most important producer and exporter of wind turbines and solar panels, but in the developed countries domestic production hardly depends on supply chains, on metals and products supplied by emerging economies.

In 2016 a new alliance OPEC+ was formed to include two of the three largest oil producers—Russia and Saudi Arabia, and also some Central Asian oil producers, like Kazakhstan and Azerbaijan. This expanded cartel became extremely important in the last two years and just before the pandemic really blew up the Russians and the Saudis engaged in a brief price war, but after that the alliance proved very effective in limiting its supply and fuelling a steady price increase. But no energy transition is possible without the raw materials/fossil fuels, like hydrocarbons and coal, supplied by OPEC+ and other countries. While U.S. shale drillers and Canadian producers cannot boost oil and natural gas production very fast, EU domestic hydrocarbon production was on a downward trend, and EU has been trying in vain to cut its consumption of fossil fuels because renewable energy depends a lot on the weather conditions, having an intermittent character. In the first part of 2021 the wind energy production has been quite low in Europe, the electricity consumption was on the rise and the EU was facing a growing electricity cost burden due to the high price of natural gas. In the EU there are three markets that influence each other in terms of prices: the electricity market, the gas market, the carbon market.

The EU has not yet emerged from the energy crisis when the war in Ukraine broke out and when EU energy prices have skyrocketed and remained at very high levels in March, April and May 2022. European politicians have been active in punishing Russia for Ukraine with, so far, six rounds of sanctions that have hurt the EU more than they have hurt Russia and led to very high prices for oil and natural gas, industries in EU are warning they might have to close if the EU would ban Russian gas or if Russia decides to turn the tap off in retaliation, and people are going to protest. It was not Russia but Ukraine who stopped the flows from one entry point in Eastern Ukraine on May 11, 2022 and Gazprom said it was technically impossible to reroute gas flows to Europe via Ukraine. Brussels officials proposed oil and gas sanctions, and voted for a ban on Russian coal imports to take effect in August. Russia supplies 45% of Europe's thermal coal, used for electricity and heat generation. The EU is now trying hard to find a replacement, while the world's biggest coal exporter Indonesia is hiking its prices massively and Australia, another coal giant, is warning it will not have enough for Europe. On the other hand EU plan to ditch Russian gas may cost $ 214 billion more than planned. Replacing Russian oil, gas and coal will not be an easy task for EU Member States, although EU and International Energy Agency tried to find together some measures to cut the dependence of Member States on Russian hydrocarbon imports. It was the 10-point IEA plan, launched on March 3, 2022, that covers the gas supply, electricity system and end-use sectors, and could lead to a reduction in imports from Russia by 50 billion cubic meters per year (1/3). On March 18, 2022 IEA launched a 10-point plan to reduce oil use with the support of 10 actions that can be taken to cut oil demand by 2.7 million barrels a day within four months. In the table no.1 one can see the EU energy mix and the share of imports from Russia in 2020.

Table no.1: EU energy mix and the share of imports from Russia in total imports in 2020 (%)

Resource	**Energy mix**	**Imports from Russia**
Total petroleum products	34.5	25.7
Natural gas	23.7	41.1
Renewable energy	17.4	-
Nuclear energy	12.7	-
Solid fossil fuels	11.5	52.7 (hard coal)

Other	0.2	-
Total	100.0	-

Source: Eurostat, 2020 (https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_energy_mix_and_import_ dependency&stable=1#EU_energy_dependency_on_Russia).

For a very long time EU energy policy has been confronted with the dilemma of focusing on energy independence or on energy security, which also implies a certain degree of independence, but in no case an excessive dependence on imports of resources. In the case of EU the environmentalists crushed not only any ambitions related to energy independence by promoting bans on nuclear energy and natural gas development but also imposed an energy transition based on interventionist policies, meant to develop renewable resources, like solar and wind, which are necessary but volatile and intermittent and need backup from nuclear, hydro, and natural gas for the security of the energy supply. Renewable energy storage is also virtually impossible, as one cannot build an industrial-size network of enormous batteries, the cost would be prohibitive and there would be a high demand for large imports of materials, such as lithium A battery energy storage system of Europe's size would cost more than $2.5 trillion, according to a MIT Technology Review paper (James Temple, 2018).

In 2021 economic recovery induced a high inflation due to the large gap between demand and supply for many products. The energy crisis was caused by insufficient gas supply, the soaring cost of CO2 permits and the boom of whole electricity prices. EU is in a co-dependency position with Russia in the field hydrocarbons. For replacing Russian natural gas (150 billion cubic meters) the alternatives are much more expensive and a bit difficult to achieve, as liquefied natural gas from Norway, USA, Algeria, Qatar, Israel needs buiding more terminals and much more LNG vessels. For their economic survival European countries should have diverse and cheap sources of energy supply, like nuclear energy, indigenous gas reserves, other competitive resources, otherwise European industry and consumers may collapse due to the rising cost of energy. It we want cheap and abundant energy in Europe, one cannot blame too much nuclear, coal, gas, and oil for polluting effects and one cannot promote interventionist policies which entail a higher cost for all consumers. Fossil fuels cannot be fully substituted with renewables that are intermittent, volatile, and unpredictable. Installing renewables involves a huge cost to networks, it is estimated that fixed cost of networks will increase by the $150 billion. Germany invested massively in renewables (doubling bills for consumers), spending more than $200 billion on subsidies, but now by reactivating coal power plants it depends more on lignite and Russian gas to guarantee supply (ZeroHedge a, 2022).

In May the EU announced its intention to ease environmental regulations in order to replace Russian fossil fuels with renewable energy and imported hydrogen. The draft obtained by Financial Times calls for the acceleration of wind and solar projects without the need for an environmental impact assessment across the EU's 27 member states, as lengthy and complex administrative procedures are a key barrier for investments in renewables and their related infrastructure (ZeroHedge, b, 2022). The war in Ukraine has sped up the EU's transition to renewable energy with the objective to cut emissions by at least half by 2030 and have zero carbon emissions by 2050. On May 10th, Frans Timmermans, vice-president of the European Commission and responsible for the European Green Deal, indicated that imported or domestic produced hydrogen could be a substitute for Russian natural gas used by Europe's industrial countries: *"It's essential not just to reduce our carbon footprint, it's essential to keep our economy competitive. We need a new energy source for difficult to abate sectors. And hydrogen is that energy source"*. In his opinion the EU could produce 40% of electricity from renewable sources by 2030. The EC's draft was going to be released after a week and calls for a 30% increase in the rate of renewable project construction as due to the unprecedented geopolitical situation created by Russia's invasion of Ukraine and the skyrocketed energy prices, there is a need for coordinated and urgent action to accelerate the deployment of renewable energy. In another draft EC established strict guidelines for green hydrogen via electrolysis because its production usually includes the use of fossil fuel while green hydrogen has to use electricity from renewable resources. But replacing Russian fossil fuels and concentrating on wind and solar projects does not seem sustainable at all due to uncertain weather conditions, lack of wind and sun for some time, and also due to massive funds and long periods for building wind and solar farms, for which many turbines and panels must be purchased from import (ZeroHedge,b, 2022).

Russia's invasion of Ukraine raised the issue of EU high dependence on Russian gas and oil. Is Russia a reliable energy supplier or not? It can be a matter of debate, but due to this war it is a great concern over natural gas and oil supply to Europe which prompted the EU and the biggest economies in Europe dependent on Russian hydrocarbons to urgently overhaul their energy security strategies (Paraskova, 2022). Moving away from Russian gas could come at a very high price. Can EU survive next winter without Russian gas? Although European Commission believes that it is quite possible, this will be a major challenge for the EU and many European

economies, especially Germany, which imports half the gas it needs from Russia. Southeast European countries, some Central European countries and Russia's neighbours like Estonia and Finland, are 100% dependent on Moscow for their natural gas supply. The war in Ukraine has already cut off Russian gas supply not due to sanctions applies by the EU but due to military operations. For EU Member States ensuring energy security would mean giving up to Russian deliveries in the quickest way possible, even at a high economic price.

Some important leaders like German Chancellor Olaf Scholz and French President Emmanuel Macron have become tougher in relations with Russia, more favourable to sanctions and to a drastic reduction in their dependence on Russian imports. Italy has already found alternatives routes for gas from other suppliers such as Algeria and the Trans Adriatic Pipeline (TAP) from Azerbaijan. Other EU members are entirely dependent on Russian gas, and for those countries reducing that dependence would need a lot of EU and supra-government coordination and solidarity for decreasing their dependence on Russian hydrocarbons. In May European Commission has rewritten oil ban to give Hungary, Slovakia and Czech Republic more time. Hungary and Slovakia would get until the end of 2024 — an extra year on top of the original timetable — to comply with the ban. The Czech Republic, which also expressed concerns about the timescale proposed by Ursula von der Leyen earlier this week, will have until the end of June 2024 (Politico, 2022).

If the total annihilation of energy dependence on Russia is to be desired this year and next year, then it must be borne in mind that the EU should not become very dependent on China, from where gets the silicon, aluminium, rare-earths, copper, lithium, etc. necessary for the massive investments in renewables and from where it imports many wind turbines and solar panels. It is not possible to demonize nuclear energy and fossil fuels. It is not normal to have an effective energy transition without understanding the importance of energy security, especially security of supply, and economic competitiveness. All resources- wind, solar, hydro, oil, natural gas and nuclear- are important for avoiding any energy crisis and not to severely erode economic competitiveness and social welfare. It is a nonsense to maintain the hidden tax scheme for CO2 emissions during an energy crisis and to apply border taxes on oil products and natural gas, which are not taxing producers but are taxing consumers in European countries. Any energy transition must be competitive, cheap, resilient, based on all resources and all technologies, bringing more competition and efficiency and less ideology (ZeroHedge a, 2022).

5. Conclusions

Nowadays there are some dilemmas that are very difficult to solve: to choose between energy security and energy independence, to choose between fast developing renewable resources or preserving fossil fuels for a long time, to establish the number one priority in energy policy: if energy security is predominant or decarbonising the economy, to use integrated plans or sectorial strategies in approaching energy policy, to adopt a moderate fiscal system or one based on very high levels with environmental budgetary and social implications.

What environmentalists have done in Europe during the last years, and mainly after Paris Agreement and the European Green Deal adoption, led to soaring energy costs and more dependence on hydrocarbon imports, especially from Russia, and the emergence of an energy crisis, with a strong impact on natural gas and electricity in 2022. Energy market and price liberalization did not support the increase of domestic fossil fuels supply while interventionist policies were meant to speed up energy transition and the fast development of renewable resources, which are necessary but volatile and intermittent and need backup from classical resources. In our opinion it was a great mistake to promote bans on nuclear energy and natural gas development, thus contributing to a short supply of energy resources. With a share of only 7 or 9% in the global CO_2 emissions, the European Union has set out to save the planet from global warming without the participation of other major players, such as those from Asia (China and India), as evidenced by the results from COP 26, held in Glasgow.

Facing the shock of COVID-19 pandemic and the impact of energy crisis, EU is now confronted with the harsh consequences of Russia’s invasion in Ukraine, which not only led to skyrocketed prices of oil and natural gas but also revealed the high dependence on Russian exports of fossil fuels. The six rounds of sanctions adopted by EU have hurt the EU as well as Russia and led to very high prices for oil and natural gas and may cause a lot of troubles to industry and population. A very limited global supply of LNG, oil and coal led to very high international prices and on short and medium term it is considerably more difficult to find viable and efficient supply alternatives for the EU. Frans Timmermans, Vice-president of the European Commission and responsible for the European Green Deal, thinks that imported or domestic produced hydrogen could be a substitute for Russian natural gas and accelerating the development of renewable resources may reduce the dependence on imports. But we believe this will be a long term process because the quick replacement of fossil fuels imported

from Russia and development of wind and solar projects does not seem sustainable under the present circumstances.

Reducing the dependence of MS on Russian fossil fuels would need a lot of EU and supra-government coordination and solidarity for decreasing their imports and also some powerful support of foreign partners. EU must use for a while all available domestic resources, like nuclear and fossil fuels, even if the latter have a high impact on the environment. On the other hand it is important that EU should not become too dependent on China for products needed in renewable energy production, raw materials or processed products, like wind turbines and solar panels. A new energy security strategy is needed both at EU level but also at national levels where there are integrated national energy and climate plans (NECPs) covering a ten year period (2021-2030) introduced by the Regulation on the governance of the energy union and climate action (EU)2018/1999, agreed as part of the Clean Energy for All Europeans package which was adopted in 2019. A rapid end of war in Ukraine may change for better energy situation in the EU if an honourable peace will be reached sooner or later and this destructive and disturbing war will not continue for a long period.

References:

[1.] Cernat, M. (2021). EU energy policies - who wins and who loses? Maria Cernat in dialogue with Andrei Mocearov on energy prices, Baricada, 24 October;

[2.] European Commission, a (2014). Communication from the Commission to the European Parliament and the Council- European Energy Security Strategy /* COM/2014/0330 final */;

[3.] European Commission, b (2015). Energy union,COM/2015/080, Brussels, February 25;

[4.] European Commission, c (2020). Fifth state of the energy union report, October;

[5.] European Commission, d (2021). Sixth state of the energy union report, October;

[6.] Eurostat (2020). https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2a.html;

[7.] Eurostat(2020).https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_energy_mix_ and_import_ dependency&stable=1#EU_energy_dependency_on_Russia;

[8.] Temple J.**,** (2018). The $2.5 billion reason we can't rely on batteries to clean up the grid**,** MIT Technology Review, July 27$2.5 trillion reason we can't rely on batteries

[9.] Paraskova T.**(**2022). Europe Is Rushing To Overhaul Its Energy Security Strategy, Oilprice.com, March 08;

[10.] Barigazzi J., Kijewski L. and Moens B. (2022). EU rewrites oil ban to give Hungary, Slovakia and Czech Republic more time, Politico, May 6;

[11.] Slav I**.** (2022). The West Is Suffering The Consequences Of Poor Energy Decisions, Oilprice.com, April 10;

[12.] ZeroHedge, a (2022) Environmentalists Are Crushing Europe's Energy Independence Ambitions, Oilprice.com, April 10;

[13.] ZeroHedge**,** b (2022). What Does The EU Need To Do To Wean Itself Off Russian Fossil Fuels?, Oilprice.com, May 10.

EU Policies to Combat the Energy Crisis

PAUL CALANTER
European Studies Center, Institute for World Economy
Romanian Academy
ROMANIA
paul.calanter@yahoo.com

DANIELA ZISU
SC Cepstra Grup SRL
ROMANIA
daniela.zisu@cepstra.ro

Abstract: The European Union is facing a complex geopolitical crisis, which represents a threat to its energy security. Having this in mind, EU must redouble its efforts to become energy independent, focusing on renewable energy. In the following paper, we intend to analyze the measures that the Union wants to take in order to combat the energy crisis. Therefore, it will be analyzed the situation of nuclear energy and natural gas in the EU, given that these were the two technologies with the greatest contribution to electricity generation. At the same time, in the paper we will examine the REPowerEU plan, which the Commission wants to develop, in order to support sources of electricity supply, improve energy efficiency and to make the switch to renewable energy faster. The purpose of these actions is to gradually eliminate gas imports from the Russian Federation and also the EU's dependence on fossil fuels and would function as an insurance against the shocks of prices. Also, at the end of the paper, we will expose small-scale energy solutions that can be applied in residential areas but also large-scale solutions that can significantly contribute to reducing dependence on fossil fuels.

Key-words: energy crisis, renewable energy sources (RES), policies, climate change

JEL Classification: Q28, Q48, Q54

1. Introduction

Although the economy of the European Union has slowly started to recover from the pandemic, new and old crises are looming. The EU needs to be aware of the energy price situation, which is mainly due to market gas instability rather than carbon prices, and stable cooperation between governments and institutions is needed to find common solutions to support families and businesses affected by price increases.

In this situation, and also in addition to the inflation of energy prices, EU is currently facing a complex geopolitical crisis, which is not only a threat to the energy transition strategy, but also to the essence of its energy security. A society that does not have access to reliable energy is in danger in terms of social and economic progress, and this concern affects the whole Europe, not only EU. In order not to erase the Energy Union, it is very important to propose a common EU solution to this problem in order to stay away from the elaboration of a series of uncoordinated national measures (Starace et al., 2022).

High dependence on gas imports is one of the EU's biggest problems. Member States depend on gas in different ways, but the interconnectedness of gas markets is now leading to overdependence in some Euro Zone countries. The long-term goal of the EU should be independence from fossil fuels.

But in the short-medium term, the European Union needs to get a certain degree of independence and to keep away from disruptions from only one supplier, as evidenced by the current rise in energy prices: recent gas shortages have led to higher prices, driving up prices for electricity on the market last fall and winter. The EU may have the temptation to take short-term measures to deal with the energy price crisis and deal with geopolitical risks.

But a return to oil, gas or even coal is not the right answer to guarantee the energy independence of the EU in the medium and long term. On the contrary, with the threat of a climate emergency, the urgency of the

transition to a zero emissions Union is becoming more urgent. In this context, the EU's energy transition must also become an economic and security issue that can sustain the European economy for years to come.

2. The causes of the energy crisis

Europe has to redouble its efforts in order to achieve energy independence by concentrating on RES. The current energy crisis has been mainly caused by the growing global natural gas demand and China's massive imports of LNG. It has also been exacerbated by Ukraine war, which has major implications for the energy security. Russia is undoubtedly one of the key players in the world energy market, along with Saudi Arabia and the United States. The invasion of Ukraine further demonstrated Europe's dependence on Russian gas and showed that diversification of energy supply is crucial for energy security.

Currently, the political problem for Europe is the supply of an adequate amount of energy at a price that can be afforded by all citizens, while RES are not sufficient to meet demand. An uninterrupted power supply must be provided for everyone at an affordable price, especially for the most vulnerable in society. This implies a front against speculative pressure of market actors, both at European level, with harmonized policies, and at national level, to achieve a balance between gas and electricity prices (Koundouri, 2022).

In the last five years, nuclear energy and natural gas have been the two resources that have contributed the most to electricity production. In 2021, 27% of the EU's electricity came from nuclear power plants and 17% from natural gas. That is why European leaders, in their efforts to ensure adequate energy resources while keeping costs low for consumers, have seen in these energy resources an alternative to low-cost energy, using existing infrastructure and existing knowledge. On December 31st 2021, the European Commission sent to the governments of the Member States an additional draft of the EU classification, which included nuclear energy and natural gas, granting them a consultation margin of four months. But these technologies are not "clean". Natural gas has a significant impact on the environment, exacerbating the effects of climate change, while nuclear power produces toxic waste that is dangerous to the ecosystem and health.

The EU taxonomy is a list of economic activities that are in line with six environmental objectives, namely: limit climate change, adapt to climate change, use and protect marine and water resources, transition to a cyclical economy, prevent and reduce pollution, protection and restoration of biodiversity and ecosystems. It is a valuable sustainable fundraising tool to help companies demonstrate the viability of their projects based on specific criteria, such as climate change mitigation and adaptation, marine protection, cyclical economics, pollution prevention and the protection of biodiversity. Including the nuclear energy and natural gas in the EU taxonomy has certain conditions towards the compliance with modern technical standards, demolishing installations and their replacement by RES in the future. However, in addition to the technical difficulties, they have high costs. Nuclear power plants will be considered sustainable only if they meet the latest technical standards, have received a construction permit for 2045, and the owners are obliged to finance the storage costs of the final radioactive materials, as well as the costs of demolishing the nuclear power plant. Sustainable labeling can only be extended for another two decades if plans are in place for the safe management of nuclear waste, but this is costly and difficult.

There are two options for natural gas, direct emissions must not exceed 270gr CO2/kWh for energy production and annual emissions from power plants must not exceed 550kg CO2/kW on average for the next 20 years, which supposes a reduction of the period of operation for production of the station on an annual basis. In order to obtain the license, new natural gas installations must demonstrate that it is not possible to produce electricity using RES, the plant replaces a high-emitting plant and the reduction in emissions/kWh is at least 55% and also the plant can produce low-carbon and renewable fuels at the same time, at least 30%, 55% and 100% starting in 2026, 2030 and 2036. In addition, there must be a formal plan for the country's coal phase-out.

From a financial point of view, given these long-term figures, it would be preferable if Europe accelerated the promotion of renewable energies, rather than labeling the use of nuclear energy and gas as "sustainable" activities, even if only on a temporary basis. It will have many benefits. In the first place, with existing technologies, the unitary cost for energy production from RES are lower compared to the costs for fossil fuel and nuclear energy production. This will offset the initial cost of RES installations in the long run. Secondly, RES would help achieve climate neutrality by 2050, a goal needed to address the catastrophic effects of climate change, while natural gas and nuclear power make things more difficult. In addition, the use of RES would make Europe autonomous from the point of view of the energy supply. The current energy crisis and the important role of

countries like Russia, China and India in shaping the energy market show how important independence is in the face of geopolitical pressure.

Research can make a decisive contribution to the energy transition through the appropriate transformations. It can offer effective ways to divert polluting energy systems towards zero emission systems through the development of renewable energy sources such as solar power, wind, battery storage, hydrogen, electric vehicles and more. However, the transition to sustainability, along with the elimination of fossil fuel energy production, requires other transformative steps in areas such as the circular economy, electricity transmission, improving the energy efficiency of buildings, the implementation of nature-based solutions to preserve more carbon dioxide in the soil or taking measures to adapt to changing climatic conditions.

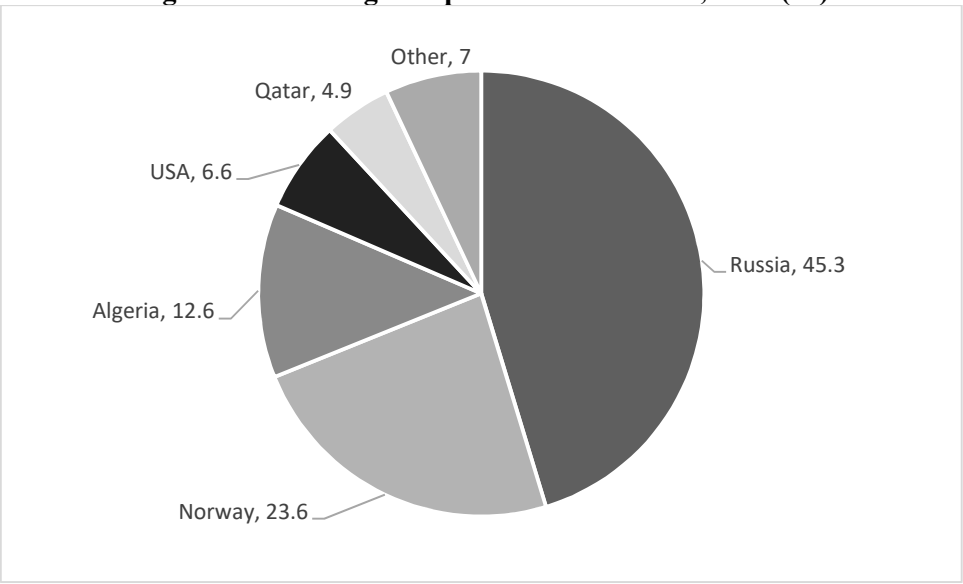
For the EU, in addition to political decisions at the central level, Member States must decide on the energy mix and the balance between energy security, energy price stability and their commitments to climate neutrality. The Green Deal is a cornerstone of carbon independence for economies. The clean and renewable energy industry must be supported by common recovery and sustainability mechanisms and be part of the economic recovery of the Member States.

In the EU, the societies are interconnected and the economic policies is unique. That is why there must be actions that protect our societies and support the national economies. In an issue as important as the energy crisis, there should not be considered the level of preparedness for the response at the Government level. No country can deal with such a crisis on its own. Rather, a common response is needed through a common strategy for energy security in the EU. Time is running out, the goal is elusive, and delay will cost lives and billions of euros each year in infrastructure damage and economic disruption. The Green Deal and its policies may be the best guarantee for the economy to become a carbon free one.

3. REPower EU

Since the Russian invasion of Ukraine, the need for a rapid transition to clean energy has never been louder and clearer. The EU imports 90% of its gas consumption, with Russia supplying more than 40% of the EU's total gas consumption (Figure 1). Russia also accounts for 27% of the EU's oil imports and 46% of its coal imports.

Figure 1: Natural gas import share in the EU, 2021 (%)



Source: Authors according to the European Commission database, 2022.

The EU must be prepared for each scenario. The Union could become independent of Russian gas long before the end of the decade. The sooner and more decisively EU diversifies its supply sources, accelerates the application of green energy technologies and reduces energy demand, the sooner it can replace Russian gas.

Constantly high energy prices are likely to lead to increased poverty and affect the competitiveness of companies. Energy-intensive industries, in particular, have faced higher production costs. High energy prices translate into higher prices for other goods, especially food. The combination of rising energy and transportation

prices and rising food prices would exacerbate pressure on low-income households where the risk of poverty is high (EC, 2022). To deal with the current emergency, the Commission will examine all possible urgent measures to limit the effect of the dispersion of gas prices on electricity prices, such as temporary maximum prices. The Commission will urgently consult with all actors and propose options.The Commission reaffirms the possibility of regulating prices and implementing transfer mechanisms to help protect consumers and European economy. The legal framework of the electricity market, in particular Article 5 of the Electricity Directive (2019/944), allows Member States, under the current exceptional circumstances, to set retail prices for households and micro-representatives. The EU's state aid rules give Member States the opportunity to provide short-term support to businesses and farmers affected by high energy prices and help reduce their exposure to energy price volatility through medium and long term.

Phasing out EU's dependence on fossil fuels imported from Russia could be achieved well before 2030. To this end, the Commission proposed a REPowerEU plan that would increase the sustainability of the EU's two-pillar energy system, diversify gas supply and reduce the dependence to fossil fuels faster. Full implementation of the proposals under the „Fit for 55" legislative package would reduce the EU gas consumption by 30% in 2030, equivalent to 100 billion cm.

The principle of "energy efficiency first" is more relevant than ever and must be applied in all sectors and policies, with consumer response measures complementing those on the supply side. Under the current circumstances, the co-legislators may also consider setting more ambitious targets than those set out in the "Fit for 55" legislative package proposals, setting higher or faster targets for renewable energy and energy efficiency. The Commission proposed a REPowerEU plan based on the identification, in dialogue with Member States, of the most appropriate projects and reforms, at national, regional and EU level. This is based on the National Energy and Climate Plans and their updates, existing Recovery and Sustainability Plans (SRPs), Cohesion Policy Programs and all other relevant plans, as well as climate sustainability needs.

An unprecedented supply of liquefied natural gas to the EU in January 2022 ensured gas supply security last winter. The EU could import 50 billion cm more LNG per year (eg Qatar, USA, Egypt and West Africa). By diversifying pipe import sources (eg Azerbaijan, Algeria, Norway), another 10 billion cm could be delivered annually, which would no longer be imported from Russia. Doubling the target of the „Fit for 55" legislative package on biomethane would lead to a production of 35 billion cm per year by 2030. To this end, the CAP Strategic Plans drawn up by Member States should focus financing on biomethane produced from sustainable biomass sources, including, in particular, agricultural waste and residues, and also household garbage.

The Commission will prioritize the assessment of the need for measures and investments in hydrogen-ready gas infrastructure and interconnections in order to remove barriers to the full use of the EU's liquefied natural gas capacity. An additional 15 million tonnes (mt) of renewable hydrogen, on top of the 5.6 million tonnes (mt) provided by the „Fit for 55" legislative package, could replace annualy 25-50 billion cm by 2030 of gas imported from Russia. This figure would consist of an additional 10 mt of hydrogen imported from various sources and an additional 5 mt of hydrogen produced in Europe, exceeding the targets set in the EU Hydrogen Strategy and maximizing local hydrogen production.EC will develop the regulatory framework to promote the European hydrogen market and support the development of integrated gas and hydrogen infrastructures as well as hydrogen storage facilities. The Commission will give priority to the evaluation of state aid notifications for hydrogen projects and will commit to complete the evaluation of the first hydrogen projects of common European interest within 6 weeks of the notification to the Member States. The overall goal should be to allow the evaluation to be completed by the summer.

„Fit for 55" legislative package envisaged doubling the EU's photovoltaic and wind capacity by 2025 and tripling it by 2030, reducing annual gas consumption by 170 billion cm in 2030. By accelerating the installation of solar PV systems on roofs that would produce up to 15 TWh this year, the EU could save an additional 2.5 billion cm of gas. The Commission will present a communication on solar energy in June to help unlock the potential of solar energy as a major source of renewable energy in the EU. The Commission will contribute to the further development of the value chain for solar and wind power and heat pumps, while boosting the EU's competitiveness and addressing its strategic dependencies. If necessary to attract sufficient private investment, measures will include channeling EU funds to next-generation technologies and mobilizing support from InvestEU or Member States. Particular attention would be given to accelerating investment in retraining and upskilling the workforce, key elements in support of the transformation.

The Member States and the industry should continue to supervise the supply of critical and other raw materials, to promote strategic partnerships for security of supply and to consider taking other measures, such as strategic stocks where necessary. Doubling the projected annual rate of heat pump installation in the first half of

this period would lead to the annual deployment of 10 million heat pumps in the EU over the next five years. That would save 12 billion cm for every 10 million cm of heat pumps installed in homes.

The REPowerEU plan could accelerate the deployment of innovative and cost-effective hydrogen-based renewable electricity solutions in industrial sectors. The Commission would pre-implement the Innovation Fund to support the transition to electrification and hydrogen, including through a pan-European system of carbon contracts, as well as to increase the EU's capacity to produce innovative equipment with zero or low carbon emissions, as electrolysers, technologies for the production of solar/wind energy and other technologies.

A neccessary condition for accelerating the implementation of projects for RES is the simplification and shortening of the permitting process. Prolonged administrative procedures have been identified as one of the main obstacles to investment in RES and related infrastructure. The Commission requires Member States to ensure that the planning, construction and operation of renewable energy plants, their connection to the grid and the interconnected grid itself are considered to be in the public interest and that they meet the requirements for the most favorable procedure available in its planning and authorization procedures. Member States must quickly map, evaluate and ensure that suitable land and seas are available for renewable energy projects, in line with their national energy and climate plans, their contribution to the revised 2030 renewable energy target and other factors, including the availability of resources, network infrastructure and the objectives of the EU biodiversity strategy.

The Commission will also provide guidance on when and how regulatory sandboxes will be needed to enable the testing of innovative technologies, products or services to promote coexistence between the use of renewable energy sources and the protection of the environment. The guidelines will focus on setting limits on regulatory sandboxes, such as time, territory, and ongoing regulatory oversight, to minimize potential risks.

This year, EC and the EIB group will establish the most appropriate financing mechanisms to encourage the development of electricity purchase contracts in Europe, which is already possible within InvestEU. This will include facilitating better access to power purchase contracts for new buyers such as SMEs.

4. Clean energy solutions for reducing the energy dependence

Due to the difficult situation confronting EU, the Member States are looking for alternative clean energy solutions and reducing their dependence on fossil fuels. Given the war in Ukraine, reducing imported natural gas from Russia and achieving "strategic autonomy" has become a crucial goal. While big industries and strategic infrastructures need a long-term plan to establish a sustainable clean energy supply chain and massive reorientation of investments, there are already some big and small solutions that could help countries meet their emissions targets and eliminate energy imports in the short term.

In this section, we will present small-scale energy solutions that can be applied in residential areas, but also large-scale solutions that require more investments. All of these companies are European start-ups, some are at an early stage and others have already received significant investments. Given Russia's threat to cut off gas supplies, the EU is already in an energy crisis. Governments, but also ordinary citizens, must take action now and choose clean solutions that benefit both the environment and ultimately allow them to be energy independent.

In the EU there are a few start-ups which are inventing clean energy solutions that can support the limitation of the potential effects of the energy crisis. Some solutions that will be exhibited can be easily installed in residential buildings, others will require much more generous space. They all have the same target: clean energy without harming the environment (Du Besse, 2022).

Cyklone Tidal Energy decided to harness the power of waves to generate clean energy. According to Volker founder Osterlitz, offshore wind turbines will be damaged very quickly by natural elements. Therefore, Cyklone Tidal Energy believes that it would be much more efficient to use this kinetic energy from ocean waves to generate cheap power. According to the company, the energy generated by the Cyklone Tidal Energy turbines placed in the sea can produce energy at a low price (it would cost only 1 cent/kWh, compared to the price of diesel of 5 cents/kWh).

Enapter is a technology company based in Italy, with offices in Germany, Thailand and Russia. The company developed electrolysers that allow the production of green hydrogen. The electrolysis created by Enapter is modular and has a plug-and-play design and is already used for energy storage, mobility, heat, industry and fuel supply.

Enpal is a German startup that is launching an innovative scheme that allows homeowners to rent solar panels from the company instead of buying them. Since the cost of solar panels is a barrier for people interested

in installing them, Enpal can enable more people to access clean energy. The lease agreement between the client and Enpal includes meeting, maintenance and insurance. Consumers pay the rent for 20 years and after the period they can buy the panels for only 1 euro. Last year, Enpal received an investment of 250 million euros. They have more than 10,000 customers in Germany. Unfortunately, Enpal operates only in Germany, but there is great potential in this sector.

Grove Energy. With the growth of the electric vehicle market, it is becoming increasingly important to find clean energy solutions to charge these vehicles. Grove Energy's solution is an independent, decentralized network of small hydrogen-powered charging stations. They will be able to produce up to 2x22 kWh of electricity, allowing electric vehicles to be charged overnight.

Kraftblock. In some situations, the problem is not in the production of energy, but in making it smart and preventing the energy used from being wasted. Only about 60% of the energy in industrial products is used for the product itself. A percentage of 40% is represented by waste. Kraftblock technology allows the heat of the industrial process to be recycled, stored and converted into energy at the right time. There are some industries that require a lot of heat to function. Thanks to Kraftblock, the heat can be reused or converted into electricity. With Kraftblock technology, large factories can play an important role in preventing the energy crisis.

Mowea offers a unique modular design to harness the wind energy. It combines standardized micro wind turbines into a single wind power system. The system can be built according to customer needs and can be fully integrated with existing infrastructures. The company's greatest strength is represented by the viability of the installation. Its microturbines can be placed anywhere, even in confined spaces. An example is the Vantage Towers in Germany that has installed Mowea microturbines in 52 of its radio towers, and the turbines cover two-thirds of the power consumption at medium wind speeds.

Phelas. One of the important issues related to renewable energies is their periodicity. To solve this problem, Phelas built liquid energy reservoirs from the air for solar and wind power. Phelas system is based on the concept of liquid air storage: during the charging process, the air is cooled to cryogenic temperatures and liquefied. When power is needed, the cryogenic liquid heats up and evaporates. The strong growth in volume and pressure is used to generate electricity. Phelas could be crucial for storing additional energy from solar or wind power and reusing it when needed, and energy conservation is one of the key solutions to avoiding energy crises.

Windcity offers an alternative clean energy solution that could also be installed on rooftops. It is a wind turbine with an unconventional design, which allows greater acceleration with low speed winds compared to conventional wind turbines. Windcity wind turbines are made specifically for urban and suburban areas where sales flows do not generate enough energy for a conventional wind turbine. Windcity turbines can generate clean energy by rotating with vehicle flows. The italian company wants to apply this type of technology to watercourses. The unconventional design of wind turbines could also be integrated with solar panels to enable large-scale rooftop energy solutions.

Wind My Roof. Another solution to produce energy from wind sources for roofs is WindBox, manufactured by the French company Wind My Roof. This innovative solution allows the wind to blow into a module placed on the roof, where there is perfect exposure to the wind. WindBox can also have solar panels on top: the energy produced in this mix from the sun and sold has a very low carbon footprint.

X-Wind wants to challenge traditional wind turbines with its innovative kites, which are powered by high-altitude winds that drag power units located on the dedicated circular rail tracks. The X-Wind system is completely zero emissions, safe for animals and the landscape, while all that is visible are kites flying, instead of huge turbines.

5. Conclusions

The present energy crisis has led to an increased number of interventions in the energy market, but not in the gas market, even if gas prices are the main driver of electricity prices and certainly the selling prices of natural gas are not in line with the real costs. These interventions are aimed at trying to make quick profits on the part of electricity producers. They are often based on some misconceptions (Starace et al., 2022).

For example, they suggested that high spot prices could generate revenue for non-gas generators and vertically integrated companies. But they ignored the fact that a lot of energy does not receive the spot price or the daily price, because most electricity is sold in advance to consumers through supply contracts. The European Commission proposed guarantees and restrictions on the application of measures at the level of the Member States. But this may not be enough, and decisions must be implemented at the EU level. Indeed, these

uncoordinated market interventions distort and ultimately destroy the integrated electricity market, which is based on the formation of a common price rule for the entire European Union.

There are several specific measures that could be taken to keep prices low. With regard to structural measures, liquidity futures markets and long-term price signals need to be developed and play an important role in helping to minimize risks and facilitate investments. But the European Commission is currently considering options to temporarily limit the effect of gas prices on electricity. Experts believe that an EU-wide cap on gas prices is needed to return to the pre-crisis price. However, the real solution to the current price crisis will not be to change poorly made changes in the design of the electricity market or to generate additional income that does not exist. Structuring solutions should make it possible to speed up the implementation of flexible and zero-emission technologies. This is the only way to eliminate dependence on gas.

The zero emission European Union is a difficult process, and 2050 is just an investment cycle away. This energy crisis is the impetus to speed up the EU's energy transition. This process is irreversible. For example, technologies based on renewable energy sources must be implemented at a faster pace, guaranteeing licenses and procedures throughout the Union.

Under the REPowerEU plan, an additional 35 TWh could be generated through renewable energy projects by next year, reducing natural gas use by more than 6 billion cubic meters. This would also guarantee the special benefit of household electricity bills. Gas boilers should be gradually replaced with high-efficiency heat pumps and the development of a European clean heat industry should be supported. According to Franz Timmermans, the Union must double its percentage of heat pumps in the next five years, saving 20 billion cm of gas per year by 2026 and more than 60 billion cm per year by 2030 with 50 million heat pumps installed in the UE.

The equivalent of 25% of current EU gas imports from Russia could be saved by 2030 through the renovation and electrification of residential buildings in the EU, according to the European Climate Foundation. Interconnections and electrical infrastructure should be promoted to guarantee the flexibility and reliability of the system and to optimize the use of current resources. A Union that uses zero-carbon technologies, electrifies domestic heating and transportation, and diversifies fuels for heavy industry, is a more sustainable and independent Union.

Acknowledgement: This paper has been financially supported within the project entitled: "Support Center for IEM research - innovation projects competitive in Horizon 2020", ID 107540. This project is co-financed by the European Regional Development Fund through Competitiveness Operational Programme 2014 - 2020.

References:

[1] Du Besse, A., 2022, Europe's Energy Crisis: Small-scale Solutions To The Rescue. Available at: https://impakter.com/europes-energy-crisis-small-scale-solutions-to-the-rescue/

[2] European Commission, 2022, 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: REPowerEU: Joint European Action for more affordable, secure and sustainable energy. Available at: https://eur-lex.europa.eu/resource.html?uri=cellar:71767319-9f0a-11ec-83e1-01aa75ed71a1.0001.02/DOC_1&format=PDF

[3] European Commission, 2020, Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions: A hydrogen strategy for a climate-neutral Europe. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0301&from=EN

[4] European Commission, 2020, Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions: EU Biodiversity Strategy for 2030. Available at: https://eur-lex.europa.eu/resource.html?uri=cellar:a3c806a6-9ab3-11ea-9d2d-01aa75ed71a1.0001.02/DOC_1&format=PDF

[5] European Commission, 2021, Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions: 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021DC0550&from=EN

[6] 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

[7] European Parliament, 2019, Directive (Eu) 2019/944 Of The European Parliament And Of The Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0944&from=EN
[8] Koundouri, P., 2022, Lessons from Europe's energy crisis. Available at: https://sdg-action.org/lessons-from-europes-energy-crisis%EF%BF%BC/
[9] Starace, F., Lévy, J., Galán, I., 2022, Energy prices, geopolitical crisis and net-zero goals: a brave new Europe towards energy independence. Available at: https://www.politico.eu/sponsored-content/energy-prices-geopolitical-crisis-and-net-zero-goals-a-brave-new-europe-towards-energy-independence/

Renewable Energy during the Pandemic Crisis

DIANA-MIHAELA JULA
Ph.D. Student
School of Advanced Studies of the Romanian Academy (SCOSAAR)
Department of Economic, Social and Legal Sciences
diana.jula@yahoo.com

Abstract: In this paper, we studied, for Romania, whether the COVID-19 crisis induced significant changes in the pattern of electricity generation, both as total production and on different sources. We used data concerning the net electricity generation by types of fuels in the pre-crisis period (2006 - March 2020), during the state of emergency imposed in the context of the pandemic (March 2020 - May 2020) and over the state of alert (June 2020 - February 2022). As methodology, we estimated some econometric models with dummy variables applied Wald tests for the hypotheses that, in Romania, the electricity production patterns do not differ significantly in the states of emergency and alert compared to those recorded for the pre-crisis period. We found that during the state of emergency, if the dynamics were cleared by both autoregressive, seasonal and cyclical effects, as well as long-term trends, then only wind energy increased compared to the normal period (pre-crisis). During the alert period the patterns of electricity production returned to those of the period before the outbreak of the COVID-19 crisis for all generation sources.

Keywords: net electricity generation by type of fuel, renewable energy, COVID-19 pandemic

1. Introduction

During the pandemic energy demand has been influenced by declining in commercial activities and, in particular, by the drastic reductions in transport, tourism, entertainment and leisure activities and, of course, the blocking of supply chains (International Energy Agency, 2022). Although household energy consumption did not decrease, it could only partially compensate for the decline in other areas (Todeschi, et al., 2022). The electricity production has adapted to fluctuations in global demand.

There is a vast amount of literature that studies the impact of COVID-19 crisis on electricity production. Among these studies we mention Olabi, Wilberforce, Elsaid, Sayed, & Abdelkareem (2022) who analysed the impact of the pandemic on renewable energy in European Union, the United States, China and India, more specifically, on the process of "commissioning of RE projects", process that was "stalled due to lack of funding allocation and interruptions in the supply of equipment and components due to lockdown measures", affecting, in particular, solar and wind projects (p. 563).

Khanna (2021) discussed the impact of the "demand destruction", caused by the crisis, on "the beginning of the end for fossil fuels". In Khanna's words, the COVID-19 crisis could be "for the renewable energy industry ... a cloud with a silver lining". Hemrit & Benlagha (2021) also found "significant positive effects of the pandemic uncertainty on renewable energy index".

International Energy Agency (2021, p. 195) notes that, although the pandemic crisis "severely affected the global energy system", however "electricity proved to be more resilient than other energy sources. Global demand for electricity fell by only 1% in 2020". Vara (2021) claims that "COVID-19 brought a significant decline in energy generation using fossil fuel, while renewable power gained new momentum."

Radtke (2022) discussed a smart energy system in the post-crisis era. Nicola, et al. (2020) developed a review of the impact of COVID-19 on energy demand. Pastory & Munishi (2022), Salisu & Adediran (2020) and Shaikh (2022) analysed the influence of the pandemic on energy market volatility.

The impact of the COVID-19 crisis on renewable energy in European countries is presented in a Eurostat Report (Eurostat, 2021). Werth, Gravino & Prevedello (2021, p. 6) argue that in Europe, "energy generation by coal, oil and nuclear was reduced considerably, in favour of intermittent renewable sources and, in some countries, fossil gas." Other studies regarding the impact of COVID-19 on European renewable energy sector are Goddard (2020) and Kies, et al. (2021). Agdas & Barooah (2020), Au, Saldaña, Spanswick & Santerre (2020) studied the impact of COVID-19 on electricity sector in United States, Balest & Stawinoga (2022) in Italy, Bover, Fabra, García-Uribe, Lacuesta & Ramos (2021) in Spain, Mehlig, Simon & Staffel (2021) in UK. Luo, et al.

(2022) analysed the impact of COVID-19 on the green power sector in Netherlands. Wang, Huang & Li (2022), Lu, Liu, Xie & Xu (2021), Dong, Ji, Mustafa & Khursheed (2021) conducted a survey concerning the crisis impact on renewable energy in China. Shekhar, Suri, Somani, Lee & Arora (2021) studied renewable energy in India, during the pandemic.

For Romania, we mention the papers by Jula (2021a) and Jula (2021b), Iancu, Darab & Cîrstea (2021) and Soava, Mehedintu, Sterpu & Grecu (2021).

In this paper, we studied, for Romania, the impact of the COVID-19 crisis on the net production of electricity by types of fuels, in the pre-crisis period (2006 - March 2020), during the state of emergency imposed in the context of the pandemic (March 2020 - May 2020) and over the state of alert (June 2020 - February 2022). We tested whether the COVID19 crisis induced significant changes in the pattern of electricity generation, both as total production and on different sources.

2. Data and Methodology

We used monthly data concerning *net electricity generation by type of fuel* from Eurostat (table nrg_cb_pem, retrieved from https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en). Data of the Eurostat, in Gigawatt-hour (GWh), refer to total electricity generation, electricity produced from combustible fuels (renewable and non-renewable), coal and manufactured gases, natural gas, oil and petroleum products (excluding biofuel portion), hydro (pure, mixed and pumped hydro power), geothermal, wind (on shore and off shore), solar (thermal and photovoltaic), nuclear fuels and other fuels not elsewhere classified (n.e.c.).

Monthly electricity generation data by fuel types are available at Eurostat since January 2016. Given that the state of alert, generated by the COVID-19 pandemic, was lifted in Romania starting with March 9, 2022, we selected February 2022 as the end date of our analysis. In the Eurostat database, mentioned above, for Romania, there are no data reported on electricity produced from combustible fuels non-renewable, from mixed and pumped hydro power, geothermal, wind off shore, solar thermal and electricity from other fuels n.e.c.

As methodology, we used the econometric estimations of some models with dummy variables (Jula & Jula, Econometria seriilor de timp, 2019) and Wald tests for the hypotheses that, in Romania, the electricity production patterns do not differ significantly in the states of emergency and alert, compared to those recorded for the pre-crisis period.

3. Econometric models and results

3.1. Total electricity generation

For the time series *total electricity generation* (net electricity generation by all the sources), the standard unit root tests (Augmented Dickey-Fuller test, Phillips-Perron test, Dickey-Fuller GLS test, Elliott-Rothenberg-Stock Point-Optimal test, Ng-Perron tests) reject the null hypothesis of unit root at 5% level, in models with constant and linear trend as exogenous and the Kwiatkowski-Phillips-Schmidt-Shin test statistic do not reject the null of stationarity. Moreover, HEGY test (Hylleberg, Engle, Granger, & Yoo, 1990) rejects the unit roots for all seasonal frequencies, in the models with seasonal dummies. Based on these results, we accept the hypothesis that the series is stationary in the model with constant and trend (Figure 1).

We test whether or not electricity production during the COVID-19 crisis differs significantly from production in normal times.

We considered three periods (pre-crisis, state of emergency, state of alert) and built an econometric model as the following:

$$TEG_t = a_1 D_{2016m01-2020m02} + a_2 D_{2020m03-2020m05} + a_5 D_{2020m06-2022m02} + \\ + b_i D(month_i) + trend + cycle + e_t \qquad [Eq.1]$$

$$e_t \sim SAR(p)(P)_{s=12}$$

where

t – time index (t = 1, for 2016m01, i.e., January 2016, …, t = 74, for 2022m02, i.e.. February 2022)

TEG – total electricity generation

$D_{2016m01-2020m02}$ – dummy variable for pre-crisis period, with the value 1 between January 2016 – February 2020 and zero between March 2020 – February 2022.

$D_{2020m03-2020m05}$ – dummy variable for the state of emergency period, with the value 1 between March 2020 – May 2020 and zero otherwise (the state of emergency has been introduced on March 16, 2020 and ended on 14 May 2020)

$D_{2020m06-2022m02}$ – dummy variable for the state of alert period, with the value 1 between June 2020 – February 2022 and zero between January 2016 – May 2020 (the state of alert was in effect from May 15, 2020, until March 8, 2022)

$D(month_i)$ – dummy variables for each month. In order to avoid the perfect collinearity with the dummy variables introduced for the periods of pre-crisis, the state of emergency, the state of alert respectively, we dropped the dummies for January and December.

trend – polynomial time function

cycle – cyclic component (usually, four years)

$SAR(p)(P)_{s=12}$ – seasonal autoregressive process, with p - the order of the autoregressive part, P - the order of the seasonal autoregressive part and seasonality (s) = 12 months

e_t – error variable

$a_1 \ldots a_5$ – coefficients of the dummy variables

b_i – coefficients of the dummy variables for each month (i = 2, …, 11)

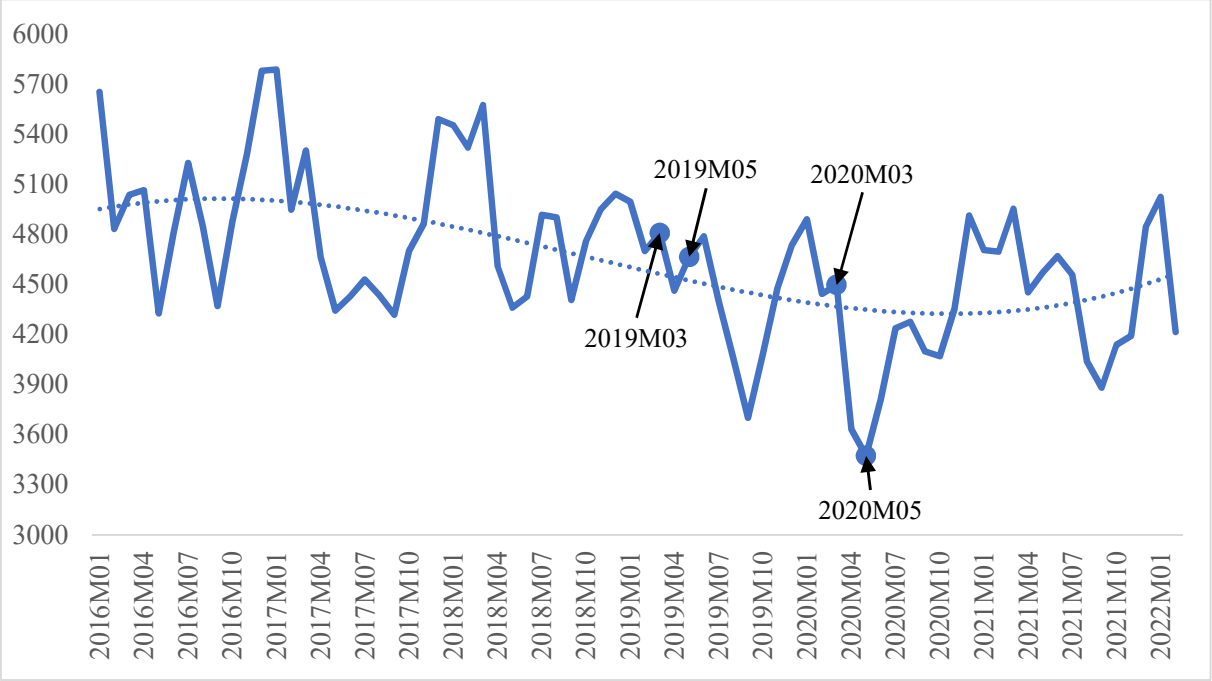


Figure 1. Total electricity generation

Source: Eurostat database (table nrg_cb_pem), https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en

The coefficient a_1 estimates the average, in normal times (before the pandemic), of total net electricity generation, if the dynamics were cleared by both autoregressive, seasonal and cyclical effects, as well as long-term trends. The a_2 estimates the average of production during the state of emergency, while a_3 evaluates the average during the state of alert. If the coefficients a_2 and a_3 differ significantly from the a_1, then the COVID-19 pandemic meaningfully affected the total net electricity generation.

Next, instead of considering the period of the state of emergency homogeneous, we detailed it by months. This version of econometric model is the following:

$$TEG_t = a_1 D_{2016m01-2020m02} + a_2 D_{2020m03} + a_3 D_{2020m04} + a_4 D_{2020m05} + a_5 D_{2020m06-2022m02} + b_i D(month_i) + trend + cycle + e_t \quad [Eq.2]$$

$$e_t \sim SAR(p)(P)_{s=12}$$

where

$D_{2020m03}$ – dummy variable for March 2020 (the state of emergency has been introduced since March 16, 2020)

$D_{2020m04}$ – dummy variable for April 2020 (April 2020 is the only month that has been fully covered by the state of emergency)

$D_{2020m05}$ – dummy variable for May 2020 (the state of emergency ceased on 14 May 2020)

and the other symbols are identical to those in the first model.

Here, the coefficients a_2, a_3 and a_4 estimate the average of production during each month from the state of emergency period, while a_5 evaluate the average during the state of alert. If the coefficients a_2, a_3, a_4 and a_5 differ significantly from the a_1, then the COVID-19 pandemic meaningfully affected the total net electricity generation. The estimators for both econometric models are in Table 1.

Table 1. Total net electricity generation

Dependent Variable: Total electricity generation

Variable	Coefficient (Std. Error)	[t-Statistic] Prob.	Variable	Coefficient (Std. Error)	[t-Statistic] Prob.
$D_{2016m01-2020m02}$	5584.684 (67.67495)	[82.52218] 0.0000	$D_{2016m01-2020m02}$	5585.596 (62.9910)	[88.67295] 0.0000
$D_{2020m03-2020m05}$	5387.135 (232.0771)	[23.21270] 0.0000			
			$D_{2020m03}$	5337.661 (338.9654)	[15.74692] 0.0000
			$D_{2020m04}$	5146.278 (271.9079)	[18.92655] 0.0000
			$D_{2020m05}$	5507.192 (257.0961)	[21.42075] 0.0000
$D_{2020m06-2022m02}$	5550.766 (148.1768)	[37.46043] 0.0000	$D_{2020m06-2022m02}$	5560.998 (138.3696)	[40.18944] 0.0000
cos(2πt/48)	-150.8561 (54.19134)	[-2.783768] 0.0074	cos(2πt/48)	-144.8918 (48.36602)	[-2.995735] 0.0000
t	-11.01293 (1.997918)	[-5.512200] 0.0000	t	-11.07255 (1.920959)	[-5.764074] 0.0247
AR(1)	0.387630 (0.102623)	[3.777235] 0.0004	AR(1)	0.395949 (0.099667)	[3.972700] 0.0002
AR(3)	0.366594 (0.128596)	[2.850736] 0.0062	AR(3)	0.362852 (0.137249)	[2.643748] 0.0108
AR(4)	-0.468397 (0.124169)	[-3.772238] 0.0004	AR(4)	-0.502631 (0.134169)	[-3.746249] 0.0005
SAR(12)	-0.595404 (0.120803)	[-4.928715] 0.0000	SAR(12)	-0.633361 (0.116832)	[-5.421106] 0.0000
Monthly dummy variables			Monthly dummy variables		
R-squared	0.887319		R-squared	0.895172	

Source: Econometric estimates based on Eurostat data (table nrg_cb_pem), on line at https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en.

All coefficients a_i are significantly different from zero, at the threshold $p < 10^{-4}$. The time series for total net electricity generation has a four-year cyclical component. For the first model, when the dynamics were cleansed of cyclical, seasonal, autoregressive and trend effects, the probabilities associated (in the Wald test) with the hypotheses that the coefficients in COVID-19 crisis periods do not differ significantly from those in pre-crisis time are 0.34 (for the state of emergency) and 0.75 (state of alert), respectively. Both probabilities are well above the standard threshold of 0.05! Besides, the probability associated with the hypothesis that all the coefficients are equals among them (i.e., statistically, $a_1 = a_2 = a_3$) is 0.63. This means that, taken as a whole, the electricity

generation patterns during COVID-19 crisis do not differ significantly from those in the pre-crisis period (Table 2).

Table 2. Wald test on coefficient equality in econometric equations of total net electricity generation

The null hypothesis: if the dynamics were cleansed of seasonal, autoregressive and trend effects, then ...	Probability	Obs.: Wald test for coefficients from …
Average of total net electricity generation during the state of emergency = average on pre-crisis period	0.338	Eq. 1
Average of total net electricity generation on March 2020 = average on pre-crisis period	0.447	Eq. 2
Average of total net electricity generation on April 2020 = average on pre-crisis period	0.088	Eq. 2
Average of total net electricity generation on May 2020 = average on pre-crisis period	0.745	Eq. 2
Average of total net electricity generation during the state of alert = average on pre-crisis period	0.749	Eq. 1
Averages of total net electricity generation in all periods are equal to each other	0.630	Eq. 1

Source: Econometric estimates based on Eurostat data (table nrg_cb_pem), on line at https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en

For a more detailed analysis, we divided the emergency period (March 16, 2020 - May 14, 2021) by months. Econometrically, we solved a model like the one described by equation 2. For this model, the probability associated in Wald test with the hypothesis that the coefficient of dummy variable for April 2020 ($\hat{a}_3 = 5146.278$) do not differ significantly from pre-crisis period (when the estimator is $\hat{a}_1 = 5585.596$) is 0.089. April 2020 is the only month that has been fully covered by the state of emergency. This means that, the average of total net electricity generation on April 2020 is significantly smaller than the average before the COVID-19 crisis, when the dynamics were cleansed of cyclical, seasonal, autoregressive and trend effects. For March 2020 and May 2020, the coefficients do not differ significantly for pre-crisis parameter (for March, this probability is 0.44, in Wald test and for May 2020, the probability is 0.74). Moreover, the pattern of production in state of alert returned to the pre-crisis standing: if we reject the hypothesis that, statistically, $a_5 = a_1$, then the risk of error is 0.80 (well above the standard threshold of 0.05!). This means that the COVID-19 pandemic negatively affected the Romanian total net electricity generation in April 2020 and did not significantly affect the pattern of production in the other months of the emergency and alert states. This finding is consistent with the International Energy Agency remark (International Energy Agency, 2021, p. 195) that, even if the pandemic crisis "severely affected the global energy system", however "electricity proved to be more resilient than other energy sources. Global demand for electricity fell by only 1% in 2020" (see also Jula, 2021b).

3.2. Electricity generation by combustible fuels

As in the case of total electricity production, discussed above, for the time series *electricity generation by combustible fuels* (Figure 2), the standard unit root tests (Augmented Dickey-Fuller test, Phillips-Perron test, Dickey-Fuller GLS test, Elliott-Rothenberg-Stock Point-Optimal test, Ng-Perron tests) reject the null hypothesis of unit root at 5% level, in models with constant and linear trend as exogenous and the Kwiatkowski-Phillips-Schmidt-Shin test statistic do not reject the null of stationarity. Moreover, HEGY test (Hylleberg, Engle, Granger, & Yoo, 1990) rejects the unit roots for all seasonal frequencies, in the models with seasonal dummies. Based on these results, we accept the hypothesis that the series is stationary, in the model with constant and linear trend.

We test if *electricity production by combustible fuels* during the COVID-19 crisis differs significantly from production in normal times.

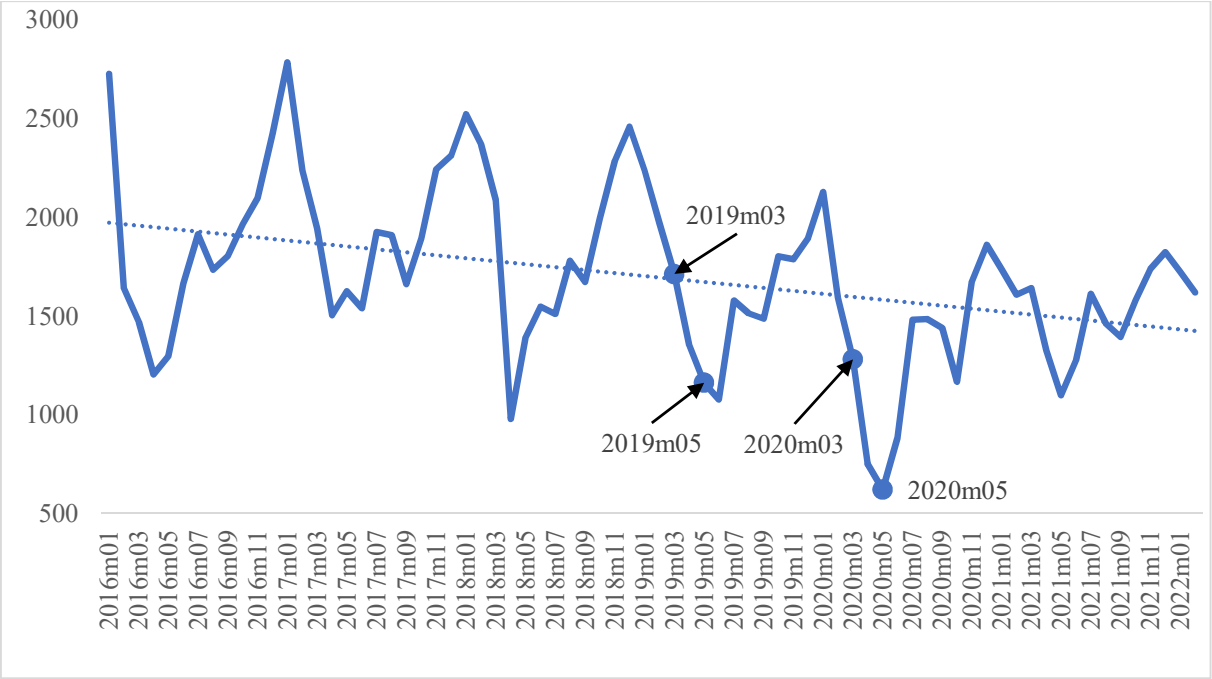


Figure 2. Electricity generation by combustible fuels

Source: Eurostat database (table nrg_cb_pem),
https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en

We have considered, as above, three periods (pre-crisis, state of emergency, state of alert) and built an econometric model as the following:

$$CF_t = a_1 D_{2016m01-2020m02} + a_2 D_{2020m03-2020m05} + a_5 D_{2020m06-2022m02} + \\ + b_i D(month_i) + trend + cycle + e_t \qquad [Eq.3]$$

$$e_t \sim SAR(p)(P)_{s=12}$$

where CF is electricity generation by combustible fuels and the other symbols are identical to those in the model described by Eq. 2. The estimators for econometric models are in Table 3.

Table 3. Electricity generation by combustible fuels

Dependent Variable: Electricity generation by combustible fuels

Variable	Coefficient (Std. Error)	[t-Statistic] Prob.
$D_{2016m01-2020m02}$	2331.013 (54.06268)	[43.11685] 0.0000
$D_{2020m03-2020m05}$	1866.608 (227.2754)	[8.212976] 0.0000
$D_{2020m06-20220m02}$	1926.900 (82.04903)	[23.48474] 0.0000
cos(2πt/48)	-125.1142 (48.62657)	[-2.572960] 0.0127
AR(1)	0.336174 (0.146501)	[2.294678] 0.0254
R-squared	0.840751	

Source: Econometric estimates based on Eurostat data (table nrg_cb_pem), on line at
https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en.

All coefficients a_i are significantly different from zero, at the threshold of 0.1%. The average of electricity generation by combustible fuels during the state of emergency ($\hat{a}_2$ = 1866.6) is significantly smaller than the average after the COVID-19 crisis ($\hat{a}_1$ = 2331.0), when the dynamics were cleansed of cyclical, seasonal, autoregressive and trend effects: the probability associated (in the Wald test) with the hypothesis that the coefficients do not differ significantly (i.e., statistically, $a_2 = a_1$) is around of 0.039, and for $a_1 = a_2 = a_3$ the probability is less than 0.0001. This means that the COVID-19 pandemic negatively affected the net electricity generation by combustible fuels, especially during the state of emergency period. When we detailed the state of emergency period over months, the model coefficients were not economically significant.

3.3. Electricity generation by renewable sources (hydro, wind and solar)

For the time series *electricity generation by combustible fuels* (Figure 3) the standard unit root tests (Augmented Dickey-Fuller test, Phillips-Perron test, Dickey-Fuller GLS test, Elliott-Rothenberg-Stock Point-Optimal test, Ng-Perron tests) reject the null hypothesis of unit root at 5% level, in models with constant as exogenous and the Kwiatkowski-Phillips-Schmidt-Shin test statistic do not reject the null of stationarity. Moreover, HEGY test (Hylleberg, Engle, Granger, & Yoo, 1990) rejects the unit roots for all seasonal frequencies, in the models with seasonal dummies. Based on these results, we accept the hypothesis that the series is stationary.

We test whether *electricity generation from renewable sources* (hydro, wind, and solar) during the COVID-19 crisis differs significantly from pre-crisis generation.

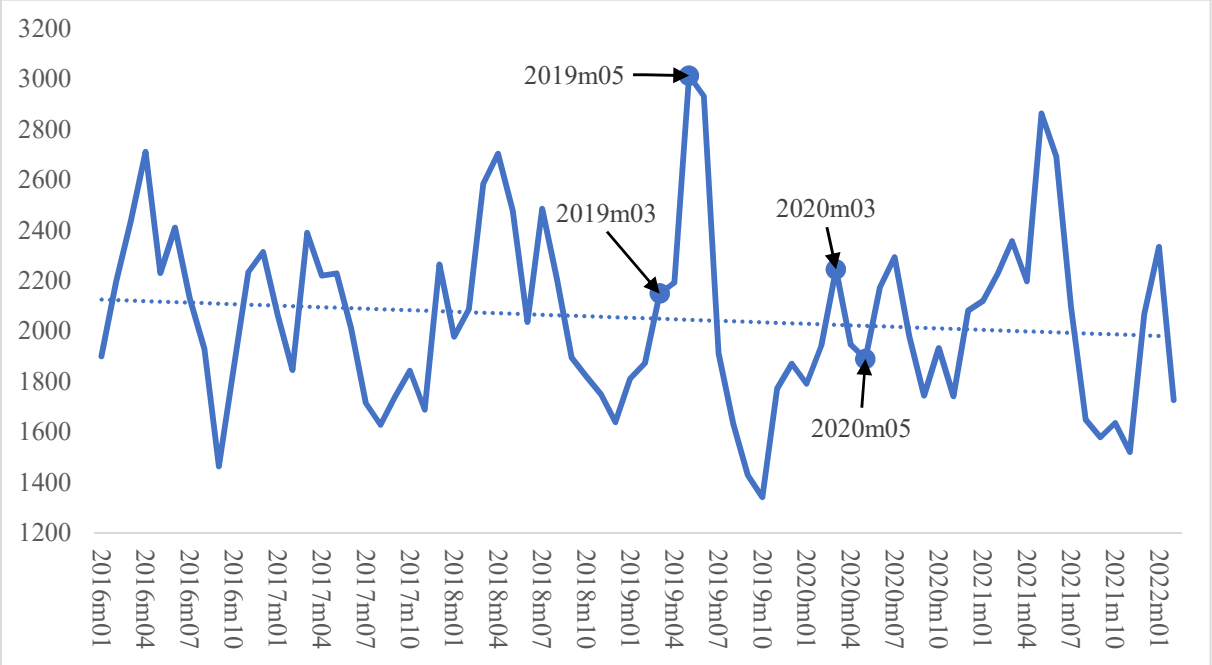


Figure 3. Electricity generation by renewable sources (hydro, wind and solar)

Source: Eurostat database (table nrg_cb_pem),
https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en

We have considered, as above, three periods (pre-crisis, state of emergency, state of alert) and built an econometric model as the following:

$$\begin{aligned} Renew_t &= a_1 D_{2016m01-2020m02} + a_2 D_{2020m03-2020m05} + a_5 D_{2020m06-2022m02} + \\ &+ b_i D(month_i) + trend + cycle + e_t \qquad \text{[Eq.4]} \\ e_t &\sim SAR(p)(P)_{s=12} \end{aligned}$$

where *Renew* is electricity generation by renewable sources (hydro, wind and solar) and the other symbols are identical to those in the model described by Eq. 1. We also estimated a model in which we detailed the state of emergency, by months, similar to Eq. 2. The estimators for econometric models are in Table 4.

Table 4. Electricity by renewable sources (hydro, wind and solar)

Dependent Variable: Electricity generation by renewable sources (hydro, wind and solar)

Variable	Coefficient (Std. Error)	[t-Statistic] Prob.	Variable	Coefficient (Std. Error)	[t-Statistic] Prob.
$D_{2016m01-2020m02}$	1992.095 (50.02085)	[39.82529] 0.0000	$D_{2016m01-2020m02}$	1988.654 (46.21333)	[43.03203] 0.0000
$D_{2020m03-2020m05}$	1597.550 (228.5363)	[6.990355] 0.0000			
			$D_{2020m03}$	1678.969 (601.4599)	[2.791489] 0.0072
			$D_{2020m04}$	1232.781 (417.1901)	[2.954963] 0.0046
			$D_{2020m05}$	1689.610 (301.7218)	[5.599893] 0.0000
$D_{2020m06-2022m02}$	2028.967 (71.18291)	[28.50358] 0.0000	$D_{2020m06-2022m02}$	2031.560 (66.25892)	[30.66093] 0.0000
AR(1)	0.317997 (0.126893)	[2.506027] 0.0150	AR(1)	0.360767 (0.130991)	[2.754132] 0.0079
SAR(12)	-0.465966 (0.153064)	[-3.044265] 0.0035	SAR(12)	-0.551522 (0.143227)	[-3.850671] 0.0003
Monthly dummy variables			Monthly dummy variables		
R-squared		0.701086	R-squared		0.723497

Source: Econometric estimates based on Eurostat data (table nrg_cb_pem), on line at https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en.

All coefficients a_i are significantly different from zero, at the threshold of 0.01. The average of electricity generation by renewable sources (hydro, wind, solar) during the state of emergency ($\hat{a}_2 = 1597.55$) is significantly smaller than the average after the COVID-19 crisis ($\hat{a}_1 = 1992.10$), when the dynamics were cleansed of cyclical, seasonal, autoregressive and trend effects: the probability associated (in the Wald test) with the hypothesis that the coefficients do not differ significantly (i.e., statistically, $a_2 = a_1$) is around of 0.079. By months, the strongest decline was in April 2020. This means that the COVID-19 pandemic negatively affected the net electricity generation by renewable sources during the state of emergency period. Over the state of alert period, the average ($\hat{a}_3 = 2028.97$) is slightly higher than that recorded before the COVID-19 crisis, but the positive difference is not statistically significant. This denotes a return of electricity generation from aggregate renewable sources to the normal pattern.

These findings contradict certain statements in the literature, for example: "COVID-19 brought a significant decline in energy generation using fossil fuel, while renewable power gained new momentum." (Vara, 2021) and "Renewable energy largely spared from pandemic effects" (Eurostat, 2021). There are also studies that have come to similar conclusions with us: Dong, Ji, Mustafa, & Khursheed (2021, p. 1) found that "COVID-19 pandemic has significantly reduced the renewable energy production in China, both in the short and long run."

We have detailed the analysis on the main sources of electricity production in Romania (hydropower, wind and solar).

a. Hydro electricity generation

For the time series *electricity generation by hydro source* (Figure 4) the standard unit root tests (Augmented Dickey-Fuller test, Phillips-Perron test, Dickey-Fuller GLS test, Elliott-Rothenberg-Stock Point-Optimal test, Ng-Perron tests) reject the null hypothesis of unit root at 5% level, in models with constant as exogenous and the Kwiatkowski-Phillips-Schmidt-Shin test statistic do not reject the null of stationarity. Moreover, HEGY test (Hylleberg, Engle, Granger, & Yoo, 1990) rejects the unit roots for all seasonal frequencies, in the models with seasonal dummies. Based on these results, we accept the hypothesis that the series is stationary.

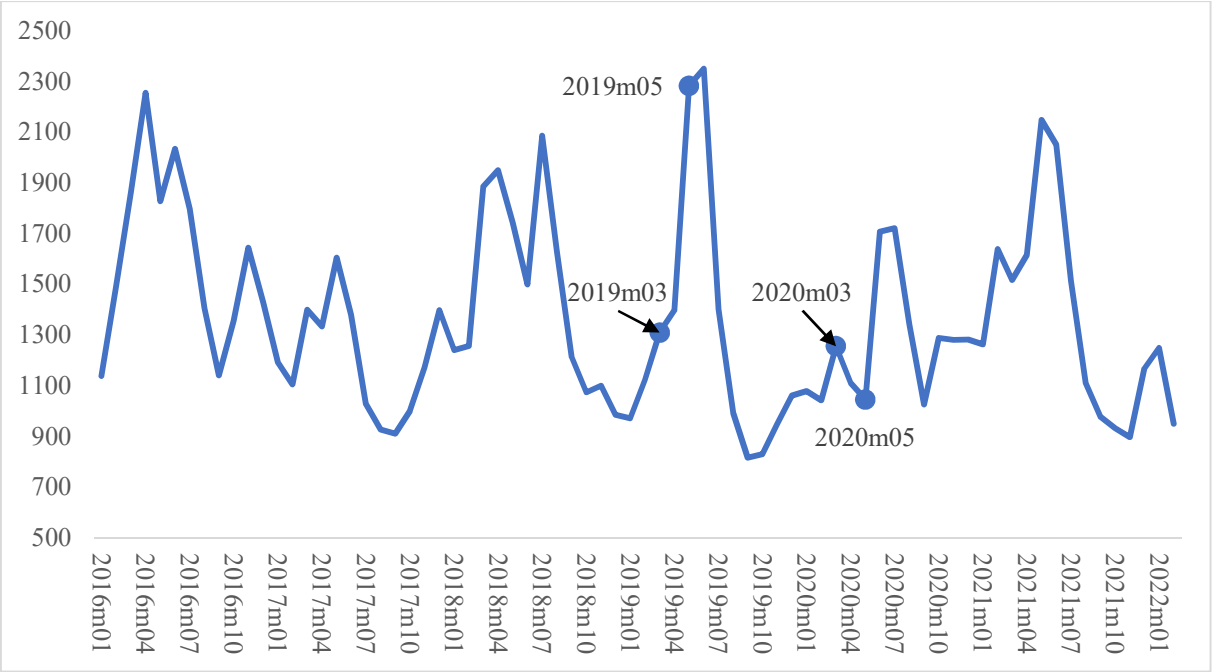


Figure 4. Electricity generation by hydro sources

Source: Eurostat database (table nrg_cb_pem),
https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en

We test whether *electricity generation from hydro sources* during the COVID-19 crisis differs significantly from pre-crisis generation.

We have considered, as above, three periods (pre-crisis, state of emergency, state of alert) and built an econometric model as the following:

$$\begin{aligned} Hydro_t &= a_1 D_{2016m01-2020m02} + a_2 D_{2020m03-2020m05} + a_5 D_{2020m06-2022m02} + \\ &+ b_i D(month_i) + trend + cycle + e_t \qquad \text{[Eq.5]} \\ e_t &\sim SAR(p)(P)_{s=12} \end{aligned}$$

where *Hydro* is electricity generation by hydro sources and the other symbols are identical to those in the model described by Eq. 1. We also estimated a model in which we detailed the state of emergency, by months, similar to Eq. 2. The estimators for econometric models are in Table 5.

Table 5. Electricity generation by hydro sources

Dependent Variable: Electricity generation by hydro sources

Variable	Coefficient (Std. Error)	[t-Statistic] Prob.	Variable	Coefficient (Std. Error)	[t-Statistic] Prob.
$D_{2016m01-2020m02}$	1167.401 (62.98506)	[18.53457] 0.0000	$D_{2016m01-2020m02}$	1165.228 (61.76362)	[18.86594] 0.0000
$D_{2020m03-2020m05}$	546.9054 (154.0143)	[3.551004] 0.0008			
			$D_{2020m03}$	595.7222 (219.3298)	[2.716102] 0.0088
			$D_{2020m04}$	280.9938 (436.2650)	[0.644090] 0.5221
			$D_{2020m05}$	558.2846 (261.5807)	[2.134273] 0.0372

Variable	Coefficient (Std. Error)	[t-Statistic] Prob.	Variable	Coefficient (Std. Error)	[t-Statistic] Prob.
$D_{2020m06-2022m02}$	1212.370 (96.80410)	1217.532 (99.23301)	$D_{2020m06-2022m02}$	1217.532 (99.23301)	[12.26943] 0.0000
AR(1)	0.507172 (0.111065)	0.537342 (0.105360)	AR(1)	0.537342 (0.105360)	[5.100040] 0.0000
SAR(12)	-0.649293 (0.102385)	-0.680558 (0.114071)	SAR(12)	-0.680558 (0.114071)	[-5.966112] 0.0000
Monthly dummy variables			Monthly dummy variables		
R-squared		0.813975	R-squared		0.825524

Source: Econometric estimates based on Eurostat data (table nrg_cb_pem), on line at https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en.

Except for the coefficients of the dummy variables attached to March 2020 and April 2020, all other coefficients in both models are significantly different from zero at the 0.01 threshold. The average of electricity generation by hydro sources during the state of emergency ($\hat{a}_2 = 546.91$) is significantly smaller than the average after the COVID-19 crisis ($\hat{a}_1 = 1167.40$), when the dynamics were cleansed of cyclical, seasonal, autoregressive and trend effects: the probability associated (in the Wald test) with the hypothesis that the coefficients do not differ significantly (i.e., statistically, $a_2 = a_1$) is 0.0001. By months, the strongest decline was in April 2020. This means that the COVID-19 pandemic negatively affected the net electricity generation by hydro sources during the state of emergency period. Over the state of alert period, the average ($\hat{a}_3 = 1217.53$) is slightly higher than that recorded before the COVID-19 crisis, and the positive difference is statistically significant (for Wald test on $a_3 = a_1$, the probability is 0.049). This denotes a return of electricity generation from hydro sources to the normal pattern (even with a slight growth).

b. Wind electricity generation

For the time series *wind electricity generation* (Figure 5) the standard unit root tests (Augmented Dickey-Fuller test, Phillips-Perron test, Dickey-Fuller GLS test, Elliott-Rothenberg-Stock Point-Optimal test, Ng-Perron tests) reject the null hypothesis of unit root at 1% level, in models with constant as exogenous and the Kwiatkowski-Phillips-Schmidt-Shin test statistic do not reject the null of stationarity. Moreover, HEGY test (Hylleberg, Engle, Granger, & Yoo, 1990) rejects the unit roots for all seasonal frequencies, in the models with seasonal dummies. Based on these results, we accept the hypothesis that the series is stationary.

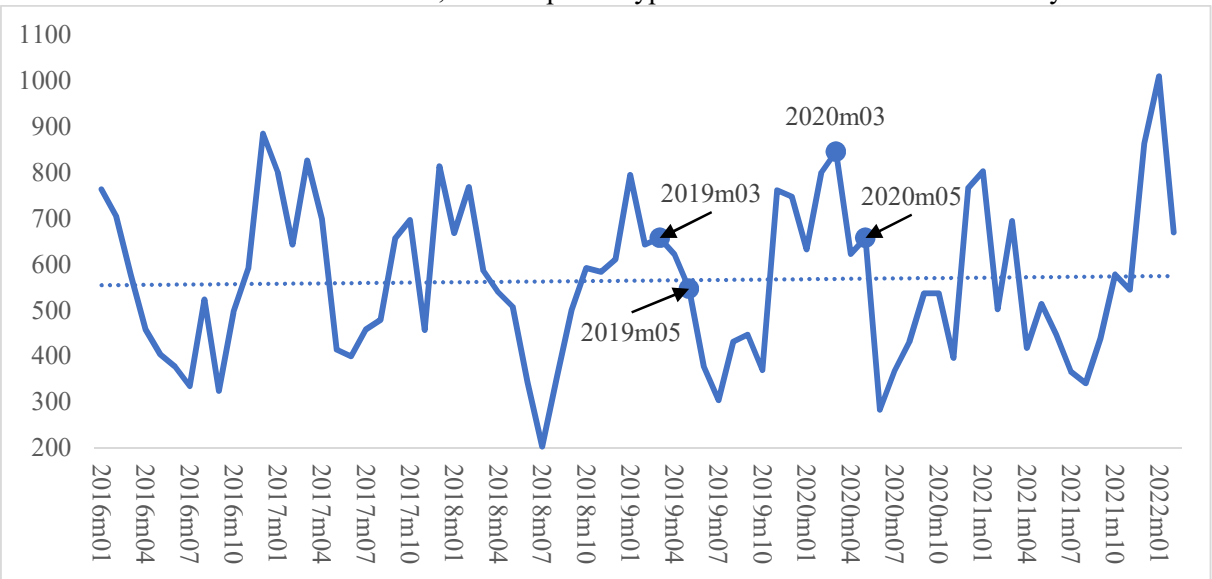


Figure 5. Wind electricity generation

Source: Eurostat database (table nrg_cb_pem), https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en

We test whether *wind electricity generation* during the COVID-19 crisis differs significantly from pre-crisis pattern production. We have considered, as above, three periods (pre-crisis, state of emergency, state of alert) and built an econometric model as the following:

$$\begin{aligned} Wind_t &= a_1 D_{2016m01-2020m02} + a_2 D_{2020m03-2020m05} + a_5 D_{2020m06-2022m02} + \\ &+ b_i D(month_i) + trend + cycle + e_t \qquad [Eq.6] \\ e_t &\sim SAR(p)(P)_{s=12} \end{aligned}$$

where *Wind* is wind electricity generation and the other symbols are identical to those in the model described by Eq. 1. We also estimated a model in which we detailed the state of emergency, by months, similar to Eq. 2. The estimators for econometric models are in Table 5.

Table 6. Wind electricity generation

Dependent Variable: Wind electricity generation

Variable	Coefficient (Std. Error)	[t-Statistic] Prob.	Variable	Coefficient (Std. Error)	[t-Statistic] Prob.
$D_{2016m01-2020m02}$	784.0107 (28.34712)	[27.65751] 0.0000	$D_{2016m01-2020m02}$	784.0107 (28.67771)	[27.33868] 0.0000
$D_{2020m03-2020m05}$	927.0204 (67.84051)	[13.66470] 0.0000			
			$D_{2020m03}$	959.7538 (112.2423)	[8.550734] 0.0000
			$D_{2020m04}$	858.1538 (112.2423)	[7.645549] 0.0000
			$D_{2020m05}$	963.1538 (112.2423)	[8.581025] 0.0000
$D_{2020m06-2022m02}$	776.7258 (32.51755)	[23.88636] 0.0000	$D_{2020m06-2022m02}$	776.7258 (32.89678)	[23.61100] 0.0000
Monthly dummy variables			Monthly dummy variables		
R-squared		0.726979	R-squared		0.729735

Source: Econometric estimates based on Eurostat data (table nrg_cb_pem), on line at https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en.

All coefficients a_i are significantly different from zero, at the threshold of 0.0001. We did not identify seasonal autoregressive (SAR) structures, trend, or cycle. The average of wind electricity generation during the state of emergency ($\hat{a}_2$ = 927.02) is significantly higher than the pre-crisis average ($\hat{a}_1$ = 784.01), when the dynamics were cleansed of cyclical, seasonal, autoregressive and trend effects: the probability associated (in the Wald test) with the hypothesis that the coefficients do not differ significantly (i.e., statistically, $a_2 = a_1$) is 0.025. The average values are higher than those recorded before the COVID-19 pandemic during all the months of emergency period. This means that the COVID-19 pandemic does not affect the wind electricity generation during the state of emergency period. Over the state of alert period, the average ($\hat{a}_3$ = 776.7258) is close to pre-crisis value and this denotes a return to the normal pattern.

c. Solar (photovoltaic) electricity generation

For the time series *solar (photovoltaic) electricity generation* (Figure 6) the standard unit root tests (Augmented Dickey-Fuller test, Phillips-Perron test) reject the null hypothesis of unit root at 1% level, in models with constant as exogenous and the Kwiatkowski-Phillips-Schmidt-Shin test statistic do not reject the null of stationarity. Moreover, HEGY test (Hylleberg, Engle, Granger, & Yoo, 1990) rejects the unit roots for all seasonal frequencies, in the models with seasonal dummies. Based on these results, we accept the hypothesis that the series is stationary.

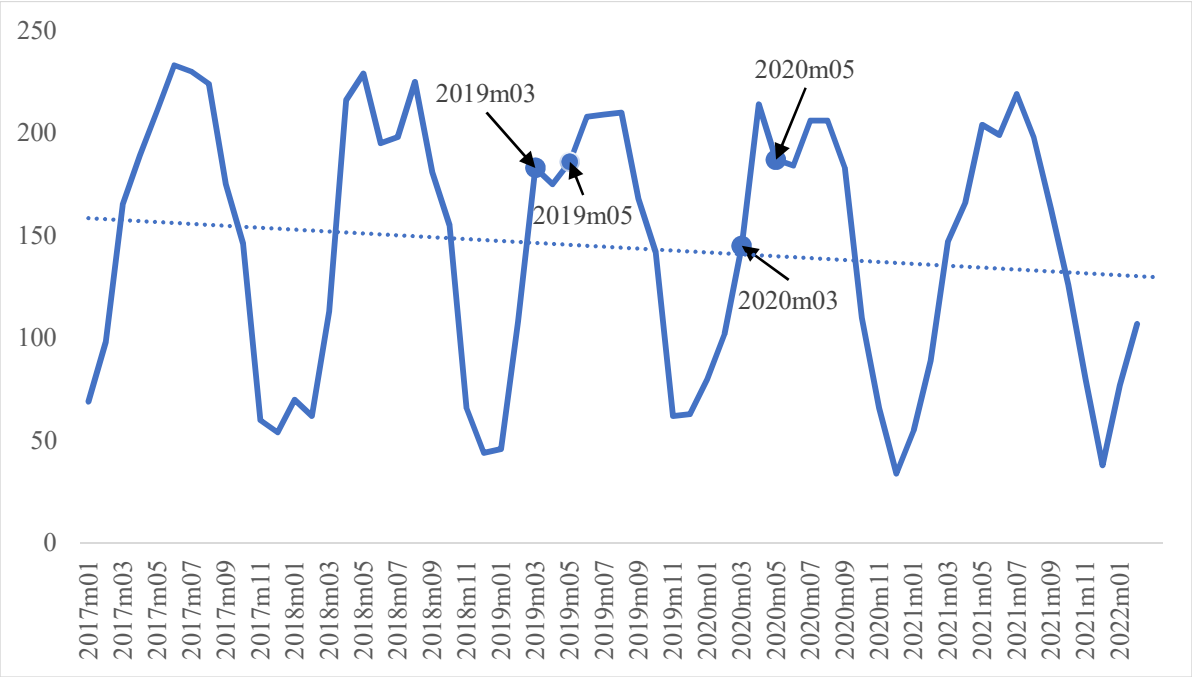


Figure 6. Solar (photovoltaic) electricity generation

Source: Eurostat database (table nrg_cb_pem),
https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en

We test whether *solar (photovoltaic) electricity* during the COVID-19 crisis differs significantly from pre-crisis pattern production. We have considered, as above, three periods (pre-crisis, state of emergency, state of alert) and built an econometric model as the following:

$$\begin{aligned} Solar_t &= a_1 D_{2016m01-2020m02} + a_2 D_{2020m03-2020m05} + a_5 D_{2020m06-2022m02} + \\ &+ b_i D(month_i) + trend + cycle + e_t \qquad \text{[Eq.7]} \\ e_t &\sim SAR(p)(P)_{s=12} \end{aligned}$$

where *Solar* is solar (photovoltaic) electricity generation and the other symbols are identical to those in the model described by Eq. 1. We also estimated a model in which we detailed the state of emergency, by months, similar to Eq. 2. The estimators for econometric models are in Table 7.

Table 7. Solar (photovoltaic) electricity

Dependent Variable: Solar (photovoltaic) electricity generation

Variable	Coefficient (Std. Error)	[t-Statistic] Prob.	Variable	Coefficient (Std. Error)	[t-Statistic] Prob.
$D_{2016m01-2020m02}$	58.64311 (2.991507)	[19.60320] 0.0000	$D_{2016m01-2020m02}$	58.49432 (2.640023)	[22.15675] 0.0000
$D_{2020m03-2020m05}$	52.82115 (9.184318)	[5.751233] 0.0000			
			$D_{2020m03}$	74.48598 (14.64677)	[5.085488] 0.0000
			$D_{2020m04}$	59.56651 (14.79459)	[4.026236] 0.0002
			$D_{2020m05}$	21.45024 (14.21183)	[1.509322] 0.1384
$D_{2020m06-2022m02}$	51.20313 (3.392917)	[15.09118] 0.0000	$D_{2020m06-2022m02}$	51.25087 (3.015039)	[16.99841] 0.0000

Variable	Coefficient (Std. Error)	[t-Statistic] Prob.	Variable	Coefficient (Std. Error)	[t-Statistic] Prob.
cos(2πt/6)	18.17438 (5.612054)	[3.238454] 0.0022	cos(2πt/6)	18.03467 (4.944337)	[3.647540] 0.0007
SAR(12)	-0.440513 (0.116588)	[-3.778386] 0.0005	SAR(12)	-0.543663 (0.118320)	[-4.594851] 0.0000
Monthly dummy variables			Monthly dummy variables		
R-squared		0.959373	R-squared		0.729735

Source: Eurostat database (table nrg_cb_pem), https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_cb_pem&lang=en

Except for the coefficients of the dummy variables attached to May 2020, all other coefficients in both models are significantly different from zero at the 0.001 threshold. The average of Solar (photovoltaic) electricity generation during the state of emergency ($\hat{a}_2 = 52.82$) is close to the average after the COVID-19 crisis ($\hat{a}_1 = 58.64$), when the dynamics were cleansed of cyclical, seasonal, autoregressive and trend effects: the probability associated (in the Wald test) with the hypothesis that the coefficients do not differ significantly (i.e., statistically, $a_2 = a_1$) is 0.502. By months, in March 2020, the average is higher than in normal times, but in May 2020 there was a sharp decrease. This means that the COVID-19 pandemic does not affect Solar (photovoltaic) electricity generation during the state of emergence. Over the state of alert period, the average ($\hat{a}_3 = 51.2$) is slightly lower than that recorded before the COVID-19 crisis, and the negative difference is statistically significant (for Wald test on $a_3 = a_1$, the probability is 0.015).

4. Conclusions

The COVID-19 pandemic has directly affected Romania's economy since March 2020. Statistically, the Gross Domestic Product decreased in 2020 compared to 2019 by -3.7% (according to Eurostat data, *GDP and main components*, table nama_10_gdp). These developments have influenced the consumption and production of electricity. Total net electricity generation decreased from 53874 million kilowatt-hours in 2019 to 50693 in 2020 and recovered to 53702 in 2021. Electricity generation by renewable sources (hydro, wind, solar) slowly decreased in 2020, at 23767 mil. KWh, from 23937 mil. KWh in 2019 and increased in 2021, to 25017 mil. KWh (data are calculated from Eurostat database, table nrg_cb_pem).

In this paper, we have not made a simple statistical comparison between electricity production (total and on generation sources) during the COVID-19 crisis and production in normal times (before the crisis). We built econometric models to evaluate the autoregressive, cyclical and seasonal components in electricity generation dynamics, as well as long-term trends. After removing these structural elements from the production dynamics by generation sources, we compared the evolution during the pandemic (separately for the state of emergency, when the restrictions were stronger and the state of alert, when the restrictions were progressively relaxed) with the production dynamics from normal times (before the COVID-19 crisis). We found, for Romania, the following:

- ✓ The COVID-19 pandemic negatively affected the Romanian *total* net electricity generation in April 2020 (April 2020 is the only month that was fully covered by the state of emergency) and did not significantly affect the pattern of production in the other months of the emergency and alert states.
- ✓ The COVID-19 pandemic negatively affected the net electricity generation by *combustible fuels* during the state of emergency period and the pattern of electricity generation in state of alert returned to the pre-crisis standing.
- ✓ The average of electricity generation by *renewable sources* (hydro, wind, solar) during the state of emergency is significantly smaller than the average before the COVID-19 crisis. By months, the strongest decline was in April 2020. Over the state of alert period, the average of electricity production by renewable sources is slightly higher than that recorded before the COVID-19 crisis. This denotes a return of electricity generation from aggregate renewable sources to the normal pattern.
- ✓ The average of electricity generation by *hydro sources* during the state of emergency is significantly smaller than the average before the COVID-19 crisis. Over the state of alert period, the average is slightly higher than that recorded before the COVID-19 crisis, and the positive difference is statistically significant: COVID-19 crisis negatively affected the net electricity generation by hydro sources during

the state of emergency period and there is a return to the normal pattern (even with a slight growth) during the state of alert.

- ✓ The average of *wind electricity generation* is significantly higher than the pre-crisis average, during the state of emergency and return to normal pattern over the state of alert.
- ✓ The average of *solar (photovoltaic) electricity generation* during the state of emergency is close to the average before the COVID-19 crisis, but over the state of alert period, the average is slightly lower than that recorded before the COVID-19 crisis, and the negative difference is statistically significant.

All those findings are under the hypothesis that the dynamics were cleaned from the autoregressive, cyclical and seasonal components, as well as long-term trends.

References:

[1] Agdas, D., & Barooah, P. (2020). Impact of the COVID-19 Pandemic on the U.S. Electricity Demand and Supply: An Early View From Data. *IEEE Access, 8*, 151523-151534. doi:10.1109/ACCESS.2020.3016912

[2] Au, J., Saldaña, J. J., Spanswick, B., & Santerre, J. (2020). Forecasting Power Consumption in Pennsylvania During the COVID-19 Pandemic: A SARIMAX Model with External COVID-19 and Unemployment Variables. *SMU Data Science Review, 3*(2), Article 6. Retrieved November 5, 2021, from : https://scholar.smu.edu/datasciencereview/vol3/iss2/6

[3] Balest, J., & Stawinoga, A. E. (2022, March). Social practices and energy use at home during the first Italian lockdown due to Covid-19. *Sustainable Cities and Society, 78*(103536), 13p. doi: 10.1016/j.scs.2021.103536

[4] Bover, O., Fabra, N., García-Uribe, S., Lacuesta, A., & Ramos, R. (2021). *Firms and Households during the Pandemic: What do we learn from their electricity consumption?* Working papers, Universidad Carlos III Madrid, Departamento de Economia, Madrid. Retrieved November 5, 2021, from https://eel107.s3.us-east-2.amazonaws.com/EEL_112.pdf

[5] Dong, C., Ji, D., Mustafa, F., & Khursheed, A. (2021, November 29). Impacts of COVID-19 pandemic on renewable energy production in China: transmission mechanism and policy implications. *Economic Research-Ekonomska Istraživanja*, p. 15p. doi:10.1080/1331677X.2021.2005651

[6] Eurostat. (2021). *Renewable energy largely spared from pandemic effects.* Product Eurostat News, European Commission. Retrieved May 19, 2022, from https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210629-1

[7] Goddard, I. (2020, March 31). *National lockdown effects on European electricity consumption and system planning.* (I. Home, Ed.) Retrieved May 1, 2022, from Invenia Blog: https://invenia.github.io/blog/2020/03/31/covid-part1/

[8] Hemrit, W., & Benlagha, N. (2021, November). Does renewable energy index respond to the pandemic uncertainty? *Renewable Energy, 177*, pp. 336-347. doi:10.1016/j.renene.2021.05.130

[9] Hylleberg, S., Engle, R. F., Granger, C. W., & Yoo, B. S. (1990). Seasonal integration and cointegration. *Journal of Econometrics, 44*(1-2), 215-238.

[10] Iancu, I. A., Darab, C. P., & Cîrstea, Ș. D. (2021). The Effect of the COVID-19 Pandemic on the Electricity Consumption in Romania. *Energies, 14*(3146), 16p. Retrieved December 6, 2021, from https://doi.org/10.3390/en14113146

[11] International Energy Agency. (2021). *World Energy Outlook (WEO).* International Energy Agency, Directorate of Sustainability, Technology and Outlooks. Paris: IEA Publications. Retrieved December 15, 2021, from https://www.iea.org/reports/world-energy-outlook-2021

[12] International Energy Agency. (2022). *Exploring the impacts of the Covid-19 pandemic on global energy markets, energy resilience, and climate change.* Paris: IEA. Retrieved February 15, 2022, from https://www.iea.org/topics/covid-19

[13] Jula, D., & Jula, N.-M. (2019). *Econometria seriilor de timp.* București: Mustang.

[14] Jula, D.-M. (2021a). Impact of the COVID-19 Pandemic on the Romanian Electricity Consumption. *Global Economic Observer, 9*(1), 166-179. Retrieved November 4, 2021, from http://www.globeco.ro/wp-content/uploads/vol/split/vol_9_no_1/geo_2021_vol9_no1_art_019.pdf

[15] Jula, D.-M. (2021b). Analysis of the Changes Induced by the COVID-19 Crisis in the Structure of Daily Electricity Consumption. In L. Chivu, V. Franc-Ioan, & A.-J. Vasile, *The crisis after the crisis. When and how the New Normal will be (Proceedings of the 7th International Conference ESPERA 2021).* Bucharest: Sciendo.

[16] Khanna, M. (2021, March). COVID-19: A Cloud with a Silver Lining for Renewable Energy? *Applied Economic Perspectives and Policy, 43*(1), pp. 73-85. doi:10.1002/aepp.13102

[17] Kies, A., Schyska, B. U., Bilousova, M., El Sayed, O., Jurasz, J., & Stoecker, H. (2021). Critical review of renewable generation datasets and their implications for European power system models. *Renewable and Sustainable Energy Reviews, 152*. Retrieved December 6, 2021, from https://doi.org/10.1016/j.rser.2021.111614

[18] Lu, Z., Liu, N., Xie, Y., & Xu, J. (2021, November 22). Time series analysis and forecasting of China's energy production during Covid-19: statistical models vs machine learning models. *Research Square*. doi:10.21203/rs.3.rs-1074872/v2
[19] Luo, S., Hu, W., Liu, W., Cao, D., Du, Y., Zhang, Z., & Chen, Z. (2022, May). Impact analysis of COVID-19 pandemic on the future green power sector: A case study in the Netherlands. *Renewable Energy, 191*, pp. 261-277. doi:10.1016/j.renene.2022.04.053
[20] Mehlig, D., ApSimon, H., & Staffel, I. (2021, April 30). The impact of the UK's COVID-19 lockdowns on energy demand and emissions. *Environmental Research Letters, 16*, 10p. doi:10.1088/1748-9326/abf876
[21] Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., . . . Agha, R. (2020). The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *International Journal of Surgery, 78*, 185-193. doi:10.1016/j.ijsu.2020.04.018
[22] Olabi, V., Wilberforce, T., Elsaid, K., Sayed, E. T., & Abdelkareem, M. A. (2022, February 4). Impact of COVID-19 on the Renewable Energy Sector and Mitigation Strategies. *Chemical Engineering & Technology, 45*(4), pp. 558-571. doi:10.1002/ceat.202100504
[23] Pastory, D., & Munishi, E. (2022). Volatility Shocks in Energy Commodities: The Influence of COVID-19. *International Journal of Research in Business and Social Science, 11*(2), 214-227. doi:10.20525/ijrbs.v11i2.1614
[24] Radtke, J. (2022, February 15). Smart energy systems beyond the age of COVID-19: Towards a new order of monitoring, disciplining and sanctioning energy behavior? *Energy Research & Social Science, 84*(102355), 15p. doi:10.1016/j.erss.2021.102355
[25] Salisu, A., & Adediran, I. (2020). Uncertainty due to infectious diseases and energy market volatility. *Energy Research Letters, 1*(2), 6p. doi:10.46557/001c.14185
[26] Shaikh, I. (2022). Impact of COVID-19 pandemic on the energy markets. *Economic Change and Restructuring, 55*, 433-484. doi:10.1007/s10644-021-09320-0
[27] Shekhar, J., Suri, D., Somani, P., Lee, S. J., & Arora, M. (2021, July). Reduced renewable energy stability in India following COVID-19: Insights and key policy recommendations. *Renewable and Sustainable Energy Reviews*. doi:10.1016/j.rser.2021.111015
[28] Soava, G., Mehedintu, A., Sterpu, M., & Grecu, E. (2021). The Impact of the COVID-19 Pandemic on Electricity Consumption and Economic Growth in Romania. *Energies, 14*(2394), 25p. Retrieved November 4, 2021, from https://doi.org/10.3390/en14092394
[29] Todeschi, V., Javanroodi, K., Castello, R., Mohajeri, N., Mutani, G., & Scartezzini, J.-L. (2022, April 12). Impact of the COVID-19 pandemic on the energy performance of residential neighborhoods and their occupancy behavior. *Sustainable Cities and Society, 82*, 19p. doi:10.1016/j.scs.2022.103896
[30] Vara, V. (2021, March 26). COVID-19 pandemic accelerated future renewable energy usage. *Power Technology*. Retrieved May 6, 2022, from https://www.power-technology.com/news/covid-19-pandemic-accelerated-future-renewable-energy-usage-poll/
[31] Wang, Q., Huang, R., & Li, R. (2022, May). Towards smart energy systems – A survey about the impact of COVID-19 pandemic on renewable energy research. *Energy Strategy Reviews, 41*, p. 20p. doi:10.1016/j.esr.2022.100845
[32] Werth, A., Gravino, P., & Prevedello, G. (2021, January). Impact analysis of COVID-19 responses on energy grid dynamics in Europe. *Applied Energy*, p. 7p. doi:10.1016/j.apenergy.2020.116045

The Strategic Role of Sino-U.S. Bilateral Investments in China's Advance in the Field of Biotechnologies

ANA-CRISTINA BÂLGĂR, PhD.
Institute for World Economy, Romanian Academy
13 September Street, No. 13th, Bucharest
ROMANIA
anacristinabalgar@gmail.com

Abstract: Recognizing from a very early stage the capacity of advanced technologies (and of biotechnologies in particular) to fundamentally change the economy, the geopolitics, and the society of the 21st century, Chinese authorities placed the development of the biotechnology sector among the top national priorities and, as a result, adopted political strategies and programmes meant to help achieving this goal. In the context of the "Made in China 2025" Strategy, which, among others, sets out China's goal of becoming a world leader in the field of life sciences and of reducing the country's technological dependency, our article sets out to present the evolution of the Chinese investment policy over the recent years, which was focused on finding an optimum synergy between guiding foreign direct investment (FDI) in line with the country's own sectoral modernisation plans, and targeting its own outward direct investment (ODI) in accordance with the same interests. With the U.S. being the global biotechnology leader and, as a result, China's main competitor in the race for global supremacy in the field, our analysis will focus on highlighting the role and importance of bilateral China-U.S. investment flows for the development of the Chinese biotechnology sector.

Keywords: biotechnologies, China, U.S., foreign direct investment (FDI), outward direct investment (ODI)

JEL classification: L65, O30, O33

1 Introduction

The spectacular achievements seen by the scientific world over the last half of a century – resulting from the unprecedented international progresses in a series of fundamental fields (e.g., genetics, molecular biology, biochemistry, embryology, cellular biology, enzymology, etc.) – and their subsequent transformation into productive processes[1] are among the essential factors that revolutionised modern-era biotechnology. As such, a succession of considerable scientific discoveries – among which, for example, the decoding and editing of the genetic code of live organisms and the subsequent remarkable applications that enabled the creation of synthetic genome organisms – crucially changed the perspectives on the applicability of the results of life science research and on the degree of complexity of the generated products, favouring a worldwide transition to a higher level of knowledge in the field of bioeconomy[2].

Once the immense potential and the transforming capacity of 21st century biotechnology for economic development and for geopolitical and societal evolution were globally recognized, government authorities and national leaders began approaching this field as a vital tool for the optimum implementation of processes such as: i) the combatting and eradication of diseases; ii) the modernisation of agricultural practices and of the food industry; iii) the strengthening of capacity for non-conventional energy generation and improved environmental protection; iv) the strengthening of military power (Greenwood, 2013). As a result, given the relevance of contemporary biotechnologies for the development of individual economies, for the preservation of the population's optimum health and increased wellbeing, for the improvement of food supply chains and for perfecting the use of renewable energy sources, all the countries of the world adopted and implemented ample national programmes that sought to create a robust internal biotechnology sector capable of supporting the

[1] As a result of the interconnections established at an interdisciplinary level with other scientific branches with practical applicability, such as chemical engineering, computer science, robotics, information sciences, etc.

[2] Bioeconomy brings together economic activities that are based on the results of research and innovation in the field of life sciences and biotechnology which became possible due to technological progresses made in related fields such engineering and information sciences (US National Academies of Sciences, Engineering, and Medicine, 2020).

increased dynamics of the medical and related sectors, as well as of local agriculture and industries (Dahms, 2004; Martin, et al., 2021).

Although a relatively late entry on the global science and technology (S&T) stage, and initially seeking merely to equal the performances that Western economies had already demonstrated in the field, China understood from a very early stage the stringent need to accumulate a knowledge capital that could enable it to achieve sustainable economic growth based mainly on innovation. As a consequence, Chinese decision-makers prioritized innovation in the national development plans and, in time, gradually consolidated this goal by including increasingly ambitious objectives which, during the recent years, culminated in assuming more and more complex targets that were meant to reduce the country's technological dependency on advanced countries (towards year 2035) and to achieve global supremacy in the field of science, technology and innovation (S&T&I) by mid this century (Cao, 2012; Xi Jinping [2015], quoted by Atkinson, [2015]).

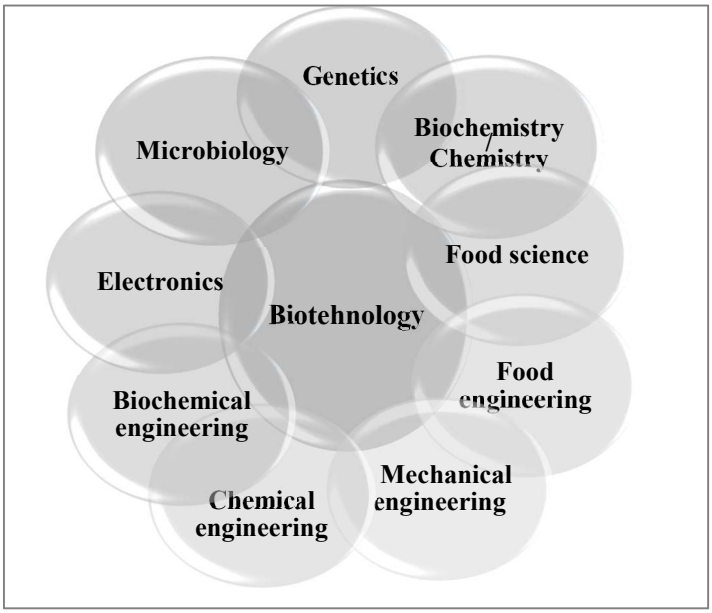
Having recognised the strategic importance of the biotechnological field for the prosperity of the national economy, and having placed it at the heart of the ample industrial development plan *Made in China 2025* (MIC 2025; of 2015) and of all the subsequent programmes. Hence Chinese government authorities undertook complex actions that sought, among others, to increase the degree of local innovation and to reach internal technological self-sufficiency, as first steps towards a future global domination in the biotechnological field.

China's quick transformation into an important player in the field of biotechnology, but also a series of policies applied for achieving the intended goals – including the national investment policy – are seen as real challenges for many of the industrialized countries (Amighini, 2019), in particular for the U.S., the traditional global leader in this sector.

The definition of the working notions

As we stated, biotechnology is not founded on one single scientific development, but it rather represents the result of the coming of age of several branches launched decades (and even centuries) ago or, as Smith J. E. noted (1996), it represents "*the industry specific for the 21st century, as the industries based on physics and chemistry characterised the 20th century*". We can therefore conclude that biotechnology does not capture one individual activity, emerging instead from the interaction of a spectrum of scientific disciplines (Figure 1). Its complexity derives from its very multidisciplinary nature, which results from the integrating use of biochemistry, microbiology and engineering sciences in order to obtain technological applications for the production and service sector (US Congress - Office of Technology Assessment (OTA), 1984; Bu'Lock & Kristiansen, 1987; Bhatia, 2018).

Figure 1: The interdisciplinary nature of biotechnology



Source: Author's graphical processing based on Smith J. E. (1996).

To be able to better understand the degree of complexity we refer to, as well as the fields of application and the scope of the biotechnological sector, we found it useful to provide a brief overview of some of the most representative definitions that were given to biotechnology, as that there is no unanimously accepted definition at international level (Box 1).

Box 1: Compendium of biotechnology definitions

⇒ *"Biotechnology combines natural and engineering sciences to develop applications that use biological systems – e.g. microbial, vegetal, animal cells and parts thereof, or molecular analogues – in bioindustries, in order to obtain goods and services"* (European Federation of Biotechnology [EFB], 1999, p. 1).
⇒ *"Biotechnology is the application of scientific and engineering principles in the processing of materials under the action of biological agents, in order to produce goods and services"* (OCDE, 1999) (the initial OECD definition); *"Biotechnology is the application of scientific technology on living organisms and on parts, products and models thereof in order to modify living or non-living materials for the purposes of obtaining knowledge, goods and services"* (OCDE, 2001)[3] (the basic OECD definition);
⇒ **As for the definitions of biotechnology used in China**, to a large extent they took explanatory elements from the universally accepted definitions provided by the international organisations or by the relevant authorities in the field in developed countries and adapted them to the specific national pragmatism (Zhe, Lifeng, & Xingua, 2009). As exemplified by Zhe, Lifeng and Xingua (2009), biotechnology research reports prepared by the bodies subordinated to the Chinese central government use two definitions which are considered to be representative at national level: a) *the first* of these, proposed by the *National Development and Reform Commission (NDRC),* describes modern biotechnology as "*[…]the result of all the activities that are based on the progresses made in the field of molecular biology, which includes genetic engineering, protein engineering, cellular engineering and zymotic engineering (zymotechnics)"* (the NDRC Department for High-Tech Industries, 2004); b) *the second,* proposed by the Ministry of Science and Technology (MOST), considers biotechnology as *"a complex system that uses individual cellular and molecular biocomponents" to "[…] solve existential problems or generate products that are useful for achieving this objective, to transfer/reconstruct the specific characteristics/properties of plants, animals and microorganisms, as well as to produce goods and services".*

Source: Author's selection based on the bibliography quoted in the box

Brief overview of the role and importance of biotechnologies in the contemporary era

After the end of World War II, which was a major obstacle for scientific research and discoveries, once the structural model of the human DNA was deciphered, it was possible to proceed to the modern stage of biotechnology, which has unlimited applications and an enormous potential for mankind's wellbeing, in a multitude of fields (Box 2).

Box 2: Applications of modern biotechnology (synthesis)

"Green" biotechnology (with applications in agricultural processes)	• A sub-field that comprises the development of certain genetically modified (trans-genic) plants or animals, activities pertaining to the genetic engineering of plants, the manipulation and use of microorganisms in order to facilitate crop growth, the production of fertile and resilient seeds, etc.
"Red" biotechnology (with applications in the medical field)	• A segment that includes complex medical procedures: the use of organisms to manufacture new medicines or the use of stem cells to replace/regenerate deteriorated tissues or regenerate certain organs.
"Blue" biotechnology (with applications in the field of aquatic and marine biology field)	• An area of biotechnology that uses the diversity found in marine environments, including the form, structure, physiology and chemistry of marine animals. It is a field that uses marine bio-resources as a source for biological applications.
"White" (or "grey") biotechnology (with applications in industrial processes)	• It entails the use of enzymes or microorganisms in various industries in order to obtain chemical and pharmaceutical products, food ingredients, energy, paper and renewable biofuels.

Source: Author's synthesis based on Bhatia (2018).

[3] Although in 2018, the OECD updated the list of biotechnology sub-fields to include the latest progresses in the field, the basic definition of biotechnology was not revised (Friedrichs & van Beuzekom, 2018).

2 Foreign direct investment – strategic instruments for the development of China's biotechnology sector

The propagation of technology transfer through guided inward direct investment

In light of the transforming policies adopted by China over the recent years and of the change determined in the country's development direction by the strategic guiding principles they contained, ample dissentions emerged on the international stage in relation to how Chinese national authorities treated foreign investing companies. As such, several analysis reports published by the U.S. and European bodies entrusted with monitoring global investment flows [e.g. European Commission, (2019); U.S. Trade Representative (2018); White House (2018)] note that there are regulations and barriers that restrict the access of foreign direct investment (FDI) on the Chinese market – e.g. insufficient protection of intellectual property rights (IPR) in the advanced technological industries (including in the case of biotechnologies), quasi-monopolies of large state-owned enterprises in the strategically important sectors, discriminatory public procurement procedures in the state-controlled fields, etc. –, and that these are used to guide the transfer of new technologies on the internal market in accordance with China's national interests.

As shown by the analyses referred to above, the main instruments on which the Chinese authorities rely to better direct FDI flows in the sectors of national interest, or to boost the transfer of new technologies to these sectors may take several forms, varying from *i)* restrictions on the share of foreign participation in joint ventures, and up to *ii)* imposing barriers and administrative burdens in the investment authorisation and approval process. These two aspects show the non-transparent and discretionary nature of China's foreign investment approval regime, which goes against the international practices agreed upon with the WTO.

To meet the criticism expressed in the international environment and the concerns raised by foreign governments and companies in relation to the opaqueness of the Chinese investment framework and the excessive rules applied to FDI, in 2019, the Chinese central authorities adopted a new *Foreign investment Law*[4] *(FIL*), which expressly prohibited actions that could lead to a "forced" transfer of technology, and promoted: *a)* technological cooperation based on the free will of investing companies; *b)* enhanced IPR protection; *c)* equal and non-differentiated treatment of foreign capital companies[5] (Standarder Trade Portal, 2021). Nevertheless, international analysts highlight that FIL continues to use a vague wording which leaves room for interpretation – in particular with respect to aspects related to "forced" technology transfers – and presents a series of loopholes when it comes to its implementing regulations, which do not contain details on how the legitimate rights and interests of foreign investors can be protected (Elen, 2020).

Also, despite the gradual liberalisation of the regime allowing for foreign direct investment inflows, which was implemented over the recent years, China still maintains a detailed FDI monitoring, control and management system, in which the *Catalogue for the guidance of foreign direct investment* plays a central role. Depending on the potential receiving industries, the Catalogue divides FDI into three groups (encouraged, restricted and prohibited), which determines both different degrees of examination when approving investments, and different levels of investment conditioning or investment regulation. From the time it was prepared until its last annual review (2020), the document has continued to specify the fields in which foreign partnerships (such as joint ventures) can be created and the shares of participation permitted to foreign companies, so that the Chinese party may have control over the newly created entities.

In light of the provisions of the *12th Five-Year Plan* (2011) and of the *Five-Year Plan on Foreign Capital* adopted later (in 2012) by the National Development and Reform Commission – which anticipated the launch of the new *MIC 2025 Strategy* –, Chinese authorities started paying increased attention to the promotion of FDI inflows in the emerging branches of the national economy, expressly referring to a need to stimulate the absorption of foreign capital in biotechnology industries (Edelberg, 2017). Given the importance of FDI absorption for accelerating innovation by national companies[6] and the fact that decision-makers were aware of the significant importance this absorption has for the development of local industries related to life sciences[7], the

[4] Adopted at the 13th Congress of China's CCP of 13 March 2019, the law entered into force at the beginning of 2020.

[5] For example, when licences are granted or when participating in public procurement calls.

[6] On the one hand, resulting directly from advanced technologies and the sharing of the know-how of foreign companies and, on the other hand, as a result of the reduction of the cost of innovation for national companies (an indirect consequence of the demonstration effect, workforce mobility, shared use of suppliers, etc.).

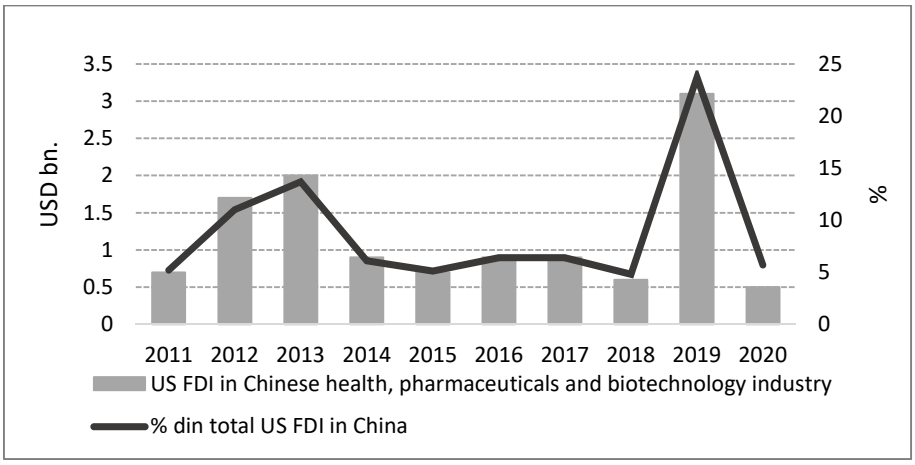
[7] Out of all the channels that can be used for technology transfer, FDI has the largest contribution to the development of the national biotechnological industry, because with the capital intended for the creation of new local facilities, foreign

Catalogue issues of the recent years not only extended the biotechnology sub-fields in which the authorities seek to encourage the inflow of foreign direct investment, but they also gradually optimised the measures intended to stimulate them. As such, depending on a series of well-delineated criteria (which are related, among others, to the specific particularities of the sub-branch towards which the investments are directed, the amount thereof, etc.), based on the recent regulatory rules, the investors in the field are granted a wide range of incentives, such as tax reliefs, lower customs duties, preferential rights on the use of land, etc.

Against this background that we described, U.S. FDI flows in the Chinese medical sector and in the pharmaceutical and biotechnology industry evolved without major fluctuations during the last decade – with the exception of 2019, when they reached an absolute maximum –, particularly fuelled by financial motivations, stimulated by the ample modernisation of the local medical system in the context of an increased population ageing (Rhodium Group, 2021).

During the period analysed (2011-2020), U.S. investments in this sector amounted overall to around USD 12 billion, which corresponds to a share of approximately 9% of the total U.S. investments in China. From this perspective, the year 2019 marked an unprecedented performance in this regard, with this share reaching a historical "peak" of 24% (Graph 1), also due to a major individual purchase worth USD 2.7 billion: the takeover of the Chinese pharmaceutical company *BeiGene*, specialising in the manufacture of cancer medication, by the American group *Amgen* (Hanemann, et al., 2021).

Graph 1: U.S. FDI in the Chinese medical sector*, the pharmaceutical and biotechnology industry, 2011-2020



Note: * Including investment in medical technologies.
Source: Author's calculations and processing based on the data published by Rhodium Group-China Investment Monitor (2021): https://www.us-china-investment.org/fdi-data.

In 2020, as a result of the negative effects of the Covid-19 pandemic – which diminished the investment appetite of U.S. companies – and because of intensified U.S.-China frictions, the value of U.S. FDI in the biotechnology sector and the related areas decreased by around USD 2.5 billion, the only significant transactions this year being the purchase of *Cstone Pharmaceuticals* by *Pfizer* (USD 200 million), and the takeover of the *Shenzhen Hepalink* pharma group by *GGV Capital* (USD 50 million).

Although at the level of the overall interval under analysis the main way in which U.S. companies chose to enter the Chinese biotechnology market was represented by aquisitions (with a share of 58% of all investment) (Box 3), at sub-sector level there were a series of differences, mainly resulting from the motivations that underpinned the decision-making process.

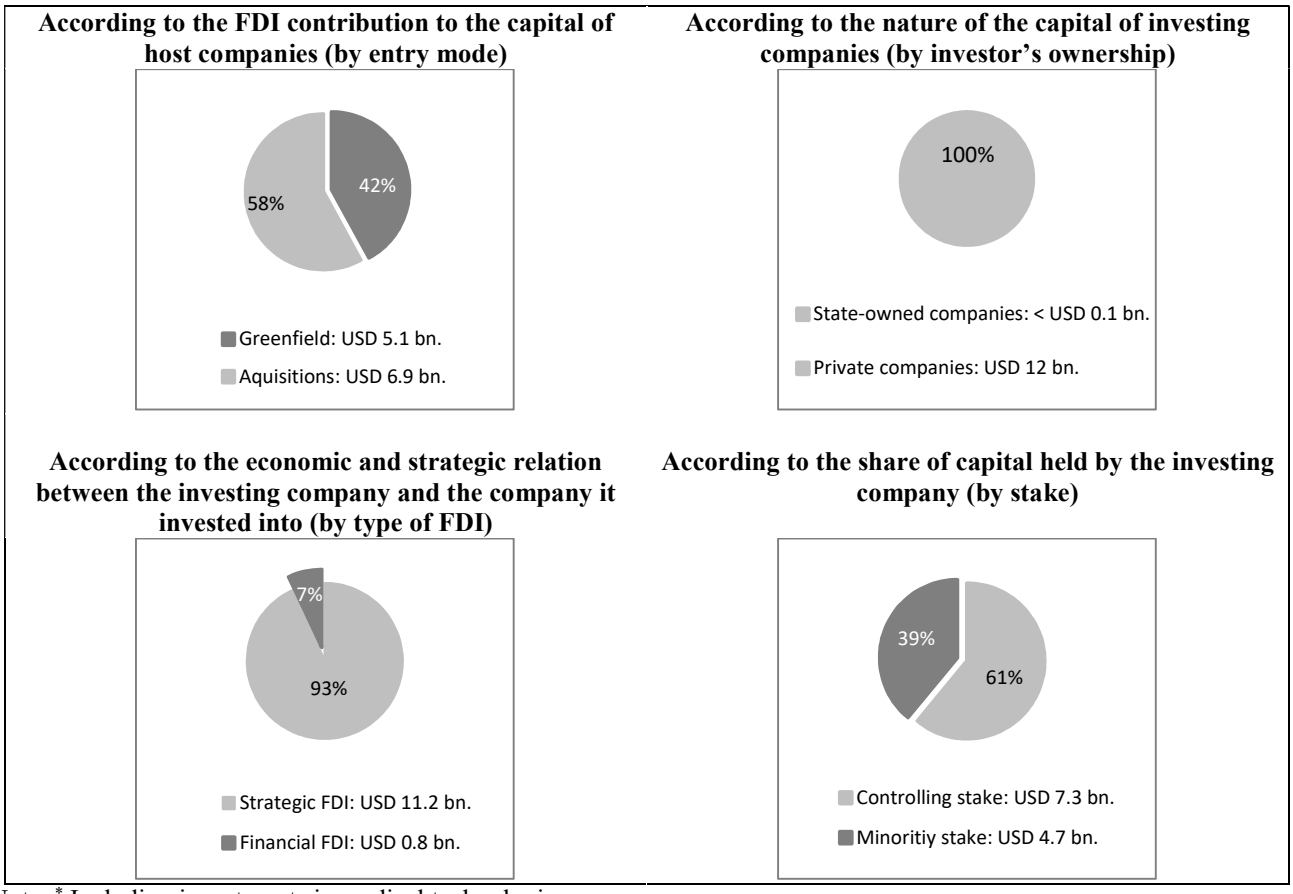
As is the case with the medical technology development and production branch, U.S. FDI sought both to benefit from China's lower production costs, and to increase their market share, which is why investments in these industries were mainly "greenfield" investments (e.g., the creation of production subsidiaries in Suzhou by the companies *Becton Dickinson* and *Johnson & Johnson*).

companies transfer IPR, expertise and good practice in the field, at the same time facilitating the integration in the global supply chains.

In the same period, U.S. companies also made a series of purchases of local companies. Several illustrative examples in this regard are: a) the acquisition of the orthopaedic implant manufacturer *China Kanghui* by the U.S. company *Medtronic* (in 2012), at a transaction value of USD 816 million; b) the acquisition of the medical device manufacturer *Trauson* by the *Stryker* group (2013) at a value of USD 764 million.

As regards FDI in the pharmaceutical and biotechnological industry, which is the most attractive investment segment for U.S. companies in the field (with a total share of around 70% in the interval analysed), the main motivations underpinning the investment decision were determined by *i)* advantages related to production costs; *ii)* the prospects of accessing a larger and dynamic market (market-seeking investments); *iii)* the opportunities related to distribution and other downstream activities, and the setting up of production facilities mainly took place via acquisitions.

Box 3: Synoptic table of the classification of U.S. FDI in the Chinese medical sector*, the pharmaceutical and biotechnological industry, 2011-2020 (cumulated values)



Note: * Including investments in medical technologies.
Source: Author's calculations and processing based on the data published by Rhodium Group-China Investment Monitor (2021): https://www.us-china-investment.org/fdi-data.

Although it presents attractive investment prospects for U.S. companies in the field, the healthcare services sector still maintains a series of formal and informal restrictions – deriving from how the functioning of hospitals and healthcare centres is regulated –, which on the one hand determined a low share of U.S. FDI in the field (5% of the overall total in the sector), and on the other hand provided the option to access the market by setting up joint ventures with Chinese participation.

Directing Chinese outward investment to increase the biotechnological intake

The upward trend of Chinese outward direct investment (ODI) in developed countries (the U.S. in particular[8]) – increasingly visible during the last decade – triggered an international need to study the determining factors of this trend. The conclusions of recently carried out analyses (Huang & Zhang, 2017) showed that since local transnational companies do not (at present) possess technological resources similar to those in highly industrialised economies – thus ruling out the exploitation of competitive advantages on external markets as a motivation for the internationalization of their activities (which would have been in line with classical investment theories) –, the main reason underlying their decision to invest abroad is that of obtaining strategic assets. As such, to acquire *know how*, Chinese companies invest in economies that are rich in technological resources, where they purchase strategic assets which they take over and then use on the national market (a phenomenon that is known as a reverse technology transfer).

Implicitly, and in order to develop its domestic biotechnology sector, China also relies to a great extent on the interaction with relevant companies in technologically advanced countries, and in this case its investments and acquisitions abroad seek to secure new research, development and innovation skills and competencies in the field, which could contribute to the strengthening of the existing national capacity (Kazmierczak, et al., 2019). With the launch of the *Made in China 2025* industrial development plan that designated the biotechnology sector as a strategic emerging branch of national interest and one which was eligible for increased government support, followed by the implementation – as a result – of a program for the reform of the internal regulatory framework in the field and the implementation of a set of measures meant to increase control over how outward investment could be directed, China's investment policy became an *"aggressive one […], based on innovation mercantilism"* (Atkinson, 2019, p. 2). As such, by establishing clear and well "targeted" goals, the new internationalisation strategy seeks to secure competitive advantages that could enable China's transition towards a new stage of industrial transformation – from a follower to a future leader in the field of biotechnologies and innovation –, which entails achieving supremacy over the U.S., the traditional holder of the dominant position in the life sciences industry.

Although the U.S. policy usually focused on the active promotion and attraction of foreign direct investment from China, the recent emergence of certain increasingly higher geopolitical and geoeconomic ambitions on China's part generated a series of concerns among U.S. decision-makers with regard to: *a)* the unilateral transfer of technological and business expertise, in the conditions in which Chinese ODI in R&D mainly seeks to bridge the national technological gap; *b)* the unfair competitive advantage over U.S. companies as a result of the government support received by Chinese companies[9]; *c)* the danger of a leak of sensitive information (Box 4).

Box 4: Examples that illustrate how, through ODI, China gained access to U.S. citizens' sensitive data

✓ In addition to the financial interests which, in accordance with the classical theories, each and every investment, as well as to the motivations related to acquiring high technologies and *know-how*, which we illustrated in this analysis, the accessing of the U.S. markets by Chinese companies involved in the conduct of activities in the field of life sciences can provide them with access to sensitive information and data bases on the medical history and state of health of U.S. citizens.

✓ Because based on the government support they benefit from Chinese companies ODI are able to provide services at much more affordable prices than national actors, they are often selected to the detriment of local companies to carry out research and tests in the medical field, in genetics, etc. For ample, in 2019, 23 companies associated with China were authorised to carry out genetic tests on the U.S. territory (Kazmierczak, et al., 2019).

✓ Following the onset of the Covid-19 epidemic, the U.S. further liberalized the access on the U.S. market of Chinese medical companies which collected sensitive data. As a result, in 2020, the *U.S. Food and Drug Administration (FDA)* authorized under an emergency procedure the use of Covid-19 test kits manufactured by the U.S. subsidiary of the Chinese company *BGI Genomics* (a supplier of medical devices and genome sequencing services), a premiere in terms of authorisation of medical devices manufactured in China (later, *Genetron Health*, another Chinese company specialising in high-precision medicine received the FDA green light).

[8] From the very first stage of the opening towards the exterior of the Chinese economy – launched at the beginning of the 2000, in order to support the internationalization of the activity of local companies –, the U.S. was always the main destination of China's outward direct investment (China Power, 2021).

[9] Because companies accessing external market usually benefit from government subsidies, they have a competitive advantage compared to local companies (for example, in the merger and acquisition call for tenders).

✓ By mid-2020, *BGI* had sold around 35 million tests in over 180 countries, including the U.S. Moreover, the same Chinese companies set up their own laboratories dedicated (apparently) to supporting the processing and interpretation of the data collected from the tested persons, thus fuelling international fears that by doing this, China is actually trying to collect heterogeneous genetic information the research of which could help China's interests of dominating the global biotechnology market (Needham, 2020).
✓ Unlike in other federal states, the U.S. legislative system has no regulations that could ensure a nationwide approach of data collection and management; it only has state laws on the management of information from certain sectors. For the medical sector, the *Health Insurance Portability and Accountability Act (HIPPA)* provides the legal framework, defines the aspect related to the protection of health information and establishes the conditions in which the disclosure of such information is permitted. Nevertheless, the HIPPA provisions do not cover all the cases in which personal data are collected, nor does it apply in situations in which patient data are anonymised.

Source: Author's synthesis based on US-China Economic and Security Review Commission (2020).

In these conditions, because the biotechnological sector is considered essential for U.S. national security, the Department of Trade raised concerns with the U.S. federal government on the risks posed by China's illegitimate actions that seek an accelerated and "forceful" technology absorption[10], and at the same time pleaded for the need to adopt measures that could confer a higher degree of protection for intellectual property and limit the transfers of *know how* to Chinese companies (Ono & Cabot, 2019).

As a consequence, in 2018, the *Committee on Foreign Investment in the US (CFIUS)* within the U.S. Department of Trade adopted the *Foreign Investment Risk Review Modernization Act (FIRRMA)*, which consolidates the system for the monitoring and mitigation of the risks that certain FDI may pose to the critical infrastructure, as they enable the access to sensitive information and/or key technologies within several industries of national interest, including those related to life sciences (Box 5).

Box 5: Synthetic overview of the recent changes in the Chinese and U.S. investment regulatory frameworks

CHINA

Beginning in 2016, the Chinese government implemented a series of measures aimed at increasing the control and surveillance of outward investments of national companies:
✓ The State Council issued (in 2016) the *Guiding opinions on the promotion and regulation of the development of applications using big data in the medical field*, which it designated as "fundamental national resources", encouraging outward investment in this sector (particularly in in the U.S.)[11] (U.S.-China Economic and Security Review Commission, 2020).
✓ In 2017, the *State Administration of Foreign Exchange (SAFE)* adopted a set of internal rules whereby it required national banks to report any transfer made abroad by Chinese-based companies which exceeded the USD 5 million ceiling. This regulation not only restricts ODI flows of Chinese companies, but it also limits the transfer of funds between the mother company and the subsidiaries abroad.
✓ In 2017, the Chinese authorities published a new package of administrative measure applicable to national companies accessing the foreign market, the purpose of which was both to restrict certain fields (by introducing blacklists), and to regulate the companies' activities in the post-investment stage. These special administrative measures were revised on several occasions (during the years 2017/2018), in order to reduce "irrational" investments[12] and redirect ODI towards technologically-intensive fields that could favour China's repositioning within global value chains. At the same time, the government sought to correlate the investment process with the development goals proposed at national level and transform the internationalization policy into an essential component of the country's economic transformation and modernisation process.

[10] Among the unfair practices employed by the Chinese companies in order to accelerate learning/the development of new skills and competencies are: the takeover of intellectual property rights, the application of opaque, discretionary measures in the investment approval process, state subsidies for acquisitions/investments in companies that own high-end technology, the relocation to China of the company's activity after the acquisition and the technology transfer are completed etc. (White House Office of Trade and Manufacturing Policy (OTMP), 2018).
[11] Although it is unlikely that the data included in individual medical records may lead to the development of new treatments, their aggregation in case of countries with large populations could facilitate medical discoveries with a high commercial value. Because of the ethnic diversity of the U.S. population, U.S. medical data are particularly valuable in this regard.
[12] Namely, investments in real estate, the hotel and entertainment industry, which have been considerable during the recent years.

The National Development and Reform Commission, by Order no. 11/2017, extended the process for the analysis and approval of the national companies' outward investments. As a result, for investments exceeding the USD 300 million ceiling, investors are required to submit additional supporting documentation at the NDRC branch of the company's province of origin. This rule does not apply to Chinese companies that fully take over the control of the company located on the foreign market (nevertheless, even these companies are subject the SAFE regulations on the international transfer of funds). Although so far the biotechnology sector has not been included on the list of sensitive industries subject to Order 11 restrictions, it remains to be seen how the Chinese authorities will choose to respond to the commercial and investment policies recently adopted by the U.S.

U.S.

- The implementation of FIRRMA led to an extension of the jurisdiction of the Committee on Foreign Direct Investment in the U.S., through the launch of a pilot-programme that sets out an obligation to report all foreign investments related to critical technologies and those directed at the collection of data that are sensitive for U.S. citizens, even in cases where the foreign companies are not the majority shareholders (which would enable them to take direct control over the newly established company[13]) (Lenvine & Paretzky, 2019). R&D activities in biotechnology are also among the 27 critical fields identified. The actions that CFIUS can take in the event of a failure to comply with the investment registration requirements and/or in the event that sensitive assets are excluded from the statements include, among others, the application of penalties of up to the value of the transaction Also, the pilot-programme forced U.S. companies to pay increased attention to permanently checking the compliance of the classification of the products, services and technologies resulting from foreign investment, in particular with the provisions of the *Export Control Act* (which is constantly changing).
- The promulgation in 2018 by President Donald Trump a of the *National Defence Authorization Act (NDAA*), the key-objectives of which being to protect U.S. technological advances through a closer monitoring of technology transfer to foreign entities. In addition to the provisions of the *Foreign Investment Risk Review Modernization Act*, NDAA includes the *Export Control Reform Act (ECRA)*, which brought significant changes in the control of emerging and fundamental technology exports, imposing additional restrictions for this transfer. As such, the ECRA extended the jurisdictional scope of export controls and tightened the restrictions, by adopting a set of measures with significant impact on cross-border transactions (Leiter, 2018):
  - the setting up of an ample documentation review process in order to identify fundamental emerging technologies and impose adequate export controls;
  - the conditioning of the granting of export licences for joint ventures on the declaration of "significant foreign ownership";
  - the call for an immediate review of the restrictions and conditions for the granting of licences for the export of U.S. products to countries under embargo (including China).

The adoption of the *Fair Trade with China Enforcement Act* (May 2019) brought additional restrictions on Chinese investments in U.S. companies in several industries designated as being of strategic importance, including in the field of biotechnologies.

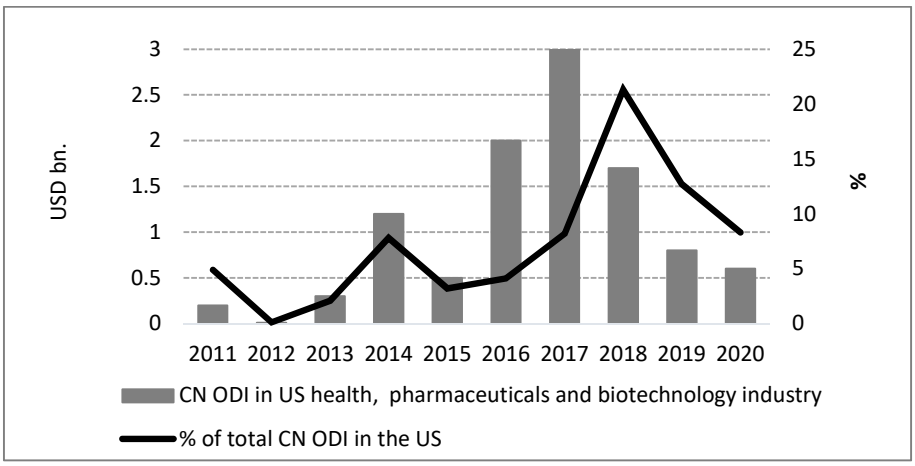
Source: Author's synthesis based on Brookfield (2019); Ono & Cabot (2019), as well as on the bibliographical sources quoted in the box above.

As regards the evolution of Chinese ODI flows directed to the U.S. medical, pharmaceutical and biotechnological sector, although the cumulated value over the last decade was relatively low (of around USD 10.2 billion; Graph 2 and Box 5), the investment activity saw a rapid increase beginning in 2016 and until the second half of 2018, when the tensions between countries began in relation to China's outward investment policy and practices[14].

[13] Until 2018, for these companies, the submission of supporting documents for investments on the U.S. territory was generally optional.

[14] As we stated, these dissensions began in 2018, based on the accusations issued by the U.S. government, according to which, the policies adopted by China in the field of investments are mainly directed to the support of priority industries and favour "large national champions", and aimed at the same time at a technological advance, by purchasing and re-innovating foreign technologies (Atkinson & Foote, 2019).

Graph 2: Chinese ODI in the U.S. medical sector*, the pharmaceutical and biotechnology industry, 2011-2020



Note: * Including investments in medical technologies.
Source: Author's calculations and processing based on the data published by Rhodium Group-China Investment Monitor (2021): https://www.us-china-investment.org/fdi-data.

Also, in accordance with the conclusions put forward by a series of reports prepared at national and international level (Deloitte China, 2018; Hanemann, et al., 2021), during the entire interval analysed and referred to above, the main factors that motivated Chinese ODI in U.S. industries pertaining to the biotechnology field were based on: *i)* the initiative of modernizing China's internal technological capacity and the related assets, in order to achieve the degree of progress set out in the MIC 2025 strategy and in the later programme documents; *ii)* the creation and/or consolidation of supply chains; *iii)* the use of the U.S. talent pool to expand R&D activities in the field.

As shown by the data presented, despite the increase in value visible at the level of Chinese investment flows dedicated to the U.S. healthcare, pharmaceutical and biotechnology sector, in the investment boom period (2016-2017), the share of this sector in total ODI from China remained relatively low (around 4% in 2016, and approximately 8% in 2017), a trend that was reversed beginning in 2018.

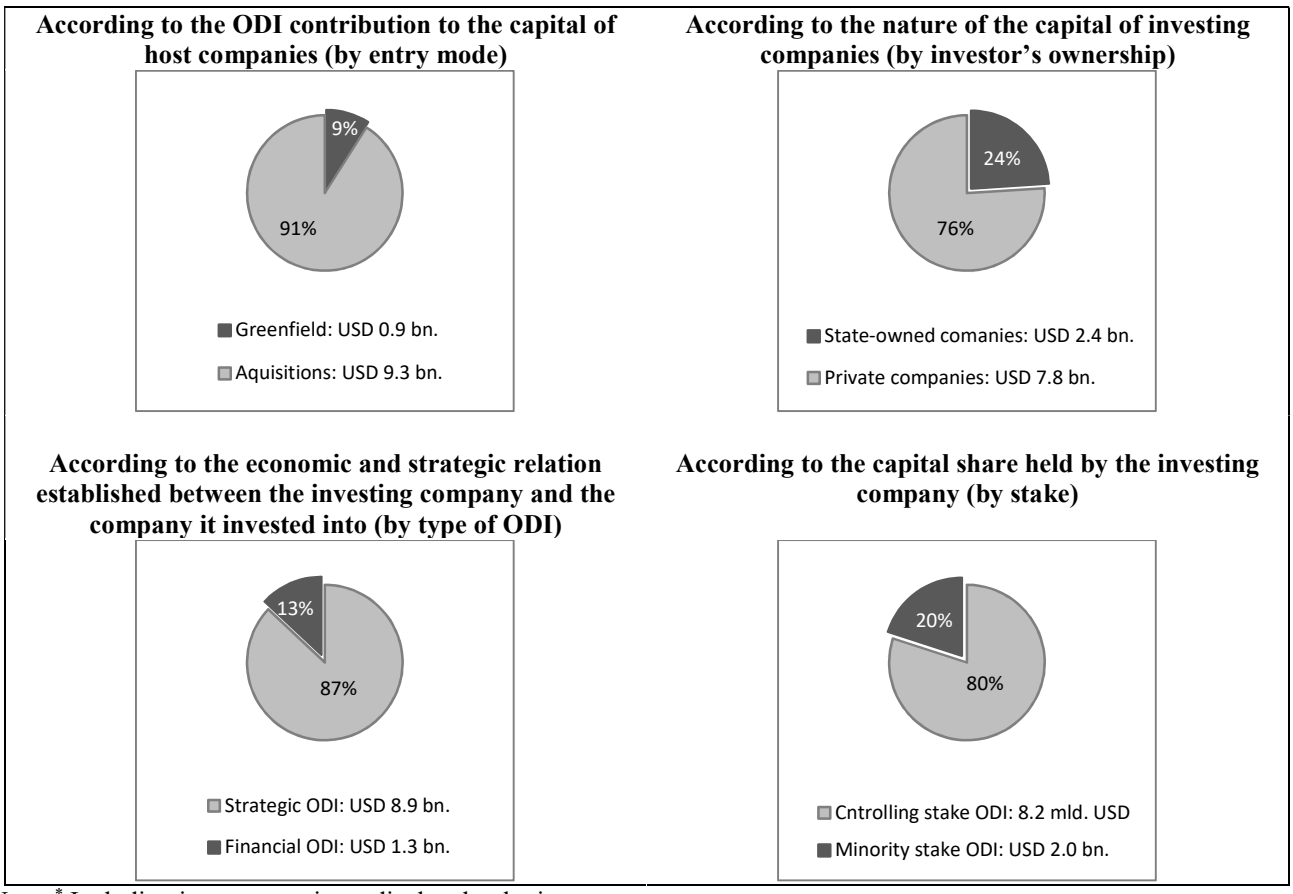
As such, in 2019, against the background of an intensified examination and monitoring of Chinese investments falling within the scope of FIRRMA and of the divestiture provisions applied (e.g. in the case of *iCarbonX*, the amount of ODI in the field of life sciences saw its first contraction after 2015 and at the same time a major decrease compared to the level seen in the preceding year (of around 50%).

As the pandemic accelerated and the tensions between the U.S. and China intensified, this declining trend continued in 2020 as well, when Chinese ODI in the biotechnological and pharmaceutical industry marked a new decrease in annual terms (of approximately 20%), although this sector ranked third among the preferences of Chinese investors[15] (Hanemann, et al., 2021). The most significant purchase contracts concluded in 2020 are: the takeover of *Absorption Systems* (by the Chinese group *Pharmaron*) and of the U.S company *Red Realty LLC* (by the *Fuan* pharmaceutical group), which totalled USD 2011 million. Also, the value of "greenfield" projects with only Chinese capital was relatively low, given that the main investments in start-ups were made by: *a) Beijing Gan & Lee Biotechnology* (USD 67 million); *b) Shanghai Henlius Biotech* (USD 65 million).

Since the main goal of Chinese ODI was always to absorb new technological skills and competencies, the preferred ways of accessing U.S. markets were mergers and acquisitions involving existing companies in the field. As a result, during the last decade, the cumulated share of acquisitions in total Chinese sectoral investments in the U.S. was of over 90%, while "grassroot" investment projects were insignificant in share (Box 6).

[15] After the entertainment industry and the consumer product services sector.

Box 6: Synoptic table of the classification of Chinese ODI in the U.S. medical sector*, the pharmaceutical and biotechnological industry in 2011-2020 (cumulated values)



Note: * Including investments in medical technologies.
Source: Author's calculation and processing based on the data published by Rhodium Group- China Investment Monitor (2021): https://www.us-china-investment.org/fdi-data.

As China's biotechnology sector is dominated by companies formed with mainly private participation[16], this was also reflected in the total investment flows targeting the U.S. in the last decade, during which only USD 2.4 million – corresponding to a share of 24% – came from state-owned companies. However, beyond the shareholding structure of the companies accessing a foreign market, the Chinese government authorities are able to influence the decisions of local companies by a variety of channels.

Among these, an important role is held by ODI monitoring, control and approval activities, whereby the authorities are able to direct investment flows in accordance with the objectives of the national industrial development policy. At the same time, another way of exercising government influence on local companies in the biotechnology field is the massive support granted by the state through direct investment flows aimed at the construction of industrial parks, the development of SMEs, or the attraction of foreign companies. In addition to these, Chinese companies also benefit from indirect financing received from state-owned industrial foundations and research centres managed by large national agencies (usually, MoST). Although the main objective of most of these funds is to finance the development of local activities, in certain cases they are also mandated to support the internationalization of relevant companies[17]. Also, the largest part of the capital of private companies comes from the large state-owned commercial banks which, in their turn, are subject to the rules imposed by the governmental regulatory authorities. Although it is difficult to measure the extent to which government control

[16] In accordance with the definition developed by the *State-owned Assets Supervision and Administration Commission of the State Council (SASAC),* private companies represent those entities in which the share of government participation is less than 20% (similarly, in state-owned companies, the government holds a share of more than 20%) (Kazmierczak, et al., 2019).
[17] For example, in 2017, in the Wuhan Donghu district, the local authorities created a special fund – amounting to USD 155 million –, intended for the increase of the degree of innovation of local high-tech companies with a view to their global expansion.

is exercised by resorting to coercion in relation to any of the aspects referred to, the Chinese authorities are at all times able to directly intervene in the transactions of individual companies, because those companies do not have the legal means to appeal against government interference.

3 Conclusions

As a result of the political measures adopted from a very early stage by the Chinese central authorities in order to regulate and guide foreign direct investment in accordance with the country's own strategies for the modernisation of the biotechnological sector and, later on, direct Chinese outward direct investment in accordance with the same national interests, correlated with the sustained efforts made over the recent years for the creation of a knowledge-based economy, China gradually reduced the gap that was separating it from the technological frontier, and became one of the main competitors in the race for global supremacy in the field of biotechnology. As such, in addition to an ample direct support for research programmes and initiatives in the field, the Chinese government applied a sustained and gradual policy seeking to encourage the entry on the Chinese market of large transnational biotech corporations (U.S. companies in particular) and the relocation of their production on the local market, coupled with the adoption of measures meant to stimulate national companies to merge with and acquire U.S. companies in the field.

Over the recent years, the competition between China and the U.S. in the field of biotechnology has become fierce, and the U.S. officials are not sparing any efforts in claiming China's advance with regard to the development of emerging technologies in critical sectors. This may be true in certain fields, but not in the biotechnology sector, for now. Certainly, Chinese biotechnological industries are evolving at an accelerated pace, and some companies become leaders on certain market sub-segments (e.g. cancer treatment), but nevertheless, the U.S. holds the dominant position in the research-development-marketing activities based on the significant results assimilated in a period of over a decade (2000-2013) in which they held almost half of the total number of patents submitted in the field of biotechnology worldwide.

Biotechnology is a critical aspect in the technological competition between the U.S. and China, because based on its complexity and multidisciplinary nature, this sophisticated discipline has the capacity to transform in an interchanging way two essential fields: medicine applications and uses that are generally the prerogative of a military power. To exemplify more clearly, as shown by the history of the 20th century, the evolution of discoveries in physics enabled the understanding and use of nuclear reactions to produce energy; however, the same scientific principles were later used for the production of nuclear weapons. Biotechnology offers a similar mix of promises and dangers. For example, the discovery of the CRISPR-Cas9 enzyme system (which was awarded the Nobel Prize in 2020) enables the highly precise encryption of a body's genome, which makes it a transforming discovery. However, while CRISPR is very promising for the development of innovating treatments for certain conditions that have long been considered untreatable, it could also lead to the production of a new generation of lethal biological weapons.

China's determination to become a global power in the field of biotechnology is reflected in the unequalled level of government support, in the minute development of roadmaps for each stage of evolution, in the design of policies for incentivising the attraction of high-quality talents (regardless of nationality), as well as in the creation of a national ecosystem that favours innovation.

Since the period when Deng Xiaoping was leading the country, China has started an ample transition process which enabled it to shift from the status of an "imitator" of developed nations to that of an innovating country. Concomitantly with this transition, biotechnology applications extended to extremely diverse fields such as: medicine, industry, agriculture, energy and environmental protection. Despite the persistent delays noted in the production of medical devices, China has reached its goal being today among the world leaders in the field of genome editing, immune therapy, cell therapy and the integration of information technology in medicine.

References:

[1] Amighini, A. (2019). Beijing: Ready for Global Technology Leadership? In A. Amighini (Ed.), *China's race to global technology leadership* (pp. 13-39). Milan: LediPublishing.

[2] Atkinson, R. D. (2015, Noiembrie 12). *China's strategy for global technology dominance by any means necessary*. Preluat de pe Forbes: https://www.forbes.com/sites/realspin/2015/11/12/chinas-strategy-for-global-technology-dominance-by-any-means-necessary/#20746128562a.

[3] Atkinson, R. D. (2019). *China's Biopharmaceutical Strategy: Challenge or Complement to U.S. Industry Competitiveness?* Washington DC: Information Technology & Innovation Foundation (ITIF). Retrieved from https://itif.org/publications/2019/08/12/chinas-biopharmaceutical-strategy-challenge-or-complement-us-industry.
[4] Atkinson, R. D., & Foote, C. (2019). *Is China Catching Up to the United States in Innovation?* Washington D. C.: Information Technology & Innovation Foundation.
[5] Bhatia, S. (2018). History, scope and development of biotechnology. În S. Bhatia, & G. Divakar, *Introduction to Pharmaceutical Biotechnology, Vol. 1: Basic techniques and concepts* (pg. 1-61). Bristol: IOP Publishing.
[6] Bu'Lock, J., & Kristiansen, B. (1987). *Basic Biotechnology.* London: Saunders College Publishing/Harcourt Brace.
[7] Cao, C. (2012). Biotechnology in China. *The Interface of Science, Technology & Security: Areas of Most Concern, Now and Ahead*, 99-109.
[8] China Power. (2021, January 28). *Does China Dominate Global Investment?* Retrieved November 01, 2021, from China Power: https://chinapower.csis.org/china-foreign-direct-investment/.
[9] Dahms, S. A. (2004). Biotechnology: What it is, what it is not, and the challenges in reaching a national or global consensus. *Biochemistry and Molecular Biology Education, 32*(4), 271-278. doi:https://doi.org/10.1002/bmb.2004.494032040375.
[10] Deloitte China. (2018). *2017 China Life Sciences and Health Care Investment Promotion Report.* Beijing: Deloitte China and China Investment Promotion Agency of Ministry of Commerce.
[11] Edelberg, P. (2017, November 08). *Is China Really Opening Its Doors to Foreign Investment?* Retrieved from China Business Review: The US-China Business Council: https://www.chinabusinessreview.com/is-china-really-opening-its-doors-to-foreign-investment/.
[12] Elen, M. (2020, January 22). *What's Missing in China's Foreign Investment Law?* Retrieved from The Diplomat: https://thediplomat.com/2020/01/whats-missing-in-chinas-foreign-investment-law/.
[13] European Federation of Biotechnology [EFB]. (1999). Environmental Biotechnology. *Task Group on Public Perceptions of Biotechnology*, 1-4. Preluat de pe https://blossoms.mit.edu/sites/default/files/video/download/Environmental_biotechnology_English.pdf.
[14] Friedrichs, S., & van Beuzekom, B. (2018). *Revised proposal for the revision of the statistical definitions of biotechnology and nanotechnology.* OECD, Science, Technology and Industry. Paris: OECD. doi:https://doi.org/10.1787/085e0151-en.
[15] Greenwood, J. C. (2013, January). *Biotech in China*. Retrieved from BIO: https://www.bio.org/sites/default/files/legacy/bioorg/docs/files/Biotechnology-Industry-Pg62-64.pdf.
[16] Hanemann, T., Rosen, D. H., Witzke, M., Bennion, S., Smith, E., & Orlins, S. A. (2021). *Two-Way Street: 2021 Update - US-China Investment Trends.* New York: Rhodium Group and National Committee on US-China Relations.
[17] Huang, Y. X., & Zhang, Y. (2017). How does outward foreign direct investment enhance firm productivity? A heterogeneous empirical analysis from Chinese manufacturing. *China Economic Review, Vol. 44, No 1*, 1-15.
[18] Kazmierczak, M., Ritterson, R., Gardner, D., Casagrande, R., Hanemann, T., & Rosen, D. H. (2019). *China's Biotechnology Development: The Role of US and Other Foreign Engagement. A report prepared for the U.S.-China Economic and Security Review Commission.* Maryland & New York: Gryphon Scientific & Rhodium Group.
[19] Leiter, M. L. (2018, September 11). *Tightened Restrictions on Technology Transfer Under the Export Control Reform Act*. Retrieved from Skadden: https://www.skadden.com/insights/publications/2018/09/tightened-restrictions-on-technology-transfer.
[20] Lenvine, D. J., & Paretzky, R. (2019). Foreign Investments In US Biotech Now Covered by CFIUS. *The National Law Review, IX*(121).
[21] Martin, K. D., Beccari, Tommaso, Kellermayer, M., Koller, M., Lal, ,., . . . Dundar, M. (2021). A brief overview of global biotechnology. *Biotechnology &Biotechnological equipment, 35*(Special Issue 1: European Biotechnology Congress 2020), S5-S14.
[22] Medical Decice Network. (2017, September 24). *China's Shandong Weigao to acquire Argon Medical for $850m*. Retrieved from Medical Device Network: https://www.medicaldevice-network.com/news/newschinas-shandong-weigao-to-acquire-argon-medical-for-850m-5933666/.
[23] Needham, K. (2020, August 05). *Special Report: COVID opens new doors for China's gene giant*. Retrieved from Reuters - healthcare&pharma: https://www.reuters.com/article/us-health-coronavirus-bgi-specialreport-idUSKCN2511CE.
[24] OCDE. (1999). *Emerging technologies: Biotechnology Statistics - European Union*. Preluat de pe OECD Directorate for Science, Technology and Innovation: https://www.oecd.org/sti/emerging-tech/biotechnologystatistics-europeanunion.htm.
[25] OCDE. (2001, Noiembrie 02). *Biotechnology, single definition*. Preluat de pe OECD - Glosary of statistical terms: https://stats.oecd.org/glossary/detail.asp?ID=219.
[26] Ono, M., & Cabot, H. (2019, September 05). *The Disappearance of Chinese Capital in US Biotechnology*. Retrieved from Back Bay Science Advisor: https://www.bblsa.com/industry-insights/2020/1/7/the-disappearance-of-chinese-capital-in-us-biotechnology.

[27] Rhodium Group. (2021). *The US-China Investment Hub*. Retrieved from China Investment Monitor: https://www.us-china-investment.org/fdi-data.
[28] Smith, J. E. (1996). *Biotechnology (third edition).* Cambridge: Cambridge University Press.
[29] Standarder Trade Portal. (2021, November). *China: Foreign Investment*. Retrieved from Standarder Trade Markets: https://santandertrade.com/en/portal/establish-overseas/china/foreign-investment.
[30] U.S.-China Economic and Security Review Commission. (2020). *Report to Congress of U.S.-China Economic and Security Review Commission.* Washington DC: US Government Publishing Office. Retrieved from https://www.uscc.gov/sites/default/files/2020-12/2020_Annual_Report_to_Congress.pdf.
[31] US Congress - Office of Technology Assessment (OTA). (1984). *Commercial Biotechnology: An International Analysis.* Washington DC: US Congress-OTA. Preluat de pe https://ota.fas.org/reports/8407.pdf.
[32] US Department of Commerce. (2003). *A Survey of the Use of Biotechnology in US Industry.* Bureau of Industry & Security. Washington DC: US Department of Commerce - Technology Administration.
[33] US National Academies of Sciences, Engineering, and Medicine. (2020). *Safeguarding the Bioeconomy.* Washington DC: National Academies Press. doi:https://doi.org/10.17226/25525.
[34] US Trade Representative. (2018). *Findings of the Investigation into China's Acts, Policies, And Practices Related to Technology Transfer, Intellectual Property, And Innovation Under Section 301 Of The Trade Act Of 1974.* Washington D. C.: Office of the United States Trade Representative; Executive Office of the President.
[35] White House Office of Trade and Manufacturing Policy (OTMP). (2018). *How China's economic aggression threatens the technologies and intellectual property of the United States and the World.* Washington DC: White House. Retrieved from https://trumpwhitehouse.archives.gov/wp-content/uploads/2018/06/FINAL-China-Technology-Report-6.18.18-PDF.pdf.
[36] Xinhua Silk Road Database. (2019, April 01). *Fuan Pharmaceutical to cooperate with U.S. firms on industrial cannabis production and processing*. Retrieved from Xinhua Silk Road Information Service: https://en.imsilkroad.com/p/303922.html.
[37] Zhe, L., Lifeng, G., & Xingua, Z. (2009). Definitions, R&D Activities and Industrialization of Biotechnology in China. *Asian Biotechnology and Development Review, Vol. 11*(No. 2), 29-43.

Understanding China's Double Reduction Policy on Educational Economy

QICHAO WANG, PhD.
Polish Studies Center, School of International Relations, Institute of Area Studies
Xi'an International Studies University, Lecturer
CHINA
Wqc0410@sina.com

XIAOTONG LUO
[2]Wuhou High School, Chengdu, Teacher
CHINA
254062408@qq.com

JIE YANG, PhD.
College of Artificial Intelligence, Chongqing Industry & Trade Polytechnic, Associate Professor
CHINA
jayoung@aliyun.com

Abstract: In July 2021, the Chinese government released the "Opinions on Further Reducing the Burden of Homework and Off-campus Training for Students in Compulsory Education" (hereinafter referred to as "Double Reduction" policy) at all levels of schooling in compulsory education system – including high schools, and off-campus education and training institutions – which were strictly implemented according to the policy. This paper briefly describes the impact of China's recent double reduction policy on the educational economic and evaluates its implementation process from macroeconomic perspective, by analyzing the private after-school and smart education industry, and by gaining an insight into the purpose and impact of the China's intention on private tutoring firms. It concludes that the "double reduction" policy has a complex and far-reaching impact on China's educational economy and on the related job market, as well as on the distribution of the family income and on education-relevant expenses, which is mainly reflected in family education costs. The findings also demonstrate that the smart education industry has rapidly grown after the launch of the policy.

Key Words:"double reduction" policy; economy; New Oriental; TAL education group; impact; smart education

JEL Classification: A2, I2, I25, I28

1 Introduction

The Chinese Communist Party implemented the "double reduction policy" as its pillar policy in educational sphere. The "double reduction" policy is an important measure to implement the Party's education policy. It is of great significance for fulfilling the fundamental task of fostering people's standard of living, by fundamentally improving the quality of school education and teaching, as well as by promoting a comprehensive and healthy growth of young people. The recent Chinese policy refers to a reduction in the total amount and time of commitment required by school homework and to a contraction in the burden of after-school training programs. When compared to the double reduction policy in South Korea, the Chinese government not only simply reduces after-school classes but also emphasizes the importance of education at school, more specifically, the quality of education at school. In order to implement the "double reduction" policy, schools are facing many problems. Beginning with classroom teaching, schools need to entrust students with the main position of the classroom. This is not only a challenge but also an opportunity for schools to deepen the reform of education and teaching.

The "double reduction" policy possesses a long-term and strategic plan on China's education industry. The overburden of students in basic education for K-12 level has always draw significant attention from both parents, educational enterprises and the schooling system in the society. Since the 1990s, "burden reduction" in primary and secondary schools has gradually commenced to be linked to the implementation of so-called "quality

education" aiming a "wholeness nurture" educational philosophy , such as "exemption from entrance exams for primary school students", "cancellation of rankings and reports" and other practices that emphasize "burden reduction" as a "baton for improving student quality", in order to guide teachers in the various school system to promote the implementation of "quality education" by reducing the difficulty of examinations, improving evaluation methods, and lessening the homework time.

In the first few years of the 21st century, Beijing started to make the "burden reduction" policy not only in the extracurricular activities but also in concluding the in-class teaching and learning behavior with a prominent feature of continuous evolution based on curriculum reform and the development of students' core literacy. Compared with the previous "burden reduction" relevant policies, although the current "double reduction" policy also includes explicit factors such as controlling the amount of homework and restricting off-campus training, the more important feature is that it focuses on the in-class teaching, namely the improvement of teaching quality is the core path of "burden reduction", so as to ensure that students meet the prescribed academic quality standards by improving teaching methods, driven with the ideology of "teacher should be responsible for the student", approaches such as designing high-quality homework with less homework time and so on to eliminate the continuous promotion of "burden reduction" obstacle. It can be seen from this that the original intention of the "double reduction" is to allow primary and secondary school students to develop in an all-round way, to bring the "effective" education back to school.

The core is to eliminate the burden of the excessive homework and off-campus training of students in the compulsory education stage, to reverse the short-sighted and utilitarian education evaluation orientation such as "grading dominated and ratio of key high school entrance", to adhere to the simultaneous development of whole-person education, and to implement the fundamental task of morality and education. "Double reduction" is of great epochal significance to China's basic education reform in the background of Sino-US competition context. It is an important measure to solve the fundamental problem of the education reform in China as to accord with Chinese characteristics in the development of education. The "double reduction" policy not only touches upon the reform of education system, but also has an important impact on the educational market which mainly reflect in several major aspects: the decrease in family expenditure on education, finding a way for traditional education and training institutions to survive in the context of the continuing growth of the smart education industry.

2. Incline of family expenditure on education

The "double reduction" policy represents an important measure to implement the Party's education policy. It is of great significance in the implementation of the fundamental task of life to foster people, comprehensively improve the quality of school education and teaching, as well as to promote the comprehensive and healthy growth of young people. At present, schools are facing many problems. In order to improve the impact of the teaching quality, we must begin from classroom teaching. Under the "double reduction" policy, classroom teaching should focus on the core literacy of the subject, highlight the dominant position of students, carefully design scenarios and inquiry activities, should stimulate students' desire to actively explore, as well as guide students to use their existing knowledge and experience to engage in inquiry learning.

The "double reduction" policy is a significant tool to build a sound education ecology that effectively relieve parents' anxiety, and promote students' all-round development and healthy growth.

The burden on students is effectively reduced by improving teachers' in-class teaching capability and homework design and, at the same time, the quality of after-school services is improved, by reducing the quantity but not quality, as well as by reducing students' learning pressure and their off-campus education and training. Moreover, this set of cuts in educational activities has implications for reducing family expenditure on unnecessary education and training, leading to an alleviation of financial pressures on household balance (sheets).

In addition, the "double reduction" also rectifies the chaotic market of off-campus education and training institutions, it tightly supervises the relevant tuition charges of off-campus education and training institutions, clarifies the methods and standards of tuition fee, and resolutely curbs arbitrary education fee charging to the students' parents, so that to take the liability of price-pitch from the off-campus education and training institutions back to education-related functional department, which regulates arbitrary price, to make the educational industry in a status of reasonable and stable charging standards, and supervision of the prepaid fees of off-campus education and training institutions to prevent the problem of any refunds loss for parents (Song, 2022). As a result of the variety of adopted policy measure the family's educational-related expenditure can also be relatively reasonable and stable. In short, the "double reduction" may reduce the family's excessive expenditure on

education, which is a great benefit for the family's overall saving plans and dramatically relieves the family anxiety on the burden of over-spending on non-necessities items regarding to education.

Besides, the "double reduction" policy requires the provincial governments to formulate measures for ensuring funds for after-school services. To fulfill the goal, various local governments clarify relevant standards, and adopt financial subsidies, service or agency charges to ensure that funds are raised in place. The performance of teachers participating in after-school services is functioned as a crucial reference for the evaluation of career promotion, recognition and reward and performance-based income. In addition, the effectiveness of the "double reduction" is included in the quality evaluation of compulsory education in county-level school system, and the students' participation in after-school services, off-campus training and the reduction of training expenses are regarded as important evaluation measurements. It can be noted that schools provide high-quality in-class and after-class services to improve students' core literacy, and the government has also adopted financial subsidies to further reduce family education expenditures.

3. Impact on private institution: case of New Orient and TAL education

The implementation of the "double reduction" policy has brought a fierce impact on the education and training industry. According to data from the Ministry of Education of China, by the end of 2021, the already-registered 124,000 offline training institutions subject of the compulsory education have been reduced to 9,728. The rate was 92.14%, the previous registered 263 online and off-campus training institutions were reduced to 34, the reduction rate was 87.07%, and the rate of "transition from profit to non-profit" reached 100% (Wu, 2021); pre-charging supervision essentially achieved full coverage. The total amount of supervision exceeds 13 billion Chinese Yuan; all provincial-level governments in China have issued relevant guiding principles on price standards, and the average fee has dropped by more than 40% comparably, 25 listed companies have completed the clean-up and rectification with statement that the business is no longer engage in subject training in compulsory education.

Since the Chinese government enacted the "double reduction" policy to alleviate the burden of students' after-school tutoring and counseling, many private education institutions are facing challenges. The impact of this new restriction on the educational industry is immediate. Companies such as New Oriental Education and Technology Group Corporation listed on New York Stock Exchange (NYSE: EDU) and Tal Education Group (NYSE: TAL) encounter the question of the adjustment and re-shape China's education industry and the related economic growth. New Oriental, founded in 1993, is a comprehensive education group. At present, it is the largest private education service provider in China, in terms of the number of courses, of the total number of students and of geographical distribution. TAL is a science and technology education company committed to exploring a new model of future education around the world, focusing on Smart Education and open platform, as well as on quality education and after-school training. Founded in 1997; it has been the main market competitor of New Oriental for many years.

The "double reduction" policy has fundamentally changed the status and role of private education institutions in the field of education, resulting in a major crisis for private education institutions. The current "double reduction" policy strictly regulates the chaos of educational institutions and turns the off-campus education and training institutions into a low-profile industry in a short time. In this context, how to deal with such a policy and conduct a quick transformation has become a key-issue. Based on the understanding of the "double reduction" policy, the leading companies –New Oriental Education Technology Group (New Oriental) and TAL education group – have provided the following measures for transformation:

(1) New subject-based off-campus training institutions for students in the compulsory education stage will be no longer authorized and approved by the governments at various levels, and the existing subject-based training institutions will be uniformly registered as non-profit institutions. A pre-approval principle will be applied for the online subject training institutions under the "double reduction" policy;

(2) Disciplinary training institutions shall not be listed for financing, and capitalized operations are strictly prohibited; listed companies shall not invest in discipline training institutions through stock market financing, and shall not purchase the assets of discipline training institutions by issuing shares or cash payment; foreign investment shall not pass mergers and acquisitions, entrusted operation, franchise chain, use of variable interest entities, etc. to control or participate in discipline training institutions, the institutions that have violated the regulations shall be regulated and rectified.

(3) Training institutions shall not illegally take into school teachers with unfair-purpose-based "salary attraction"; personnel engaged in subject training must have corresponding teacher qualifications, and the information of teacher qualifications shall be visible within the training institution premises and in the official websites; the private information of parents and students shall not be disclosed. According to market demand, training costs and other factors determines the charging items and standards of training institutions should be supervised by relevant governing authorities.

(4) A strict regulation on the excessive influx of capital into training institutions. The financing and fee charging of training institutions shall be mainly used for training business operations, unfair competition and marketing behaviors such as fictitious original prices, false discounts and brand-marketing for the promotion of business are resolutely prohibited. Foreign personnel hired in China must comply with relevant national regulations, and it is strictly prohibited to hire foreign personnel from abroad to carry out training activities within China.

(5) Off-campus training institutions shall not occupy national statutory holidays, as well as winter and summer vacations to organize subject-based training.

In addition, the logic behind the effectiveness of these measures will be studied to provide guidance for the crisis management practice of other enterprises. The most interesting discovery is that both New Oriental and TAL have strong dynamic capabilities, which help them respond effectively to the crisis. The results of this study provide enlightenment for modern enterprise crisis management.

In addition, observing from January 2021, when the China Central Commission for Discipline Inspection and the State Supervisory Committee straightforwardly point out the "chaos" in the online education industry and came to the promulgation of the "double reduction" policy in July the same year, many top leading education-focus companies have been warned and penalized. As a result, a professional career "panic" started to spread within the industry and even went further to bring a severer impact on the industry.

New Oriental Education Technology Group Co., Ltd. was listed on the New York Stock Exchange in 2006. It was the first company in China's education industry to be listed in the United States that provides counseling for different age groups. Its share price has fallen from its peak of 19.97 in February 2021 to its lowest point of 1.68 in August 2021. In response to the new restrictions, New Oriental Education and Technology Group immediately announced in July 2021 the plan to lay off some of the employees of the relevant departments, for cost-saving purposes. In late August 2021, the company announced plans to transform its K-12 education counseling into a quality-oriented education. The company is going to invest heavily in industries that are not subject to policy restrictions, such as sports, art, programming, etc.

From 2021 onwards, it was also observed that the Chinese after-school education and training companies listed on the NYSE have been impacted by relevant regulations, the market confidence was insufficient, the stock price fluctuated violently and it dropped sharply, indicating that the "double reduction" policy has affected the relevant listed companies on the stock market (see table 1). The response was remarkable, and it had a significant log-term impact on the company.

Table 1: The stock price for listed Chinese education companies

Stocking code	Name	2020.12.31 Price	2021.7.30 Price	2022.3.31 Price
EDU.N	New Orient	186.04	2.17	1.15
GOTU.N	Gaotu Edu	51.71	3.19	1.72
IH.N	Hongen Educ	18.12	6.84	2.14
TAL.N	Haoweilai Edu	71.51	6.07	3.01
ONE.N	Jingrui Edu	3.80	0.517	1.62
FEDU.N	Siji Edu	1.08	0.65	0.647
NEW.N	Puxin Edu	5.82	0.69	2.08
HLG.O	Hailiang Edu	65.84	35.5	13.35
LXEH.O	Lixiang Edu	8.43	9.00	4.78

Source: Authors after Yahoo Finance.

As the "industry" crisis is triggered by national policies, it will lead to fundamental and permanent changes in the market scale and profit gaining pattern for private education companies. Therefore, New Oriental and TAL began to shift their strategic focus from K-12 to other education fields, and accelerate the development of family education, vocational education and university education. For example, New Oriental has set up a "quality education growth center", which has six sections, including the College of Art Creation, the College of Humanistic Development, the College of Language and Business Literacy, the natural science and creative space

station, the intellectual sports training center and the family education wisdom center. In addition, New Oriental announced the establishment of Bingo, the Chinese language and culture learning project, to expand the overseas Chinese market. In this case, New Oriental and TAL quickly took countermeasures. First, an announcement was issued to cancel the release of financial reports and to provide further updates in due course. In addition, a statement on the social media website announced that relevant businesses had been closed to ensure compliance with rules and regulations, which had a negative impact on the company's operations. The temporary cancellation of the release of financial reports rarely occurs, suggesting that New Oriental and TAL education are trying to adjust. At the same time, they have taken a wise move to keep the public informed of the latest situation. To some extent, these actions reflect the flexibility of the two companies and avoid more harm at such an urgent time.

On the other hand, due to the large reduction of off-campus education and training institutions, a remarkable number of employees were forced to lose their jobs. According to the statistics, the number of employees in China's education and training industry has reached 15 million, and the number of unemployed people affected by the "double reduction" policy has reached 10 million, which meant two of the thirds have to re-enter the job market. Therefore, the "double reduction" policy has generated a huge impact on off-campus education and training institutions. Encountered with this situation, off-campus education and training institutions should actively respond and actively adjusted into the following possible development trends.

Smart education is the first consideration. Although China vigorously promotes the "double reduction" policy, smart education is China's leading direction in education industry, so it would serve a high possibility of transform to the smart education industry for these institutions. Education for adults is the second matter and an important option. More and more citizens are receiving higher education through adult academic education. The object of adult education is all kinds of on-the-job and practitioners, and the results of the education can directly and effectively improve the quality of laborers as well as improving productivity levels, and thus promote labor productivity and economic benefits. Adult education will be supported by policies and will become a breakthrough point for major educational institutions to transform. The third is vocational training. The market size and potential of the online lifelong education industry are large, due to the two advantages of vocational education: on the one hand, the endogenous motivation of professionals to improve themselves; on the other hand, the strong demand for high-quality talents in various industries. After the introduction of the "double reduction" policy, the failure of the K12 market was considered a "loss" and the job-orientated vocational education become a popular possibility for transformation.

Besides, education technology companies seek growth in emerging markets by going overseas, such as New Oriental constantly expanding abroad and building national brands and images.

In sum, we believe that through the improvement of educational level of children's parents and the change of family-based education concepts that implies that the student is not only limited to academic performance, but also pays more attention to the overall development and growth the government education policy has registered important achievements. The demand for education such as K12 education has increased, and K12 education enterprises have a large number of customer resources between 5 and 18 years old, which implies a huge potential market.

For the "sudden" unemployed in the industry, they should actively face the changes, broaden the job horizon and give full play to the advantages of industry experience as following. The first and ideal option is to seek for a position in the public school, considering job stability and occupational relevance, which is the first choice for most education and training teachers. In line with it, the position in the private school was considered, long before K12 had undergone great changes, the career planning of many education and training teachers, who gave priorities of private schools rather than of public schools. For young teachers, the treatment of private schools is generally higher than that of public teachers, and the growth is also much higher than that of education and training institutions. Private tutoring is the third choice under the premise of macro-policy restrictions on off-campus education industry, the private tutoring industry has begun to pick up. The K12 is also utilized by the online courses, meanwhile the last two options are seeking for jobs in non-education industry such as pursuing further studies and take the public servant exam as well as positions in state-owned enterprises.

4. Opportunities for smart education industry

"Double reduction" policy proposes that the education authorities should develop and call for various high-quality online education and teaching resources, and use national and local education and teaching resource platforms to form high-quality school network, provide students with free high-quality special education

resources and courses covering all grades and subjects. The aim is to promote the balanced development of educational resources and educational equity.

The smart education industry has to help “double reduction” to achieve data-driven quality and efficiency improvement. Currently, the smart education industry is in a matured stage featuring with the application of smart teaching toolkits such as smart Apps, iPad software, etc., school teachers are able to synchronously send out the feedback and obtain students’ mastery of relevant subject-based knowledge, visual reports reflecting students' learning is available so as to comprehensively understand students’ individual differences and conduct more precisely targeted teaching guidance. Students can complete self-directed deep learning upon teachers’ personalized comments. During the after-school learning session, teachers can push “error-collection sets” and design targeted questions as well as drawing inferences from other learning resources to students who have spare capacity or seek help based on the diagnosis and accurate grasp of their learning situation, so as to enable “privately customized” large-scale teaching increasingly cover the whole subject and the whole school stage. It is safe to say the smart education related e-products and pre-purchased software and Apps are quite welcome and prevalent among the parents and students in China.

In addition, in 2021, the “Opinions on Vigorously Strengthening the Construction and Application of Online Education and Teaching Resources in Primary and Secondary Schools” was jointly issued by the Ministry of Education, the National Development and Reform Commission, the Ministry of Industry and Information Technology, the Ministry of Finance, and the State Administration of Radio and Television to expand the coverage of high-quality digital education resources in the compulsory education stage and improving the teaching quality of primary and secondary schools provides an action guide, and its reform ideas coincide with the requirements of “double reduction”. Documents such as the “Ministry of Education’s Opinions on Comprehensively Promoting the Informatization of Teacher Management” and “China's Education Modernization 2035” attach great importance to intelligent and smart-learning online education resources. The Ministry of Education’s “Education Informatization 2.0 Action Plan” also proposes to promote that information technology and intelligent technology should be deeply integrated into the whole process of education, promoting improved teaching performance and optimizing effective management (Ministry of Education, 2018).

Smart education industry includes educational informatization and online education. The big data of smart education can effectively monitor students’ classroom learning situation and homework completion in a timely manner, and smart tools can facilitate teachers to design high-quality homework. The “2021 Blue Book of China's Educational Equipment Industry” released by the China Educational Equipment Industry Association pointed out that the size of China’s smart education market in 2018 was about 659 billion Chinese Yuan and up to about 759.4 billion Yuan in 2019, of which the market size of education informatization was 436.8 billion Yuan (She et al, 2022). In 2021, the scale of China’s smart education market has reached 905.7 billion Yuan, and it is expected to exceed one trillion yuan in 2022 (Ke et al, 2022). Therefore, the smart education industry represents a prominent and hope-harvest developmental future with the advantage of combination of “Internet + education”, AI-based education, VR/AR+ education and so on. Besides, the current implementing policy of China’s countermeasure to the COVID-19 highly requires a “home-based” online learning pattern, which means for the teacher and student that smart equipment such as laptop, iPad and smart phone are necessary in the “learning-teaching” activities to create a large-size market and also a “digital gap” among families. The improvement of education quality must require high-end hardware facilities. Therefore, interactive whiteboards, intelligent recording and broadcasting systems, etc. have been adopted by cutting-edge AI companies and procured by schools.

Taking iFLYTEK, the leading smart education company in China as an example, under the “double reduction policy”, the smart education sector of the company increased the revenue and contributed nearly one-third of iFLYTEK's revenue in 2021, an increase of nearly 50% year-on-year. Wu Xiaoru, President of iFLYTEK, proposed on the occasion of “AI + Education Co-creation and Symbiosis--2021 Global Artificial Intelligence and Education Big Data Conference (2021 AIDE)” that intelligent technology will help double reduction and facilitate the process of evaluation as well as supporting teaching and learning activity, construct new infrastructure for education to improve the efficiency and empowerment of education (Chen, 2022). iFLYTEK provides comprehensive solutions for after-school services, through the three-dimensional after-school service parent-student-school management platform, including enriched curriculum resources and professional service support teams. At present, the comprehensive solution has covered nearly 1,400 schools in 135 districts and counties. Among the comprehensive solutions for after-school services of iFLYTEK, there is a flagship course “iFLYTEK Artificial Intelligence Innovation Education”, which focuses on the improvement of artificial intelligence literacy

of teachers and students in the K12 stage, and has been applied in 1,600 schools across the country. Therefore, the operating performance of iFLYTEK has increased year by year in the past ten years.

5. Conclusions

To sum up, it can be concluded that the "double reduction" policy has not only a great significance for China's fundamental education reform, but also a profound and complex impact on the economy that requires parent-school-student to function comprehensively in the implementation of this policy. It reduces family education expenditures, which is a great benefit to families. The traditional subject education and training institutions face a major impact and also the "re-shuffle" and imperative to fully understand the novel education and teaching philosophy of "variation in-class teaching changes everything". The policy also further emphasizes on teaching research to achieve the goal of fulfilling the "student-orientation teaching approach." The schools must sustain the main position of education, so that education and teaching can truly embark on a path of connotative and high-quality development. Thus, the control of private tutoring industries from Chinese government is crucial to its goal of achieving common prosperity and it is visible that the implementation of "double reduction" policy is a tough and protracted battle in the long-term.

Funding information: the research is funded from two grants:
(1) 2021 General Project of Humanities and Social Sciences Research of Chongqing Municipal Education Commission (Grant No.21SKGH362),
(2) Project of Chongqing Industry & Trade Polytechnic (Grant No. ZR202111)

References:

[1] "Blue book of China's educational equipment industry (2021 Edition)". (2022). edited by China Educational Equipment Industry Association. *Intellectual Property Press*.
[2] Chen, J. (2022). The reform of school education and teaching under the "double reduction" policy. *Scientific and Social Research*, Vol.4, No, 2, pp.42-45.
[3] Guo S. (2013). Explore how to design mathematics homework. *Happy Reading*, Vol 11, p.127.
[4] Ke Qingchao, Bao Tingting, Lin Jian. (2022). The supply and service innovation of digital education resources under the background of "double reduction". *China Electrochemical Education*, Vol 1, pp. 17-23.
[5] Luo, Y. (2022). The response of Chinese private education organizations to the "double reduction" policy: evidence from New Oriental and TAL. In 2022 7th International Conference on Financial Innovation and Economic Development (ICFIED), Atlantis Press, pp. 1388-1392.
[6] Ministry of Education. (2018) "Education informatization 2.0 action plan" teaching technology.
[7] Ren Z, Mei H. (2017). Research on the reform of college education and teaching under the background of double innovation. *China Higher Education Research*, Vol.7, No.1, p.5.
[8] She, J., Lu, J., Li, S., Wang, Y., and Zhang, R. (2022). Social impact of China's double reduction policy and suggestions for improvement. *International Journal of Social Science and Education Research*, Vol.5, No.5, pp. 673-678.
[9] Song, M. (2022). Under the implementation of double reduction policy. In 2021 International Conference on Education, Language and Art (ICELA), Atlantis Press, pp. 800-804.
[10] Ministry of Education. (2021). "Opinions on further reducing students' homework burdens and off-campus training burdens in compulsory education"
[11] Wang C. (2020). Research on school education and teaching reform under the new situation. *Tianjin Education*, Vol.27, p.2.
[12] Wang T, Wu K. (2020). Research on middle school education and teaching reform under the background of new curriculum reform. *Curriculum Education Research*, Vol.16, p.1.
[13] Zhang J. (2014). *Research on the problems and countermeasures of junior middle school educational research under the background of new curriculum reform,* Inner Mongolia Normal University.
[14] Wu, B. (2021). Research on the impact of China's "double reduction" policy on out-of-school remedial classes. In 2021 3rd International Conference on Economic Management and Cultural Industry (ICEMCI), Atlantis Press, pp. 548-552.

Objective Requirements for an Effective Transition to a Green Economy

FLORIN BONCIU, PhD.
Institute for World Economy, Romanian Academy
ROMANIA
fbonciu@gmail.com

Abstract: The paper presents a critical analysis of the current approaches of the transition to a green economy also known as a "net zero" economy. The analysis is based on the identification of two hard constraints (defined as "availability condition" and "affordability condition"). The analysis puts into perspective previous technological and energy transitions that happened due to technological and market economy forces with administrative / volitive transitions in which significant changes of the economic and social environment are intended resulting from changes in the rules of the game and from mandatory standards. In this context, the paper presents several clarifications and recommendations that should be considered in order to achieve an effective and efficient transition without incurring societal and economic consequences.

Key words: green economy, technological transition, environment, Anthropocene

JEL classification: O13, O14, Q28, Q42, Q54, Q55

1. Overview on the objective necessity of limiting the impact of human activities on the environment

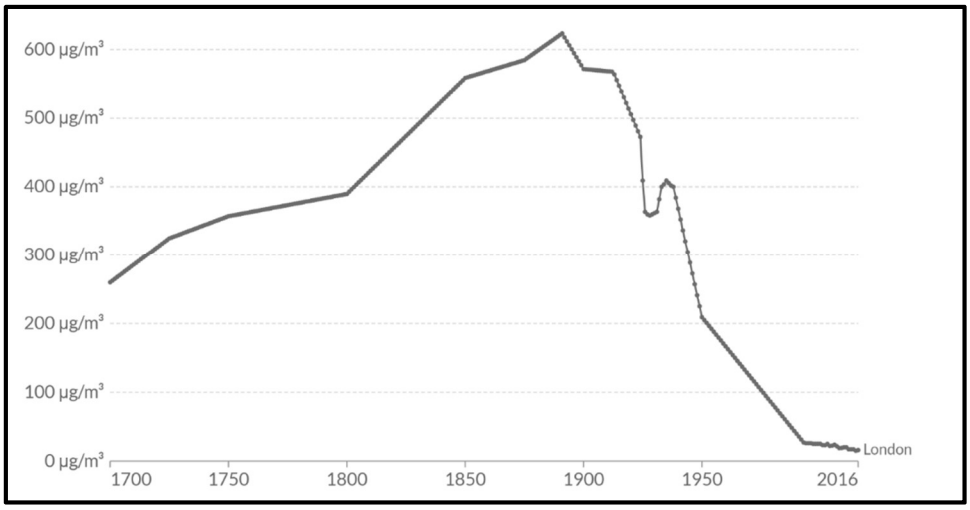
An awareness of the impact of human activity on the environment has existed for a very long time and has manifested both **locally**, in very specific circumstances, and **as a rather general idea** without any concrete strategies, targets and deadlines being set.

In the first category (local manifestations of the awareness of the impact of the human activity on the environment) we can mention the regulations on the burning of sea coal adopted in England during the reign of King Edward I (1272-1307) and revised by later monarchs, including by a tax on coal introduced in the 14th century (Alfred, 2008). A commission regulating the use of coal in London was established during the reign of King Henry V (1413-1422). More than 400 years later, in 1876, the British government established a Royal Commission on Noxious Vapors whose mission was to monitor and take measures against the air pollution caused by industrial and domestic activities. Even if these very early regulations concerning the London area or the whole of Britain during the 1st Industrial Revolution may appear as historical curiosities, their continuous observance and improvement have led centuries later, to tangible results (Wilson & Spengler, 1996), as reflected in Figure 1.

The historical data presented in Figure 1 leads us to 3 remarks, two pessimistic and one optimistic:

- A pessimistic remark is that, as far as London area is concerned, it took almost two centuries from the beginning of the 1st Industrial Revolution (around 1750) and from the implementation of various measures aimed at pollution control until a significant achievement of reduction of pollution could have been recorded;
- Another rather pessimistic remark is that it took more than a century from the moment pollution started to decline (around 1900), until a considerably lower level of pollution was achieved (after 2000);
- The optimistic remark is that pollution can be significantly reduced provided that long term, consistent efforts are made. In any case, the reduction of pollution in London area may also have certain complementary explanations related to relocation of industrial activities in other parts of the world – in the context of the globalization process, of technological innovations, of the orientation of activities towards services specific to developed countries or regions, etc.

Figure 1. Air pollution in London 1700–2016, micrograms per cubic meter



Source: Our World in Data, based on Fouquet, R., 2011: Long run trends in energy-related external costs, in volume Ecological economics, Elsevier, Volume 70, Issue 12, 15 October 2011

In our opinion, this case study is relevant because London is a large metropolitan area comprising 9.541 million inhabitants (as of 2022), as well as the capital of the country where the 1st Industrial Revolution started almost 250 years ago. At the same time, there are obvious limits in the attempt to extrapolate London's experiences and achievements in pollution control, because in its case we are talking about a large city with a coherent management, while if we analyzed a country as a whole, not to mention a continent or the entire Earth, it is much more difficult to secure a coherent and consistent management, especially over a long period of time. Speaking about large geographical regions, about continents or about the Earth as a whole, an important observation is that there are and there always have been important discrepancies in terms of development between regions of the same country, between countries and continents. Therefore, the availability of coherent management, knowledge, human skills, technologies and financial resources is very different and any single solution regarding the transition to a green economy may be difficult or even impossible to implement in a successful way during a given time interval.

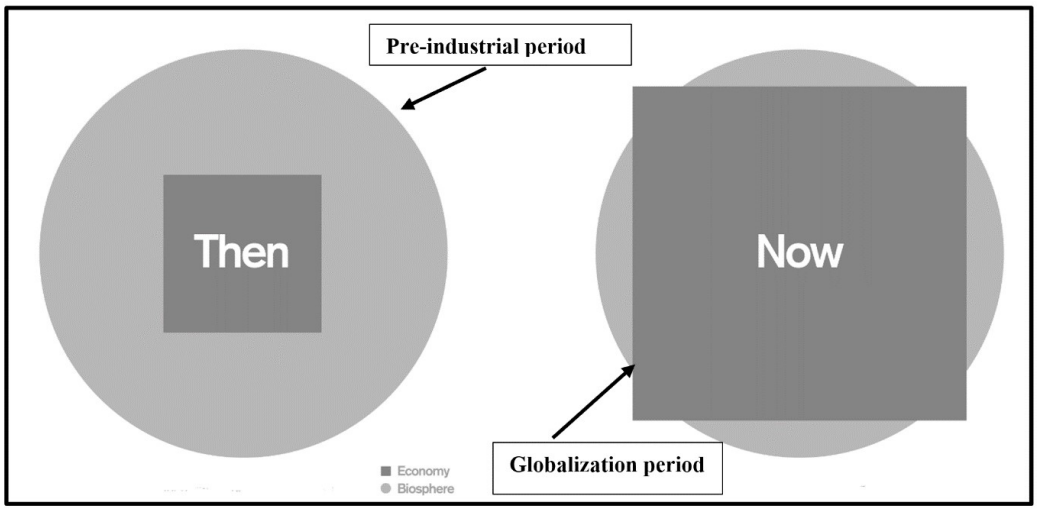
In **the second category** (a general and diffuse awareness regarding the impact of the human activity on the environment) one can first of all mention, from a chronological point of view, the reactions to illnesses that affected the cities of the Middle Ages because of the improper sanitation and waste disposal, particularly of biological waste (Castelow, 2019). In today's terms we could speak about biological pollution even if during those times the concept of pollution had not been invented yet.

Later on, reactions to environment pollution became more visible in relation to the consequences of economic activities, for example because of the large-scale use of coal during the 1st Industrial Revolution and after the beginning of the 20th century because of the large-scale use of internal combustion engines (Kiger, 2021). During this historical period (the late 1700s to about 1918) such reactions had been mostly related to local situations and very few people tried to look at the effects of the human activity at a global scale. The approach was rather based on the idea that while dangerous environmental and health-related concerns were likely to emerge at a local level due to the impact of human activities on the environment, the Earth as a planet was large enough to cope with the polluting results of human activities.

The much larger scale of the human activities undertaken after World War II, particularly in the context of globalization, made people aware of the impact of human activities on the environment, and especially on climate. Anyway, it took many decades until the concept of the "Anthropocene", a new geological era in which human activity modifies and determines the characteristics of the environment became widely accepted within the scientific world (Carrington, 2016), even if it was only validated officially in 2022 by the International Commission on Stratigraphy (Subcommission on Quaternary Stratigraphy, 2019).

If we look at the relation between economy at a global scale (human activities) and the environment, a fundamental difference appears between the period that starts with the pre-industrial era and concludes after of the World War II and after the period when globalization manifested itself most visibly (approximatively between 1980-2010) – Figure 2.

Figure 2. Relation between human economic activities and the biosphere during the pre-industrial period and during the globalization period



Source: Adapted from Global Footprint Network – Annual Report 2012, p. 21.

We can speak about a global awareness of the effects of human activities on the environment after the 1992 United Nations Framework Convention on Climate Change (UNFCCC) which recognized the existence of the global warming phenomenon and of the human responsibility for it. Several updates and extensions of the initial decisions were adopted in the following years, most notably: the Kyoto Protocol (1997) and the Paris Climate Agreement (2015) which replaced the Kyoto Protocol starting with 2016.

There are several differences between the two international agreements, but the following are significant in that they reflect the changes in the awareness of climate change and of human responsibility (Benduski, 2020):

- The Kyoto Protocol sought a reduction of greenhouse emissions by 5.2% below the 1990 levels, while the Paris Agreement aims at a limitation of global temperature increase to 2 degrees Celsius above pre-industrial era, with a more ambitious target of limiting the increase to only 1.5 degrees Celsius;
- The Kyoto Protocol referred to developed countries as being responsible for the reduction of emissions while developing countries were not targeted. It must also be mentioned that the US, a large source of emissions, did not ratify the Kyoto Protocol;
- The Paris Agreement provided obligations for all countries, developed and developing alike, irrespective of their responsibilities for past emissions;
- The Kyoto Protocol referred to 6 gases contributing to climate change, while the Paris Agreement refers to all gases influencing climate change;
- The timeframe for the Kyoto Protocol, which entered into force in February 2005 for the countries that ratified it, was shorter as its targets were supposed to be met by 2012, while the Paris Agreement, that entered into force in November 2016, has a longer perspective, i.e. 2025-2030.

2. Objective requirements for an effective transition to a green economy

We emphasize in this paper that it is necessary for certain requirements to be met in order to achieve an effective transition to a green economy. The objective nature of these requirements results from the fact that any large-scale transition from one type of economic and social organization of the human society to another should meet **2 conditions**, regardless of the level of development, of the political system, of the spiritual beliefs or of any other parameters describing the societies where such transitions are attempted:

- The access to energy and essential raw materials must be secured at all times **(the availability condition);**
- The prices for various forms of energy and essential raw materials should be affordable for the vast majority of population and for the economy **(the affordability condition).**

A failure in meeting one, if not both of these two conditions would lead not only to not achieving the proposed transition but also to social unrest, political changes, disruptions of economic activities and even wars for food, water and energy.

In order to fulfill the **availability condition,** human societies and their decision-makers seeking to make the transition to a green economy should pay attention to a very important requirement that refers to **technological capabilities**. This requirement related to technological capabilities should answer the following questions:

- Are there any feasible and mature technologies that can replace the existing ones which pollute the environment and generate climate change?
- How long does it take for these technologies to reach the maturity and stability required to make them feasible for large scale deployment?
- How long does it take to fully replace, at a global scale, the existing polluting technologies with new ones that are much less polluting or not at all?
- What is the cost of this large-scale deployment of non-polluting technologies and who is paying this cost?
- What happens during the transition period from the existing economic and social framework to the new one which defines the green economy?

Essentially, we could say that the technological capabilities of economies and of humankind as a whole are fundamental for starting and implementing the transition to a green economy. These technological capabilities are determinant for:

- What can be done?
- How long does it take to be done?
- Who can do the transition?
- How can transition itself be designed in a way as that ensures the continuity of economic and social activities?

The above statements can be illustrated by the fact that we can all agree to stop polluting the environment, we can all agree that electric cars are environment friendly, but our wishes do not transform by themselves into reality if we can non produce enough electrical cars, we do not have financial means to buy them, we do not have enough electricity and supply networks to charge the batteries, etc.

The fact that a city or a region can implement the transition to electric cars does not imply that the entire humankind can do so, and hence the problems related to:

- **a fair transition** (affordability of the transition for all);
- **a comprehensive transition** (transition for all humankind or at least for the vast majority of it);
- **an immediate or short term transition** (transition over a short period of time), etc.

From the perspective of the **accessibility condition,** the following questions must be answered before any serious attempt at an effective and efficient transition to a green economy:

- What happens with the countries / regions / populations that do not possess the technologies, the skilled labor force and the financial resources to replace the existing technologies with new ones?
- Is it possible to conceive a fair transition that will not leave any category of companies, of entrepreneurs or persons, age groups, minorities or any other social categories behind? A fair transition should be attempted within the countries, but also among the countries, whether developed or developing.
- Is it possible to avoid unfair advantages for the early adopters or for financially potent countries, companies or individuals who are able to make the transition, compared to countries, companies or individuals who are willing but are not able to do so?

In order to find valuable and pragmatic answers to at least part of these questions we can look at previous technological transitions which had a rather natural evolution, meaning they were not imposed or accelerated in any way by administrative methods. Fortunately, such examples are available in the recent periods, i.e. in the 32 years that passed since 1990. During this time important transitions took place in many parts of the world in a natural way:

- From fixed telephony to mobile telephony and then from simple cellular phones to smartphones;
- From telex and telegram to fax machines and then to the internet;
- From black and white to color TV and then to high-definition TV (4K, 8 K, etc.);
- From TV reception based on radio waves and antennas to cable TV and internet based TV;
- From film based cameras to digital cameras and then to smartphone cameras;

- From mainframe computers to PC, notebooks and laptops, tablets, etc.;
- From maps and radio communication for navigation to GPS;
- From local computing and storage to cloud computing and storage.

The examples are much more numerous, but most people have experienced these technological transitions in a personal way and still have vivid recollections of the "before" and "after" situations. It is true that some countries moved faster than others in these transitions and some of the technologies were available sooner in developed countries (some of these technologies were available even before 1990 such as color television or cable TV). But the world economy and humankind as a whole made these transitions after 1990 in a natural way and without any significant disruptions.

More related to the transition to a green economy are **the energy transitions** of the past 250 years (Bhutada, 2022):

- Before the beginning of the 1st Industrial Revolution people relied on biomass (wood and other combustible materials of resulting from agricultural activities) for domestic and economic activities and to a lesser extent on energy from the wind and water. The share of biomass in the global energy mix varied from about 98.3 in 1800 to 6.7% in 2020.
- **The first significant energy transition** was the transition to coal that took place after the beginning of the 1st Industrial Revolution and which marked a substantial increase of industrial output and of transports. The share of coal in the global energy mix increased from 1.7% in 1800 to a maximum of 54.4% in 1920 and declined afterwards to about 22.5% in 2020.
- **The second significant energy transition** took quite a long time (approximatively between 1859 and the early 1960s) and was characterized by a gradual increase of the use of oil and gas that were more and more involved in various industrial processes, in transports of all sorts (by land, sea, air, etc.) and in the generation of electricity and heat. What is remarkable is the fact that coal continues to be in 2022 the energy source used for generating about 33% of world electricity. The use of oil in the global energy mix was of 19.1% in 1950 while the use of natural gas was of 7.3% in the same year. These percentages have increased to 35.1% for oil in 2000 and 19.7% for natural gas.
- **The third significant energy transition** started after 2000 but the changes are not impressive. Between 2000 and 2020, the share of renewables in the global energy mix increased from 6.6% to 11.2%, fossil fuels actually increased from 77.3% to 78%, while nuclear energy declined from 5.9% to 4%.

From the above examples results that by **technological transitions or energy transitions achieved in a natural way** we have in view a transition characterized by:

- The emergence of new technologies that are made available gradually on an increasingly larger scale;
- Initially high prices that limit deployment, but on the medium term the new technologies enter the commoditization phase in which practically everybody (person or company) is able to afford them;
- New management techniques and forms of organization of companies and institutions are implemented in correlation with the deployment of new technologies, and what starts as a pioneering activity ends by becoming the norm. An important indicator of the large-scale adoption of new technologies is their implementation in public institutions and their transformation into commodities for the average persons.

As a result of these characteristics, the technological transitions that humankind experienced over the past 32 years as well as the energy transitions that happened since the 1st Industrial revolution were characterized by:

- A gradual implementation to avoid sudden disappearance of goods and services, jobs, international economic relations, etc.;
- Coexistence with previous technologies over reasonable periods of time;
- Affordable prices (at least in their later stages) to avoid certain socio-economic categories, regions or countries being left behind.

3. Natural versus administrative / volitive technological transitions

While the above-mentioned technological and energy transitions took place to a large extent without being in any way imposed by decision-makers, scientists or business circles, in case of the transition to a green economy the situation is different and differentiated by country or group of countries.

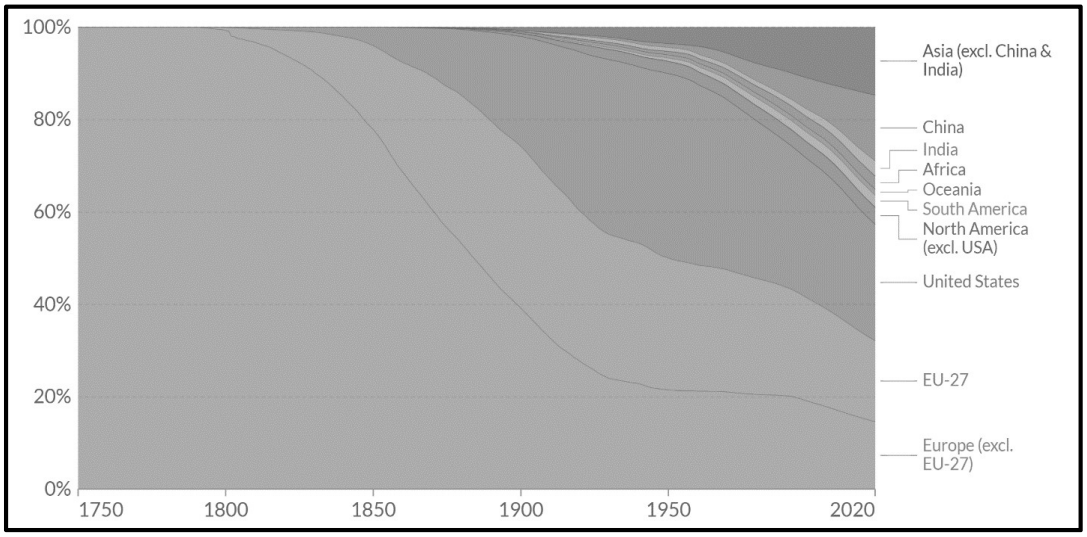
In this second case, some countries and particularly the European Union (as an organization reuniting a group of countries) have decided by means of administrative methods (normative approach) to implement certain interrelated fundamental transitions in a short to medium term:

- **from classical sources of energy to new sources of energy** which are not available on a large scale and in the required quantities, are not feasible and available at all times and are not affordable in terms of price;
- **from classical technologies to new technologies** which (with some exceptions) are not mature and stable, are not available for deployment at a global scale, lack adequate infrastructure, are prohibitively expensive, etc.;
- **from a comparative and competitive approach of the economy,** which governed international economic relations since Adam Smith and David Ricardo to the present days, **to an approach based on the responsibility for future generations and the future of planet Earth.** The problem with this approach is that it does not guarantee the results (a net zero or green economy at a global level) but expresses good will and good wishes. At the same time, this approach is not accompanied by official statements of renunciation to market economy and capitalism.

Some comments and clarifications regarding these otherwise well intended transitions related to the establishment of a green economy are necessary:

- the vast majority, if not all people, fully agree that preserving the environment, minimizing the climate change and securing a sustainable existence of economies and societies represent timely, justified and ethical goals;
- the vast majority, if not all people, fully agree that climate change is real and its economic and social implications are so substantial that they should be avoided or at least diminished to the maximum extent possible;
- the contribution of scientists and engineers to the design of such transitions is fundamental. **The decision to initiate the above-mentioned transitions is political, but their design and implementation are not.** Public exhortations of politicians, NGOs or true believers may play a useful role, they are definitely necessary, but they are not essential in achieving the desired goals. Arbitrarily chosen dates such as 2030 or 2050 (just because the figures are rounded or because some forecasts have determined that by these dates certain points of no return in climate change will be reached) as well as annual targets determined by arithmetical operations (if we want zero emissions in 2050 how much do we have to cut each year) only give the impression of a plan. The point we want to raise here is that **the decision** to reduce the impact of the human activity on the environment in such a way that it may guarantee environmental neutrality **is right**. The design of the transition and particularly how to ensure the continued supply of energy and essential raw materials during the transition period represent technical challenges that can and should be solved by scientists and engineers.
- The decisions in favor of a transition towards a green economy also raise issues related to legitimacy and ethics. The vast majority of emissions that have polluted the Earth originates in the developed countries of today – Figure 3. At the same time, the transitions to new sources of energy and new technologies are costly and many developing countries (which are not responsible for today's pollution) cannot afford them. Under these circumstances, are the developed countries of today, which contributed to the largest extent to the pollution, in a position of legitimacy to request those which did not generated the largest part of pollution to implement technologies they cannot afford? Are they ready to provide to these developing countries the financial assistance required for implementing the transitions? The COP 26 that took place in Glasgow in October 2021 gave a negative answer to that.

Figure 3. Cumulative CO2 emissions by region between 1750-2020



Source: Ritchie, H., Roser, M. (2020): "CO_2 and Greenhouse Gas Emissions". Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions'

4. Conclusions

The transition to a green economy is an **objective necessity** due to the impact of human activity on environment, particularly during the era when globalization reached its maturity, starting more or less after 1980. Most of the discussions related to the objective necessity of this transition are focused on various types of emissions that affect the atmosphere, the quality of breathing air, the ozone layer, etc. Even the targets adopted in the Paris Agreement or in official documents of the European Union are primarily focused on emissions.
But emissions are **just a component** of the human impact on environment. Among other types of impacts one can mention:

- the massive deforestation which reduced the habitable land on the Earth's forested area from 57% 10,000 years ago to 52% by 1700, 48% by 1900, 44% by 1950 to 38% by 2018 (Wallach & Aboulazm, 2022);
- pollution with plastic waste currently estimated at 5 billion tons (Lim, 2021) and taking 1,000 years, on average, to decompose is everywhere, from the Arctic Ocean (Friesen (von), Hartmann, Gabrielsen, & Rist, 2021) to human blood in the form of micro-plastics (Osborne, 2022):
- pollution of the land by means of waste, incineration of waste, chemical substances resulting from industrial processes, chemical fertilizers, buried chemicals, nuclear waste, etc.;
- pollution of water due to industrial and household activities: mining industry, including oil, pulp and paper, sewage, the use of fertilizers, dumping of garbage into water, etc. (Bradford, 2018).

The list above can be extended to include light pollution, noise pollution, electromagnetic pollution, etc. As a result, the impact of the human activity on the environment is so outstanding that the impossibility to continue on the same path as until now indefinitely is beyond doubt.

Discussions and debates in relation to the transition to a green economy **start at the choices** (how to achieve the transition) and **time frames of the transition** (how fast to implement and conclude the transition). The situation is further complicated by the fact that planet Earth is not a single entity with a global governance but a complex system of inter-related entities, with different levels of development, ranked in different positions within a multi-dimensional balance of power with different assets (technological, human and financial capabilities) and liabilities (responsibilities resulting from their historical contribution to the current state of environmental damage).

Therefore, the transition to a green economy is a topic of high priority due its importance and urgency but has a variable practical priority depending on the level of development of different countries.
Developed countries with considerable financial, technological, and human skills resources may attempt to adopt a tight time frame for the transition because they have the technologies required and can afford it financially.

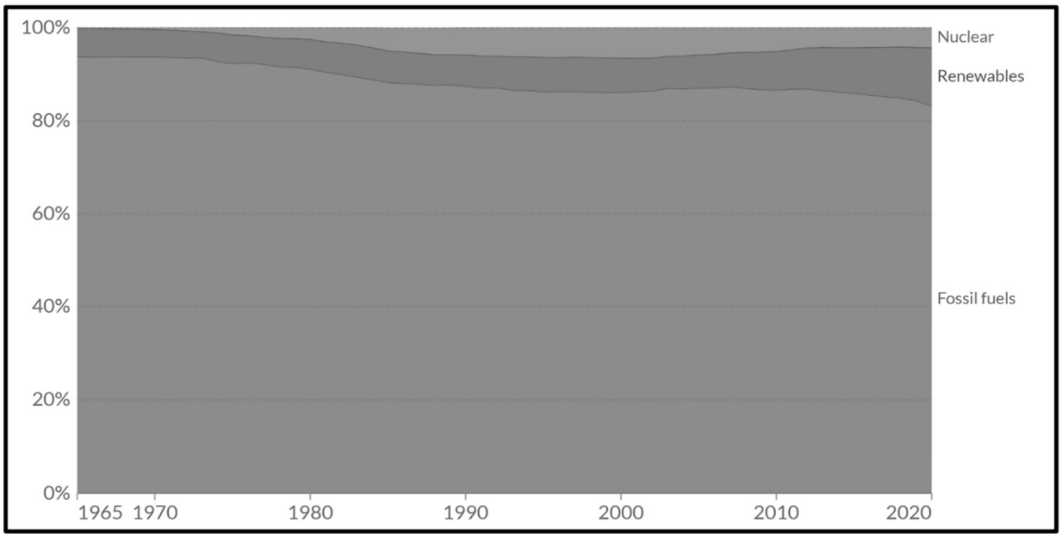
Developing countries generally agree with the necessity to preserve the environment and to adopt the transition to a green economy, but they simply cannot afford it both from a technological and a financial point of view. Decision-makers from developing countries cannot convince their populations that they should stop their development which, in many cases, was prevented or delayed by the colonial systems because they pollute the environment.

The ethical approach that calls on the support of developed countries, in the form of financial aid, to help developing countries achieve the transition to a green economy has been proposed and failed, among other occasions at the Conference of the Parties to the UN Framework Convention on Climate Change (COP26), a summit that took place in Glasgow between 31 October and 13 November, 2021. The developed countries were supposed to provide developing countries with an annual 100 billion US dollars from 2020 on in order to facilitate the adoption of new technologies that reduce the impact on environment (United Nations Office for the Coordination of Humanitarian Affairs (OCHA), 2021). The size of the financial support necessary reflects, on the one hand, the magnitude of the difficulty of achieving the transition to a green economy for the developing countries and, on the other hand, the impossibility of achieving the transition for those that want it but do not have the means to do it.

In our view, an essential aspect in designing and implementing the transition to a green economy is the understanding of **the magnitude of the process**. In Figure 4 is represented the share of fossil fuels, nuclear and renewables in the global primary consumption of energy between 1965-2020. The period analyzed is of 35 years, while there are 28 years from 2022 to 2050. In Figure 4 we can see the inertia of global energy systems and the speed of change that characterized the previous decades: fossil fuels declined their share in global primary consumption of energy from 93.7% in 1965 to 83.14%, renewables increased their share from 6.6% to 12.55% while nuclear energy increased its share from 0.17% to 4.31%.

It is true that today new technologies are available and the world leaders are more determined than ever to adopt measures that will protect the environment and stabilize climate change. But can we imagine a switch of the shares between fossil fuels and renewables? That would imply a 7 times increase of the share of renewables (from 12% to 84%) and a 7 times decline of the fossil fuels (from 83% to 12%).

Figure 4. Share of fossil fuels, nuclear and renewables in the global primary consumption of energy between 1965-2020



Source: Ritchie, H., Roser, M., (2022): Energy Mix, based on BP – Statistical Review of World Energy - 2021, published online at Our World in Data

Given the above question, in our opinion **a lesson that can be learnt** from the experiences provided by other technological and energy transitions that took place in a natural way **is that of the applicability and feasibility of a best effort approach.** In commercial services contracts there are two fundamental options: best effort and guaranteed services (McCabe, 2007). As their names show, the best effort services (which are not predictable or guaranteed) mean that the supplier is providing a service to the best of its abilities and technological

capabilities, presuming it acts in total good faith. On the other hand, the guaranteed services imply that the provider guarantees to the client certain technical parameters of the service.

In the case of the transition to a green economy **a best effort approach would mean that each country and organization will use all the knowledge, human experience and financial resources available in order to expedite the transition to a green economy as much as possible.**

The annual progress achieved could be monitored by a transparent mechanism similar with that used by the United Nations Organization in case of Millennium Development Goals (2000 – 2015) and Sustainable Development Goals (2016 – 2030). It goes without saying that the good faith of all participants is essential for the success of such an approach. This approach allows for a diversified public-private partnership and would allow for flexibility (with periods of faster and slower progress) and for diversity (letting all countries move at the best speed they are capable of).

At the same time, given the global scale of the transition to a green economy, we consider that the knowledge already available in relation to management of change processes should be used to the maximum extent possible. Maybe preparing a management of change strategy for the transition to a green economy will answer the sensitive question of replacing the Milton Friedman mantra (Friedman, 1970) that stated: "The social responsibility of business is to increase its profits", arguing that a company has no responsibility to society and people, with a more ethical and environment friendly belief.

After the beginning of the 1st Industrial Revolution, Western civilization took the lead of modernization and almost all elements that represent our current professional and personal life have been materialized in the last 150 years. One thing that is often forgotten is that, as Vaclav Smil pointed out: "We are a fossil fuel civilization" (Smil, 2017). Whatever is specific to our civilization (from fertilizers to electricity and from aviation to computers) is based primarily on the use of fossil fuels. For those who are not convinced, Figure 4 is a good place to start.

Energy transitions happened before but humankind had more time at its disposal. Will nuclear fusion manage in due time to provide the cheap infinite energy that will save civilization from extreme consequences of climate change? Will other technologies become available in order to reverse pollution and absorb emission from the atmosphere, and to concomitantly transform waste into raw materials? While we keep our hope for timely solutions provided by science and technology, we should approach the transition to a green economy with utmost seriousness, not forgetting for a moment that energy and essential raw materials should be available and affordable without discontinuities.

References:

[1] Alfred, R. (2008, July 17). *July 18, 1876: Royal Commissioners Wrinkle Their Noses.* Retrieved from Wired: https://www.wired.com/2008/07/july-18-1876-royal-commissioners-wrinkle-their-noses-2/.

[2] Benduski, M. (2020, December 09). *Paris Agreement vs. Kyoto Protocol [Comparison Chart]*. Retrieved from Care about Climate - International Climate Policy: https://www.careaboutclimate.org/blog/paris-agreement-vs-kyoto-protocol-comparison-chart.

[3] Bhutada, G. (2022, April 07). *The History of Energy Transitions.* Retrieved from Elements - Visual Capitalist: https://elements.visualcapitalist.com/the-history-of-energy-transitions/.

[4] Bradford, A. (2018, February 28). *Pollution Facts & Types of Pollution.* Retrieved from Live Science: https://www.livescience.com/22728-pollution-facts.html.

[5] Carrington, D. (2016, August 29). *The Anthropocene epoch: scientists declare dawn of human-influenced age.* Retrieved from The Guardian: https://www.theguardian.com/environment/2016/aug/29/declare-anthropocene-epoch-experts-urge-geological-congress-human-impact-earth.

[6] Castelow, E. (2019). *Disease in the Middle Ages.* Retrieved from Historic UK: https://www.historic-uk.com/HistoryUK/HistoryofEngland/Disease-in-Medieval-England/.

[7] Friedman, M. (1970, September 13). *A Friedman Doctrine: the Social Responsibility of Business is to Increase Its Profits.* Retrieved from The New York Times: https://www.nytimes.com/1970/09/13/archives/a-friedman-doctrine-the-social-responsibility-of-business-is-to.html.

[8] Friesen (von), L. W., Hartmann, N. B., Gabrielsen, G. W., & Rist, S. (2021, August 12). *A Message in a Bottle From the North Pole–How Plastic Pollutes the Arctic Ocean.* Retrieved from Frontiers: https://kids.frontiersin.org/articles/10.3389/frym.2021.613577.

[9] Kiger, P. J. (2021, November 09). *7 Negative Effects of the Industrial Revolution.* Retrieved from History: https://www.history.com/news/industrial-revolution-negative-effects.

[10] Lim, X. Z. (2021, May 04). *Microplastics are everywhere — but are they harmful?* Retrieved from Nature: https://www.nature.com/articles/d41586-021-01143-3.

[11] McCabe, J. D. (2007). *Network Analysis, Architecture, and Design (3rd edition).* Burlington (MA): Morgan Kaufmann Publishers-Elsevier.
[12] Osborne, M. (2022, March 28). *Microplastics Detected in Human Blood in New Study.* Retrieved from Smithsoniam Magazine: https://www.smithsonianmag.com/smart-news/microplastics-detected-in-human-blood-180979826/.
[13] Smil, V. (2017). *Energy and Civilization – A History.* Cambridge (MA): The MIT Press.
[14] Subcommission on Quaternary Stratigraphy. (2019, May 21). *Working Group on the 'Anthropocene' - Results of binding vote by AWG*. Retrieved from Subcommission on Quaternary Stratigraphy: http://quaternary.stratigraphy.org/working-groups/anthropocene/.
[15] United Nations Office for the Coordination of Humanitarian Affairs (OCHA). (2021, November 18). *COP 26: The climate conference that failed the South*. Retrieved from OCHA: https://reliefweb.int/report/world/cop-26-climate-conference-failed-south.
[16] Wallach, O., & Aboulazm, Z. (2022, April 01). *Visualizing the World's Loss of Forests Since the Ice-Age.* Retrieved from Visual Capitalist: https://www.visualcapitalist.com/visualizing-the-worlds-loss-of-forests-since-the-ice-age/.
[17] Wilson, R., & Spengler, J. D. (1996). *Particles in our air: concentrations and health effects.* Cambridge (MA): Harvard University Press.

The Role of Common Agricultural Policy in Climate Actions

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

ANCA - CĂTĂLINA DRAGOMIR, PhD.
SC Cepstra Grup SRL
ROMANIA
anca.dragomir@cepstra.ro

Abstract: In the current post-pandemic economic environment, both climate action and sustainable development remain essential objectives for the European Union, while the Common Agricultural Policy (CAP), with the largest funding from the European budget may emerge as a key factor for achieving them both. CAP financing framework for 2021-2027 has three broad objectives: viable food production, sustainable management of natural resources and balanced territorial development. Given that those objectives of the post-pandemic CAP are particularly wide and ambitious, this paper focuses only on a comparative quantitative analysis of climate and environmental expenditures undertaken by Member States, highlighting Romania's position in the European hierarchy. Our research aims to present the achievements and challenges of Member States' environmental and climate spending under the CAP, in order to underline which development directions could contribute to a more resilient and sustainable rural development across EU.

Key-Words: Common Agricultural Policy, post-pandemic development, climate and environmental actions, EU Member States

JEL Classification: Q01, Q15, Q2, Q28

1 Introduction – a "greener" CAP for a more resilient EU agricultural sector

For years, the dichotomy between sustainable and competitive development under CAP "umbrella" has remain a most disputed subject in the literature review (Belinska et al., 2021; Barreiro et al., 2021; Streimikis, 2020). While many analysis (Mets et al., 2021; Constatin et al., 2021) have praised the CAP progress to a more sustainable and ecological European agriculture there are some critics (Brown et al., 2021) who underlines the challenges of this process especially in terms of resilience in the complicated post-pandemic economic environment.

Recently, a complex analysis has highlighted that after their accession to EU Poland and the Baltic States can be considered as leaders in the agricultural domain (including in sustainable agriculture), while Romania, Bulgaria and Slovenia used their potential poorly (Csaki et al, 2016).

Some studies (Blake, 2020; Liegmann, 2021) consider that the new CAP may be a key element of the European Green Deal through the Farm-to-Fork Strategy, and this reality is best reflected in the fact that achieving more sustainable food and agricultural systems is intrinsically linked to the role of 'green' and digital economic development, which aims to integrate the new technologies (e.g. digitalization as a way to promote and sell organic agricultural products, thus bringing new opportunities in global chains for both producers and for consumers), but also to experiment with new production methods that will preserve resources for future generations, ensuring a more equitable access to quality food for all consumers. In our view, the opportunities opened up by the adoption of the Farm-to-Fork Strategy (European Commission, a, 2020) in terms of increasing the resilience of rural areas in the EU and boosting sustainable rural development are paving the way for new funding directions fit to ensure not only greater food security but also greener development across EU.

The climate objectives of the current CAP are particularly ambitious as they aim to enable Member States' food systems to withstand the shock of future crises (similar to that generated by the COVID-19 pandemic) but

also to create significant changes in both the supply chain and the European consumption model, in order to reduce the share of carbon emissions in agriculture, to limit the consumption of natural resources, while increasing the biodiversity of rural areas in terms of nutrition and health.

2 CAP and climate actions – selected indicators for a comparative approach across the Member states

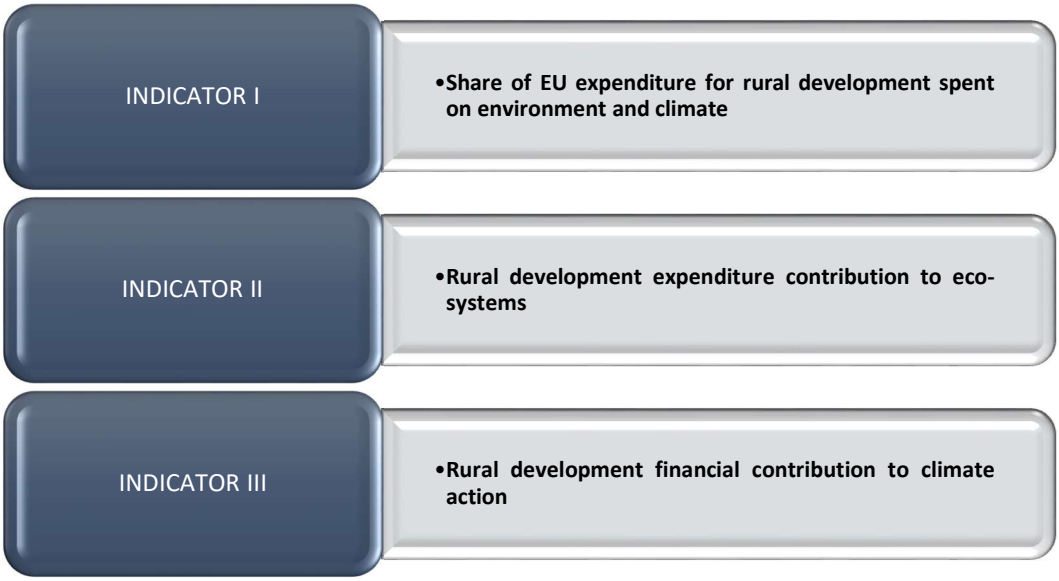
As stated by some studies (Drăgoi, 2021), CAP has slowly migrated from a policy with market orientation that openly supported European farmers and European production to a policy that sets its core around the "green" development necessary for achieving a sustainable rural space for future generation.

While having undisputed benefits this goal of CAP also poses many challenges for Member States that must adapt their rural development funding accordingly. One of the most important challenges is linked to the fact that agriculture is a sector with a lower degree of standardisation in terms of financing objectives as the latest DG Agricultural and Rural Development data are showing.

Moreover, there are significant imbalances in the economic space of the EU in general and in the development of the agricultural sector in particular, a gap that is very clear especially regarding climate actions related to CAP. After the Green Deal adoption, CAP has become more focused on climate actions, while Member States must comply with more ambitious targets in the field.

Hence, our research has selected three indicators (see Figure 1) related to climate actions undertaken through CAP financing in order to analyse the achievements and the challenges that remains for European countries in order to cope with the new "green" CAP agenda.

Figure 1: Climate actions under CAP – selected indicators



Source: Authors representation.

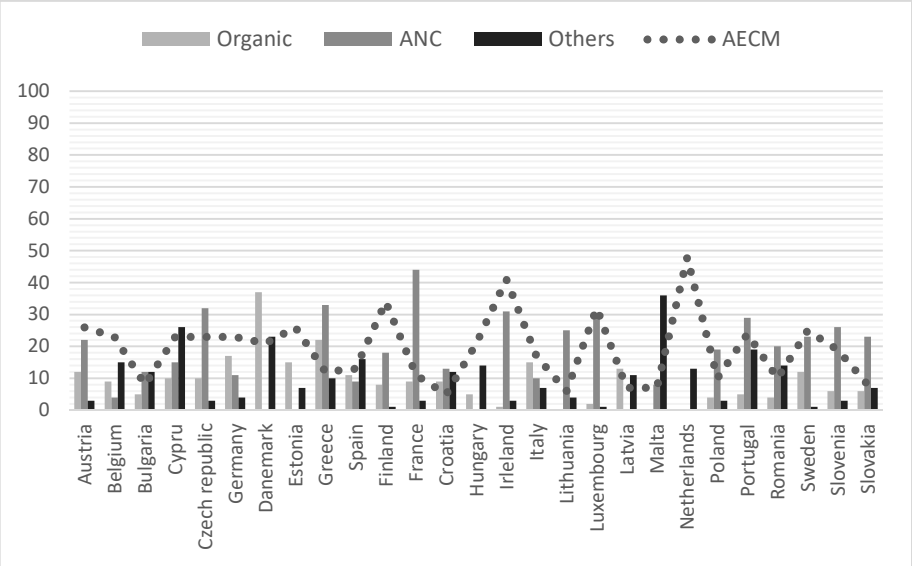
We selected those indicators because we believe that they are particularly relevant for drawing a significant picture on how have Member States managed to fulfil the climate related targets through CAP funding. For each indicator we will present the situation at EU level and across Member States using the latest available data (for the year 2020) (European Commission, b, 2020).

2.1 Share of expenditure for rural development spent on environment and climate

A key indicator for financing rural development in the EU is related to the share of Member States' environmental and climate spending in total rural development spending. Its importance is underlined by some analyzes (Bisciari et al., 2021) which show that, especially after the adoption of the new regulations of the post-2020 CAP this indicator is the core of rural "green" development, but also an important tool for rapid recovery after the difficulties caused by the COVID-19 pandemic. According to the latest European statistics available, at the level of 2020, there is an unequal performance among the Member States in terms of this indicator, with

Denmark, Greece, Cyprus, Ireland and Portugal occupying the first places, while Romania is ranking low in the European hierarchy (see Graph 1).

Graph 1: Member States' performance on the share of climate and environmental expenditure in total rural development expenditure in 2020 (%)



Source: Authors based on data published by the European Commission (2021).

Within this generic indicator on climate and environmental spending there are four sub-indicators: agri-environmental spending, abbreviated AECM (Agri-Environmental Climate Measures used for general objectives such as reversing the decline of biodiversity, conservation of landscapes in rural areas, water and soil protection, genetic resources and combating climate change); expenses for organic farming; expenditures for areas with natural constraints, abbreviated ANC (Areas with Natural Constraints) and other environmental expenditures.

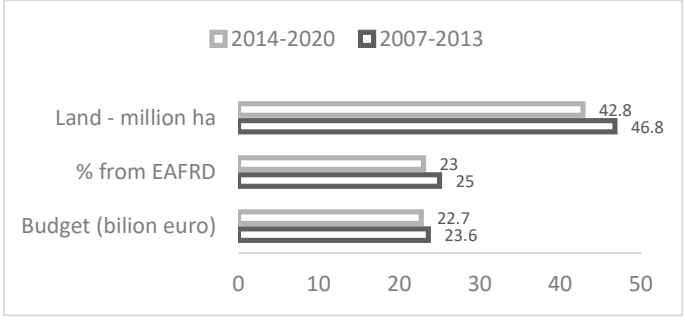
If we look at the performance of Member States in relation to each of these sub-indicators we observe a reversal of hierarchies, with some countries performing poorly on total climate and environmental measures while achieving notable performance on some of these sub-indicators (for instance Sweden, which is at the forefront of organic farming, but has a poor performance on other sub-indicators).

As we may observe in Graph 1 there is an extremely diverse distribution of climate and environmental spending across the four sub-indicators.

Thus, while most states have allocated a significant percentage for AECM expenditures, there are also countries that have allocated zero funds for some of the sub-indicators (Lithuania, Malta and the Netherlands for organic farming and Germany, Denmark, Hungary and the Netherlands for ANC).

Currently, AECM spending is considered the most important vector for achieving sustainable rural development objectives under the CAP, hence benefiting from important funds over the most recent multi-annual budgetary framework (Graph 2) because these type of expenditures are considered essential for driving the restoration, conservation and growth of ecosystem diversity in rural areas of the Member States, while also contributing to the transition to a green and low-carbon economy.

Graph 2: AECM funding under CAP multi-annual budgetary framework

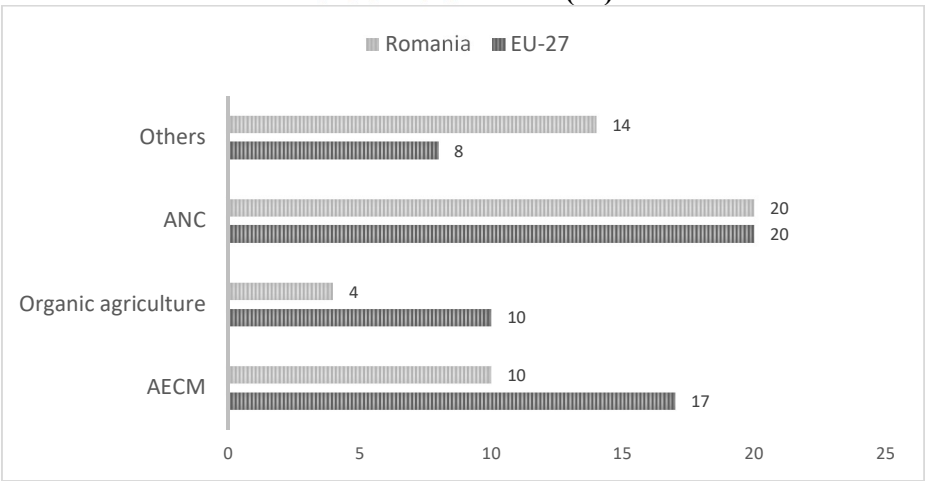


Source: Authors based on data published by the European Commission (2021).

As we may see in Graph 2, when comparing this type of measure across the EU-27 over the most recent multi-annual budgetary framework (2007-2013 and 2014-2020, respectively) one may see a decrease in funding for this indicator, both as a percentage of the European Fund for Agriculture and Rural Development (EAFRD) and in terms of the area on which has been implemented.

The data on the evolution of this indicator reveal that compared to the EU-27 average, Romania has allocated lower funds for both AECM and organic farming, matching the European average only to the ANC sub-indicator (see Graph 3).

Graph 3: Romania's performance on share of expenditure for rural development spent on environment and climate in 2020 (%)



Source: Authors based on data published by the European Commission (2021).

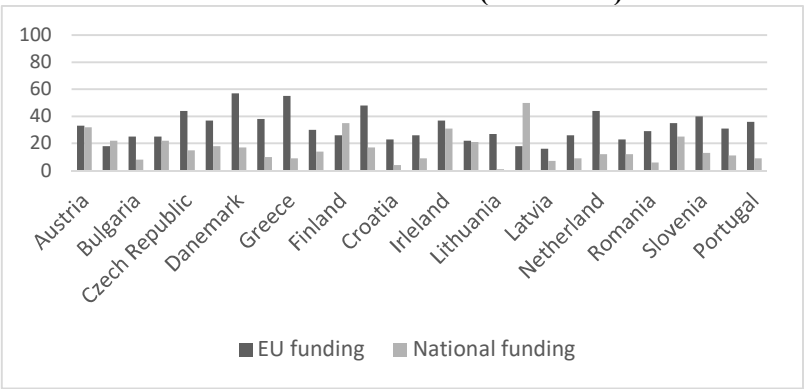
Romania's lower performance compared to the EU-27 average is explained in some analyses (Drăgoi & Dragomir, 2021) by the fact that most funding in the previous National Rural Development Plan focused on some specific development issues (infrastructure, increasing the quality of human resources involved in agriculture, reducing development gaps between rural and urban areas, diminishing poverty in rural areas, modernizing farms). In fact, some research (Rudnicki et al., 2021) indicates the association in cooperatives and large farms as a key factor in the successful implementation of AECM funding and in this regard Romania is deficient with an extremely fragmented structure of agricultural holdings and a predominance of small and subsistence farms.

2.2 The contribution of rural development expenditures to the protection of ecosystems

The protection of rural ecosystems is a key objective of sustainable development in rural areas, hence the share of expenditure allocated to this indicator is a highly relevant for the green commitments made by Member States in their Strategic Rural Development Plans.

Expenditure on rural development for the protection of ecosystems can be allocated through both European and national funding, but an analysis of this indicator evolution in 2020 shows that the vast majority of Member States have preferred funding from European budget (see Graph 4).

Graph 4: Share of expenditure on ecosystem protection in total rural development expenditure in Member States in 2020 (% of total)



Source: Authors based on data published by the European Commission (2021).

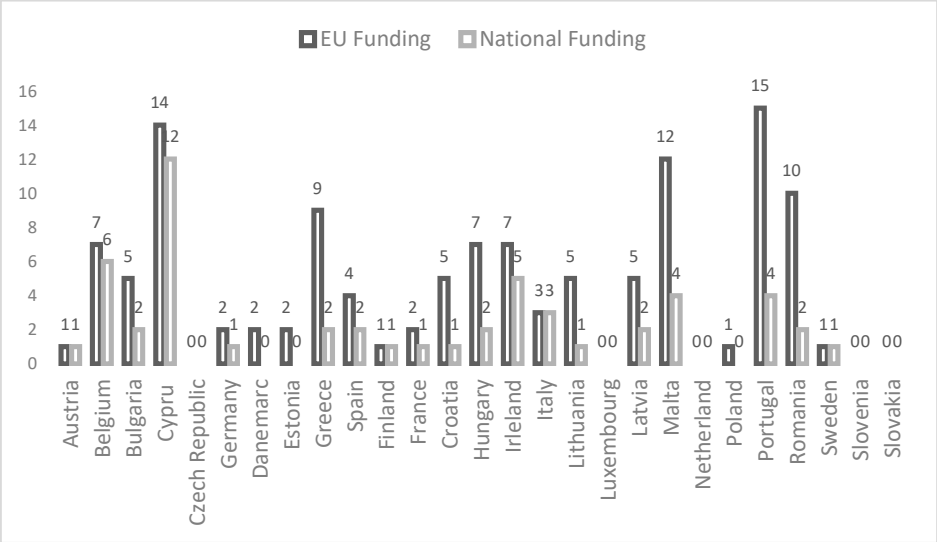
Graph 4 also shows the existence of "champions" in the field, such as Denmark and Greece, but also some countries that they have chosen to massively direct national funds towards this “green” goal (Luxembourg, which has allocated 50% of national funds).

In terms of Romania's performance, they were quite weak, with 29% of EU funds and only 6% of national funds being allocated to this indicator in total rural development expenditures for 2020.

2.3 Share of climate change expenditure in total rural development expenditure

Combating climate change and the devastating effects on agriculture remains an essential goal of sustainable rural development, all the more so as the extent and frequency of natural disasters (drought, floods, landslides, forest fires) has increased significantly in recent years throughout the EU-27 area (Gobin et al., 2013). The analysis of the share of Member States' spending on combating climate change (see Graph 5) shows an insufficient allocation of funding for this goal (both from European and national sources), with the EU average also much lower than other indicators (only 5.4%).

Graph 5: Share of climate change spending in total rural development spending in Member States in 2020 (% of total)



Source: Authors based on data published by the European Commission (2021).

Graph 5 shows that in 2020, there are four Member States that have not allocated any funds to this indicator at all (Czech Republic, Luxembourg, Slovenia and Slovakia) while the state that has allocated the highest share of funding for this indicator is Cyprus (with a total of 26% 12% of national funds and 14% of European funds, respectively).

If we analyse Romania's performance on this indicator in 2020, we notice that is better compared to both other Member States and the European average, which Romania significantly exceeded, allocating a total of 12% of rural development expenditures to combat climate change (10% from European funds and 2% of national funds).

3 Future measures under CAP for increasing climate action in rural development funding across EU

The analysis of the three selected indicators indicates that, although Member States have allocated significant funds for sustainable rural development objectives in 2020, the fight against climate change was underfunded both in the EU average and in most Member States. The best performance was registered for ecosystem protection, but progress is still needed on areas under environmental requirements (especially permanent grasslands and pastures.

The adoption of Farm-to-Fork Strategy is considered to be a key pillar in combating climate change through EU rural development programs since it will increase funding to combat climate change by focusing more on environmental goals.

The new CAP will thus accelerate the transition to a sustainable food system that will significantly contribute to climate change mitigation, but some critical analyzes show that ambitious environmental goals could

jeopardize the sustainable development by neglecting social disparities and other development gaps that many rural areas from EU are still facing today (Moschitz et al, 2021).

The analysis of the strategic objectives of the new CAP indicates that, although some of its targets, such as reducing antimicrobial sales, are not directly linked to climate action, its new directions of action are primarily aimed at reducing CO2 emissions at all stages of the value chain (in growing, storing, processing, packing, transporting, consuming and disposing of food and agricultural products).

Thus, measures of the new CAP - such as rewarding farmers for removing CO2 from the atmosphere, rules for imports associated with deforestation - are primarily aimed at reducing CO2 emissions thus making a significant contribution to combating climate change. The climate-related objectives of the new CAP aim to reduce chemical fertilizers in agriculture by 20% (thus contributing to the growth of organic farming), an indicator in which, as we pointed out earlier in our analysis, some Member States continue to perform poorly). Under the new CAP, between 2021 and 2027, Member States must increase the share of agricultural land under stricter environmental requirements, as well as organic farms (at least 25% of the total).

Both financial directions are related to climate and the environment measures that can facilitate the sustainable production of quality food by contributing not only to the well-being of European consumers but also to combating the negative effects of agriculture on accelerating climate change.

In order to increase climate and environmental ambitions, National Rural Strategic Plans (that are a key tool under new CAP) need to increase funding for ecosystem protection. The new CAP also requires that 20% of the funding allocated under Pillar I (regarding market oriented measures and agriculture at EU level) must be allocated by Member States to eco-schemes (usually through Direct Payments through the Basic Payment per hectare). These eco-schemes will reward those European farmers who choose to undertake additional activities to protect the climate and the environment, as well as animal welfare, thus supporting the objectives of the Green Deal. The provision of eco-schemes is mandatory at Member State level in the financial framework 2021-2027 of CAP, but participation in them is voluntary for European farmers.

It should be noted that these climate related ambitious of CAP will also involve higher costs for European farmers who will have to comply with stricter requirements for animal welfare standards (which may lead to a decrease in livestock numbers), larger areas allocated to organic farming (in order to increase the carbon stored in the soil), as well as practices related to reducing food waste.

The major challenge for the whole “greening” process of CAP in terms of the EU food system lies in the many compromises that will need to be made between measures aimed at protecting the environment, farm animals, consumers and the climate, but which are unlikely to successfully meet all those goals simultaneously.

4 Conclusion

Some critics of the new CAP (Beckman et al., 2021) have pointed out that a lower use of chemical fertilizers and an increase in organic land cultivation will reduce EU food production, jeopardizing food security in the internal market.

These risks mean that the implementation of the new rules and mechanisms needs to be carefully analyzed as the priorities of the new CAP will guide rural development in the EU for at least the next decade while the imbalances between ensuring the EU's food security could jeopardize the supply of food and agricultural products in the Member States, as well as the resilience of European farmers in the post-pandemic world.

This is all the more evident as two Member States, Italy and Slovakia, have recently asked permission from the European Commission for a greater flexibility in their National Rural Strategic Plans allowing them to increase production at the expense of "green" targets, expressing concerns about shortages of food supply that could occur in the context of the prolongation of the military conflict initiated by the Russian Federation in Ukraine (Fortuna et al., 2022).

The European Commission has responded to these requests with apparent inflexibility, reaffirming the importance of the CAP's "green" targets in the post-2020 period, considering that the goals of sustainable development must remain at the very core of this European policy. However, the two Member States seem determined to adjust their National Rural Strategic Plans to meet the challenges of the present. One must underline that the National Rural Strategic Plans (the principal novelty brought by the new CAP) are allowing to the Member States to be more creative in adjusting funding at national level, provided that they meet certain minimum environmental and climate requirements. This creativity could, for example, allow Member States to use additional interventions and compensatory subsidies for agricultural producers and processors affected by the

consequences of the conflict in Ukraine, thus supporting domestic agricultural production and responding to possible food security challenges.

Our comparative analysis of Member States' performance on the selected indicators shows that while many countries are performing well on the AECM, there are also states that have allocated zero funding for some sustainable rural development goals (Lithuania, Malta and the Netherlands). According to the analyzed data, Romania is on a similar position to the EU-27 average in terms of ecosystem protection, but performs well below expectations in the field of organic agriculture. The analysis of total climate and environmental spending in rural development financing at EU level revealed a slight decrease in the period 2014-2020 compared to the period 2007-2013. Taking into consideration all these challenges the new CAP can stimulate a higher growth of share of "green" targets across EU-27 in particular through the use of mandatory eco-schemes and minimum requirements for organic farms. However, it should be noted that, in our opinion, the achievement of all the climate related objectives of the new CAP must be done in a balanced way, without jeopardizing the volume of agricultural production and food security on EU-27 internal market.

Acknowledgments: This paper has been financially supported within the project entitled: "Support Center for IEM research - innovation projects competitive in Horizon 2020", ID 107540. This project is co-financed by the European Regional Development Fund through Competitiveness Operational Programme 2014 - 2020.

References:

[1] Barreiro Hurle, J., Bogonos, M., Himics, M., Hristov, J., Perez Dominguez, I., Sahoo, A.,& Elleby, C. (2021). *Modelling environmental and climate ambition in the agricultural sector with the CAPRI model* (No. JRC121368). Joint Research Centre (Seville site).

[2] Beckman, J., Ivanic, M., & Jelliffe, J. (2021). Market impacts of Farm to Fork: Reducing agricultural input usage. *Applied Economic Perspectives and Policy*.

[3] Belinska, Y., Matvejciuk, L., Shmygol, N., Pulina, T., & Antoniuk, D. (2021). EU agricultural policy and its role in smoothing the sustainable development of the EU's agricultural areas. In *IOP Conference Series: Earth and Environmental Science* (Vol. 628, No. 1, p. 012030). IOP Publishing.

[4] Bisciari, P., Butzen, P., Gelade, W., Melyn, W., & Van Parys, S. (2021). The EU budget and the Next Generation EU Recovery Plan: a game changer?. *NBB Economic Review*, (39).

[5] Blake, R. (2020). Will the European Green Deal make agriculture more sustainable?. *Outlooks on Pest Management*, *31*(5), 198-200

[6] Brown, C., Kovacs, E., Herzon, I., Villamayor-Tomas, S., Albizua, A., Galanaki, A.,& Zinngrebe, Y. (2021). Simplistic understandings of farmer motivations could undermine the environmental potential of the common agricultural policy. *Land Use Policy*, *101*, 105136.

[7] Constantin, M., Rădulescu, I. D., Andrei, J. V., Chivu, L., Erokhin, V., & Gao, T. (2021). A perspective on agricultural labor productivity and greenhouse gas emissions in context of the Common Agricultural Policy exigencies. *Економика пољопривреде*, *68*(1), 53-67.

[8] Csaki, C., & Jambor, A. (2016). 10 years of EU membership in agriculture: lessons from the new member states. International Agricultural Journal, 6, 4-8. https://doi.org/10.24411/0235- 7801-2016-0001.

[9] Drăgoi, A. E. (2021). The Role of Direct Payments For The Achievement Of „Green Deal" Objectives. *Euroinfo*, *5*(1), 57-66.

[10] European Commission, a, (2020). *Farm to Fork Strategy*. https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_ro

[11] European Commission, b, (2020). Environment and Climate Action (Summary) - (EU27) - European Union 27 (excluding UK). https://agridata.ec.europa.eu/extensions/DashboardIndicators/Environment.html

[12] Fortuna, G., Koreň, M., Foote, N. (2022). *Italy, Slovakia call to rethink CAP in light of Ukraine war*. Euractiv. https://www.euractiv.com/section/agriculture-food/news/italy-slovakia-call-for-rethinking-cap-in-light-of-ukraine-war/

[13] Gobin, A., Tarquis, A. M., & Dalezios, N. R. (2013). "Weather-related hazards and risks in agriculture". *Natural Hazards & Earth System Sciences*, *13*(10).

[14] Metz, F., Lieberherr, E., Schmucki, A., & Huber, R. (2021). Policy change through negotiated agreements: the case of greening Swiss agricultural policy. *Policy studies journal*, *49*(3), 731-756.

[15] Moschitz, H., Muller, A., Kretzschmar, U., Haller, L., de Porras, M., Pfeifer, C., Oehen, B.,Willer, H. & Stolz, H. (2021). How can the EU Farm to Fork strategy deliver on its organic promises? Some critical reflections. *EuroChoices*, *20*(1), 30-36.

[16] Rudnicki, R., Wiśniewski, Ł., & Biczkowski, M. (2021). A Spatial Typography of Environmentally Friendly Common Agricultural Policy Support Relevant to European Green Deal Objectives. *Land*, *10*(10), 1092.Streimikis, J., &

Baležentis, T. (2020). Agricultural sustainability assessment framework integrating sustainable development goals and interlinked priorities of environmental, climate and agriculture policies. *Sustainable Development*, *28*(6), 1702-1712.

Greenhouse Gas Emissions in the EU - The Current Situation and Significant Statistical Relations

GEORGE-CORNEL DUMITRESCU
Institute for World Economy
București, Calea 13 Septembrie nr. 13
ROMANIA
george.cornel@gmail.com

Abstract: The increase in greenhouse gas emissions has become a significant problem for the people and the environment. As a signatory party of the Kyoto Protocol and Paris Agreement, the European Union joined the international community's efforts to achieve a 20% cut in greenhouse gas emissions by 2020 compared to 1990 levels and up to 55% by 2030 as intermediary stages towards achieving climate neutrality by 2050. Recent studies revealed that limiting global warming to 1.5 degrees Celsius to meet the Paris Agreement requirements will still be difficult under the current level of ambition.
This paper aims to assess the progress registered by the EU member states in meeting the climate targets assumed according to the newest EU goals in the field.
It also aims to identify levers that can help meet these objectives by analysing their relationships with greenhouse gas emissions. Our research looks for potential relations between the greenhouse gas emissions and the following indicators: life expectancy, gross domestic product, final energy consumption, final energy consumption in transport, utilised agricultural area and manufacturing value-added. To this end, this paper employs scatter plots to check for linearity, calculates the Pearson's r correlation coefficient for each analysed pair and tests them at a 95% confidence level to establish the statistical significance.
Five statistically significant linear relationships at a 95% confidence level between the GHG emissions and the following indicators have been identified: life expectancy, gross domestic product, manufacturing value-added, utilised agricultural area and final energy consumption. Therefore, the decision-makers could take measures to address these levers to cut emissions at the desired level. The research is based on the literature and the data provided by Eurostat and the World Bank.

Key-Words: emissions reduction, climate, significant correlations, life expectancy, transport

JEL Classification: C1, O13, Q5.

1 Introduction

Greenhouse gases (GHG) are gasses that trap the heat in the atmosphere, thus contributing to global warming. Carbon dioxide (CO2) has the highest share of GHG emissions (76%). The burning processes and some specific chemical reactions generate most carbon dioxide emissions. The plants absorb CO2 during the photosynthesis process and generate it during the oxidation process but to a lesser extent. Therefore, preserving biodiversity and green areas is crucial in our efforts to decrease greenhouse gas emissions, naturally, as per Kyoto and Paris documents (Change, 2014).

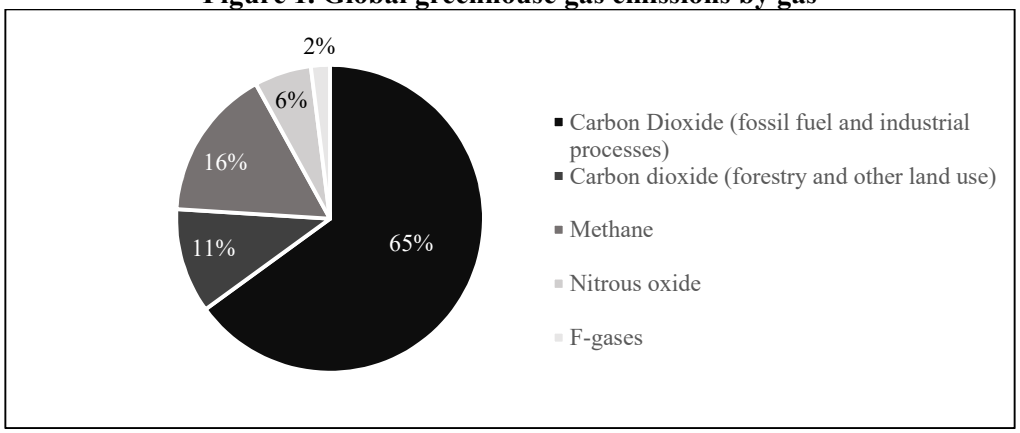
Methane`s share in GHG emissions is 16%. Fossil fuels, livestock, agricultural practices and the decay of organic waste are the primary sources of methane emissions.
Nitrous oxide has a minor contribution to GHG emissions, only 6%. Agricultural and industrial activities, the combustion of fossil fuels and solid waste, and wastewater treatment are responsible for most nitrous oxide emissions (EPA, 2020).

Therefore, the primary sources of GHG are the burning processes, the production and transport of fossil fuels, agricultural and industrial activities and specific chemical industrial reactions, agricultural practices, and waste.

In order to cut these emissions, the decision-makers have to address the primary sources of GHG and to identify ways to turn the respective economic activities more sustainably.
The 2020 global Living Planet Index shows that between 1970 and 2016, the monitored populations of mammals, birds, amphibians, reptiles and fish recorded an average fall of 68%. Approximately 22% of the plants are

threatened with extinction, most in the tropics. Human activities altered most of the land surface, polluted the oceans, and destroyed almost all wetlands (WWF, 2020).

Figure 1. Global greenhouse gas emissions by gas



Source: EPA (2021).

The annual global temperature is likely to be at least one degree Celsius warmer than preindustrial levels in the coming five years. It is very likely to be within the range of 0.91 – 1.59°C. (WMO, 2020).

The Biodiversity Ecosystem Services (BES) Index shows that 20% of all countries have ecosystems in a fragile state for more than 30% of their territory. Furthermore, 55% of global GDP is moderately or highly dependent on BES. The impact on financial assets is also enormous: The Dutch National Bank estimates a staggering EUR 510 billion, or 36% of all of the investments from Dutch financial institutions, would be lost if the ecosystem services underpinning the Dutch economy were no longer available (Swiss RE Institute, 2020).

2 Literature review

There are several important studies on the topic of this paper. Rafaj et al. (2011) analysed the impact of air pollution on life expectancy in Europe, China and India. They found that in China, current ambient concentrations of PM2.5 are responsible for 38 months-losses in the average life expectancy. Farchi et al. (2017) provide evidence supporting a reduction in red meat consumption toward the Mediterranean target of 150 grams/week per capita. A Mediterranean diet model would save 5 million years of life lost prematurely among men and women over the next 18 years and increase the average life expectancy of future generations by over seven months. Therefore, less meat means les methane released into the atmosphere and healthier people.

Tucker (1995) identified a positive relationship between carbon dioxide emissions and the GDP and found that, in general, as per capita income grows, the increase in the emissions tends to decelerate. He argued that higher income levels might lead to increased demand for environmental protection. In China's case, Cohen et al. (2019) showed that emissions go up more during booms than they decline during busts.

According to the empirical findings, Hamit-Haggar (2012) suggests that energy consumption has a positive and statistically significant impact on GHG emissions in the long-run equilibrium.

Matthew et al. (2018) observed that carbon dioxide emission is the primary source of GHG emissions; therefore, the study posits that cuts in carbon dioxide emissions would improve health outcomes in Nigeria. These cuts may be done by reducing deforestation and conservation of land, controlling wildfire, adopting better methods of combusting residues of crops, and effective use of energy by forest dwellers, amongst other measures.

Khan et al. (2014) found that energy consumption is closely connected with greenhouse gas emissions, and carbon dioxide emissions exert the most extensive influence on changes in energy consumption in different regions of the world.

Hong et al. (2014) show that material manufacturing, transportation, and on-site construction were responsible for 94.89%, 1.08%, and 4.03% of energy consumption, and 95.16%, 1.76%, 3.08% of global warming potential, respectively.

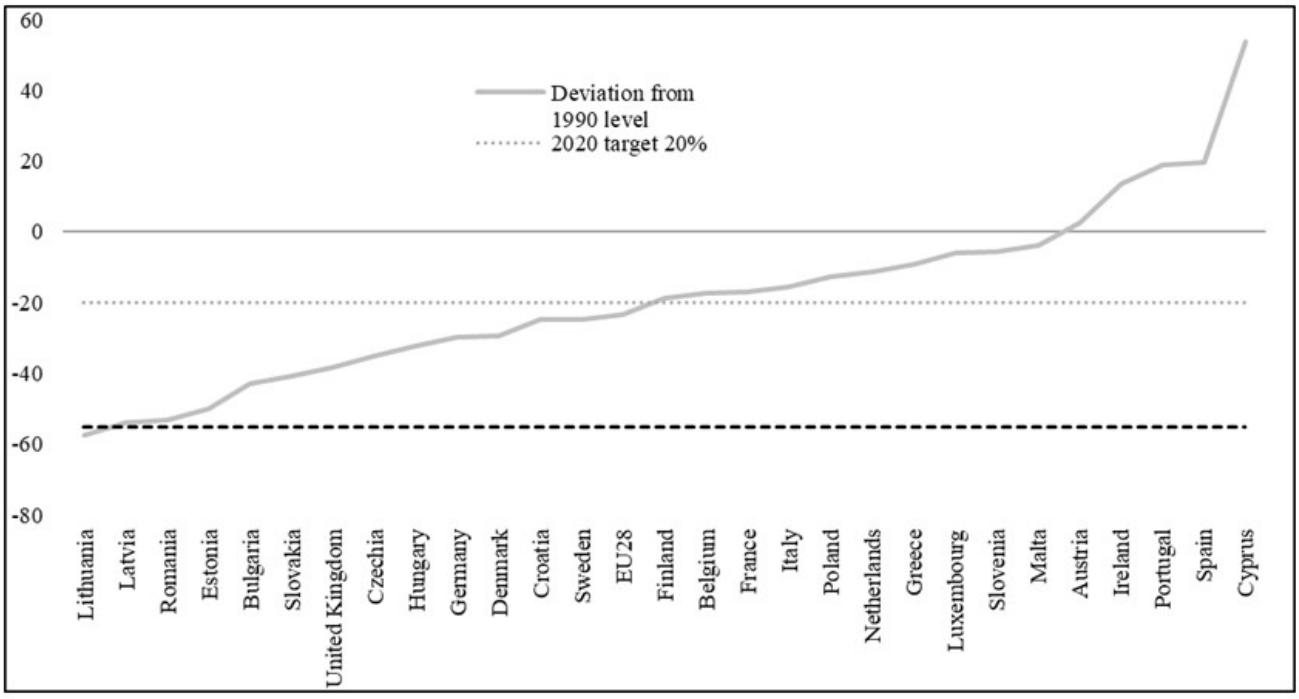
Smith et al. (2008) emphasise that agriculture accounts for 52% and 84% of global anthropogenic methane and nitrous oxide emissions. Frank et al. (2017) argue that agriculture will have to contribute to efforts to decrease GHG emissions, thus keeping global warming below 1.5 degrees Celsius and mitigating adverse effects of climate change. Climate stabilisation without compromising food security requires an intelligent

climate policy design that enables GHG-efficient mitigation in agriculture, forestry, and other land use. Considering the environmental impact, emissions associated with the actual total intake of beef range from 12,900 to 21,800 GHG CO2 equivalent; emissions saved according to the Mediterranean scenario are in the range of 8,000–14,000 GHG CO2 equivalent per year (Farchi et al., 2017).

3. Greenhouse gas emissions in the EU - the current situation

According to the statistical data provided by Eurostat (Figure 2), Lithuania, Latvia, Romania, Estonia, Bulgaria, Slovakia, United Kingdom, Czechia, Hungary, Germany, Denmark, Croatia, and Sweden met two years before the target for 2020 (a reduction by 20% in the emissions of GHG, as compared to the levels in 1990.

Figure 2. The decrease in GHG emissions in 2018 as compared to 1990, and the positioning against the targets for 2020 and 2030 (20%, 40% and 55%), in %



Source: Author's own representation, based on Eurostat (2020).

In the case of Lithuania, Latvia, Romania, Estonia and Slovakia, the former target for 2030, namely 40%, has also been met since 2018. The rest of the EU countries position themselves below the set level of ambition.

Under the new level of ambition of 55%, Lithuania is the only EU country that has already met that target since 2018. The rest of the states have to take significant measures to align with the EU targets.

From the perspective of greenhouse gas emissions as tonnes per capita (Figure 3), between 1990 and 2018, the most significant decrease was registered by the United Kingdom, by 47%, from 14 tonnes per capita to 7.5 tonnes per capita, followed by Romania (a drop of 44%), from 11 tonnes to 6 tonnes and Lithuania (44%), from 13 tonnes to 7 tonnes.

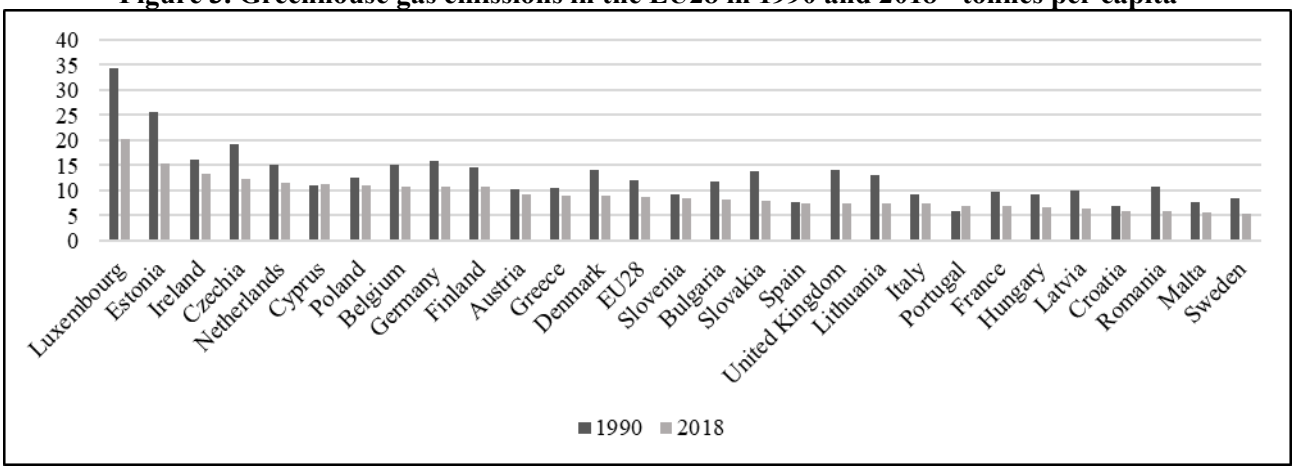
These countries rank way below the average decrease in the EU of 28%. During the analysed interval, performances above the EU average regarding the percentage decrease were registered by Denmark (-37%), Germany (-33%) and Sweden (-36%).

Compared to 1990, Portugal was the only country that has recorded a significant increase in GHG emissions per capita (+17%), followed by Cyprus with a rise of only +2%.

Still, in 2018, Germany emitted almost 11 tonnes of GHG per capita, the equivalent of Romania`s emissions in 1990.

In 2018, the emissions champions were Luxembourg (20 tonnes per capita), Estonia (15 tonnes per capita) and Ireland (13 tonnes per capita). The lowest emissions of GHG per capita were registered in Romania (6 tonnes), Malta (5.5 tonnes) and Sweden (5.4 tonnes of GHG emissions per capita).

Figure 3. Greenhouse gas emissions in the EU28 in 1990 and 2018 - tonnes per capita



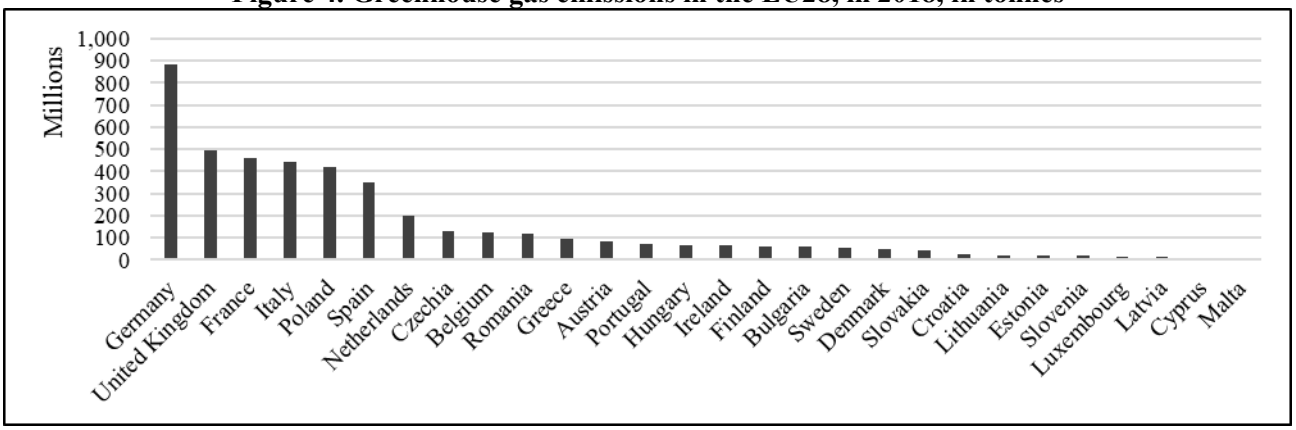
Source: Author's own representation, based on Eurostat (2020).

Regarding the emissions of GHG in tonnes (Figure 4), in 2018, Germany ranked first among the EU countries, with almost 900 million tonnes, followed by the United Kingdom with around 500 million tonnes and France with 460 million tonnes.

The last three countries in the EU regarding GHG emissions in tonnes were Latvia (12 million tonnes), Cyprus (10 million tonnes) and Malta (3 million tonnes).

Therefore, even if from the statistical point of view, the leading EU economies regarding the size of GDP, namely Germany, United Kingdom, France, Italy and Spain, recorded noteworthy progress in decreasing GHG emissions per capita, they are still the major polluters.

Figure 4. Greenhouse gas emissions in the EU28, in 2018, in tonnes



Source: Author's own representation, based on Eurostat (2020).

Among the countries in Eastern Europe, Poland ranks fifth with 417 million tonnes, Czechia the eighth with 130 million tonnes and Romania the tenth with 117 million tonnes.

According to the projections of the European Commission (2020), to meet the target of 55%, between 2021 and 2030, the EU has to invest annually approximately 126 billion euros for the energy supply sector, 22 billion euros for the industrial sector, 620 billion euros for the transport sector and 193 billion euros for the residential sector (Table 1).

Table 1. Average annual investment for the climate target, billion euros 2015

Sectors	Target 55% ALLBNK*	
	Average 2021-2030	Average 2031-2050
Investments in power grid	60.10	80.30
Investments in power plants	59.60	85.40
Investments in boilers	4.60	1.40
Investments in new fuels production and distribution	2.20	25.90

Sectors	Target 55% ALLBNK*	
	Average 2021-2030	Average 2031-2050
Total supply side investments	126.40	193.00
Industrial sector investments	21.90	14.80
Residential sector investments	193.10	176.10
Tertiary sector investments	92.90	86.00
Transport sector investments	620.30	726.00
Total demand side investments	928.20	1,003.00
Total demand side investments excl. transport	307.90	277.00
Total energy system investments	1,054.70	1,196.00
Total energy system investments excl. transport	434.30	470.00

Source: European Commission (2020).
*ALLBNK is the most ambitious scenario in GHG emissions reduction based on MIX and further intensifying fuel mandates for aviation and maritime sectors in response to the extended scope of GHG reductions covering all aviation and navigation.

4. Greenhouse gas emissions in the EU - significant statistical relations

The first step in analysing the relationship between the chosen pairs of variables was to draw the scatter plots of linearity based on the data from Table 2. With one exception, namely the relationship with life expectancy, greenhouse gas emissions were considered a dependent variable and the rest were independent variables.

Table 2. Synoptic table of the analysed indicators

Year	GHG emissions tonnes per capita (GHG)	GDP current euro per capita (GDP)	Utilised agricultural area Main area (1000 ha) (UAA)	Life expectancy Years (LE)	Manufacturing, value added current US$** (MVA)	Final energy consumption Million (TOE)* (FEC)	Final energy consumption in transport Thousand (TOE) (FECT)
1991	11.8	:	:	:	1,330,694,467,745.7	:	:
1992	11.4	:	:	:	1,407,795,158,019.9	:	:
1993	11.2	:	:	:	1,228,940,853,847.6	:	:
1994	11.1	:	:	:	1,292,938,408,296.5	:	:
1995	11.2	:	:	:	1,500,745,505,031.1	:	:
1996	11.4	:	:	:	1,492,388,768,009.4	:	:
1997	11.2	:	:	:	1,374,331,796,774.2	:	:
1998	11.1	:	:	:	1,416,763,231,928.9	:	:
1999	10.9	:	:	:	1,379,254,754,871.4	:	:
2000	10.8	:	:	:	1,272,273,050,781.2	1,133.3	:
2001	10.9	:	:	:	1,271,129,223,084.6	1,157.8	:
2002	10.8	:	:	:	1,348,031,810,434.2	1,145.8	:
2003	11.0	:	:	:	1,618,611,070,804.2	1,177.6	:
2004	10.9	:	:	:	1,840,027,778,566.8	1,189.6	:
2005	10.8	:	:	:	1,889,224,483,523.4	1,193.8	:
2006	10.8	:	:	78.9	2,011,405,428,652.9	1,197	:
2007	10.7	:	:	79.1	2,335,137,032,996.6	1,177.4	336,085.963
2008	10.4	26,130	182,807.8	79.4	2,482,423,907,762.0	1,184.8	330,269.715
2009	9.6	24,530	181,472.1	79.6	2,043,538,571,554.0	1,118.6	321,661.108

2010	9.8	25,500	180,136.8	79.9	2,106,279,556,840.3	1,166.7	320,500.622
2011	9.5	26,220	179,365.4	80.2	2,326,082,209,776.2	1,114.2	318,951.192
2012	9.3	26,680	178,197.8	80.3	2,135,253,062,539.2	1,115.7	308,965.43
2013	9.1	26,850	178,098.8	80.5	2,218,551,916,831.8	1,115.5	305,178.918
2014	8.7	27,730	178,392.7	80.9	2,301,232,633,700.3	1,067.6	309,287.354
2015	8.8	29,140	178,995.6	80.6	2,073,645,013,012.3	1,090.1	313,633.566
2016	8.7	29,310	178,750.9	81.0	2,141,509,351,373.1	1,110	321,020.086
2017	8.8	30,090	178,822.2	80.9	2,263,942,742,149.0	1,122.9	326,918.011
2018	8.6	31,000	179,144.6	81.0	2,433,238,416,899.9	1,124.1	328,590.674

* Tonnes of oil equivalent
Source: European Commission, World Bank** (2020).

The resulted scatter plots are displayed in the figures from 5 to 10. The nearer the scatter points are to a straight line, the higher the association between the variables.

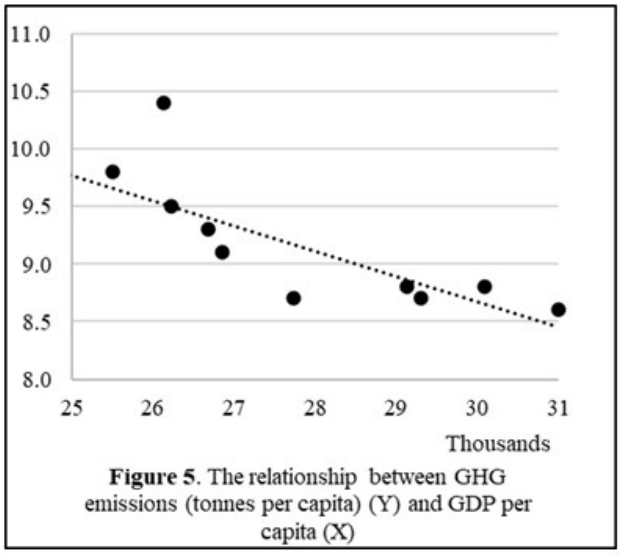


Figure 5. The relationship between GHG emissions (tonnes per capita) (Y) and GDP per capita (X)

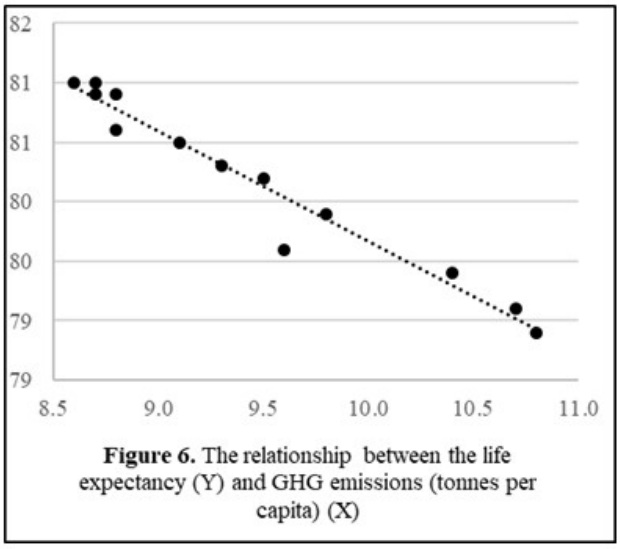


Figure 6. The relationship between the life expectancy (Y) and GHG emissions (tonnes per capita) (X)

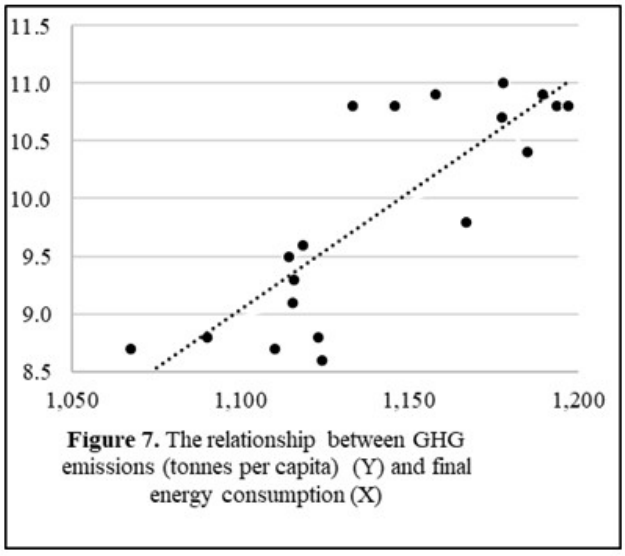


Figure 7. The relationship between GHG emissions (tonnes per capita) (Y) and final energy consumption (X)

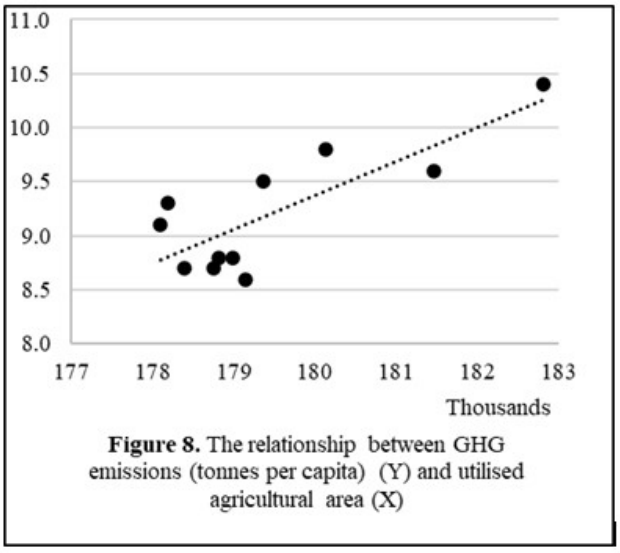


Figure 8. The relationship between GHG emissions (tonnes per capita) (Y) and utilised agricultural area (X)

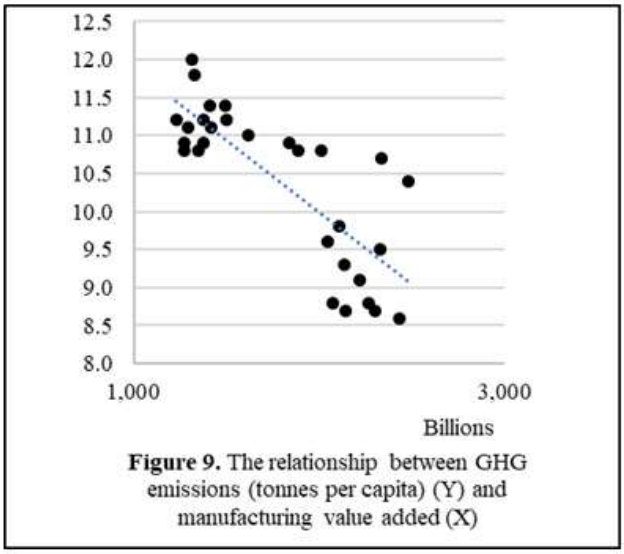


Figure 9. The relationship between GHG emissions (tonnes per capita) (Y) and manufacturing value added (X)

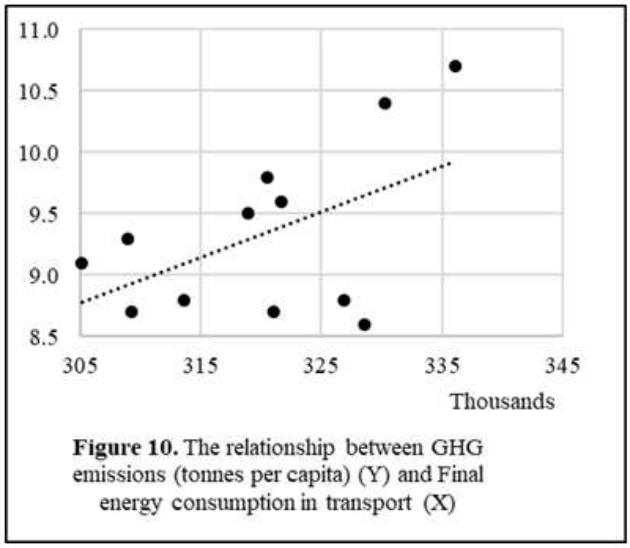


Figure 10. The relationship between GHG emissions (tonnes per capita) (Y) and Final energy consumption in transport (X)

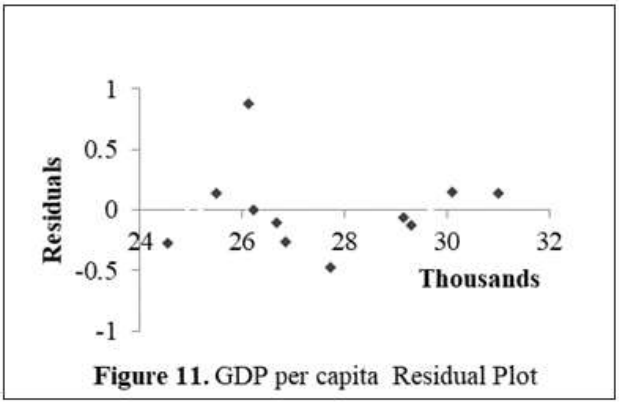


Figure 11. GDP per capita Residual Plot

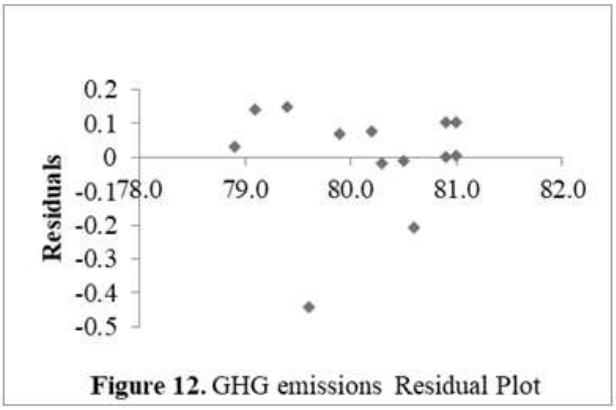


Figure 12. GHG emissions Residual Plot

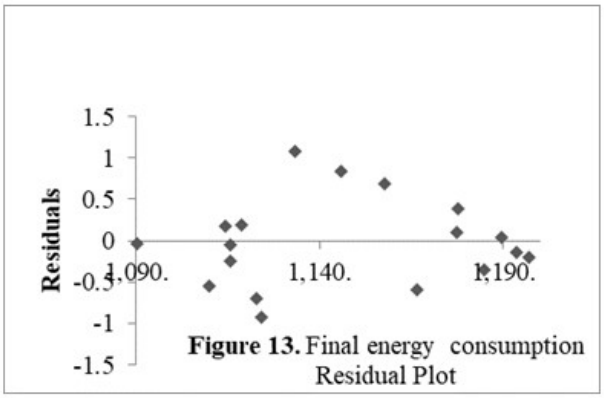


Figure 13. Final energy consumption Residual Plot

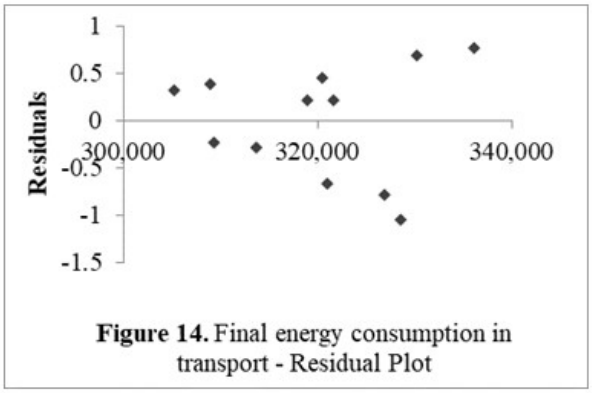


Figure 14. Final energy consumption in transport - Residual Plot

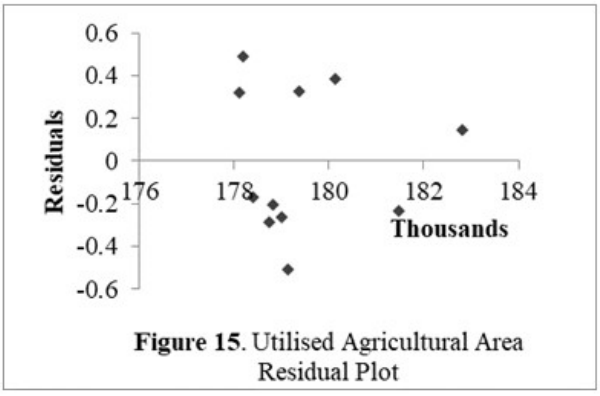


Figure 15. Utilised Agricultural Area Residual Plot

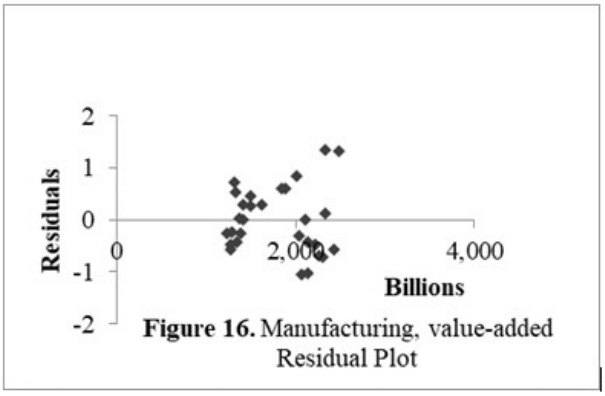


Figure 16. Manufacturing, value-added Residual Plot

The residual plots display somewhat random patterns that indicate that linear models provide a decent fit to the data. The sample Pearson`s r is calculated with the following formula:

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{n\sum x^2 - (\sum x)^2}\ \sqrt{n\sum y^2 - (\sum y)^2}} \quad (1)$$

Using Microsoft Excel, we calculated the value of Pearson`s r for the analysed data.

Table 3. Correlation coefficient and coefficients of determination between GHG emissions (GHGE) and the selected independent variables

Indicator	GDP	LE	FEC	UAA	MVA	FECT
Correlation coefficient	-0.788512832	-0.978072905	0.826897523	0.804266832	-0.794072287	0.509428296
Coefficient of determination	0.621752487	0.956626608	0.683759513	0.646845137	0.630550797	0.259517189

The values of the r coefficient indicate that there are uphill solid linear relationships (r>0.70) between the GHG emissions and final energy consumption and between GHG emissions and utilised agricultural land. Therefore, the dependent and independent variables increase together.

We also found three strong negative linear relationships between GHG emissions and GDP, GHG emissions and Life expectancy and between GHG emissions and Manufacturing value-added. As one variable increases, the other one decreases, and vice versa.

The coefficients of determination (r^2) vary from 0.9566 (GHGE/LE) to 0.2595 (GHGE/FECT). That means that the relationship between the analysed variables explains between 95.66% and 25.95% of the variation in GHG emissions. It does not mean that one variable causes the other in any relationship.

The pairs of variables are tested at a 95% level of confidence to identify if their linear relationships are statistically significant.

The null hypothesis (H0) implies no statistically significant linear relationship in the EU between GHG emissions (tonnes per capita) and GDP or LE or FEC or UAA or MVA, or FECT.

The alternate hypothesis (Ha) implies a statistically significant linear relationship in the EU between GHG emissions (tonnes per capita) and the selected independent variables.

H0: $\rho = 0$.

Ha: $\rho \neq 0$.

While Pearson`s r is the sample correlation coefficient, ρ is the population correlation coefficient. The hypotheses were tested using the t-distribution.

Calculations:

Having a two-tailed test, and $\alpha = 0.05$, the value of $\alpha/2 = 0.025$. The critical value of t that gives the area of 0.025 to the right tail of the t-distribution has to be found.

The t-distribution table was used to find the value of $t_{0.025}$. Taking into consideration the degree of freedom and the level of significance α (Table 4). Since the t-distribution is symmetrical, $-t_{\alpha/2} = -t_{0.025}$ (the value of t that gives the area of 0.025 to the left of the t-distribution).

We calculate the test statistic t using the formula:

$$t = \frac{r}{\sqrt{\frac{1-r^2}{n-2}}} \quad (2)$$

Table 4. T-Distribution indicators for our analysed pairs of variables

	GHGE/GDP	LE/GHGE	GHGE/FEC	GHGE/UAA	GHGE/MVA	GHGE/FECT
Number of observations (n)	11	13	19	11	29	12
Degree of freedom (Dof)	9	11	17	9	27	10
$t_{0.025}$	2.262	2.201	2.110	2.262	2.052	2.228
$-t_{0.025}$	-2.262	-2.201	-2.110	-2.262	-2.052	-2.228
Test statistic **t**	-3.846	-15.575	6.062	4.060	-6.788	1.872

	GHGE/GDP	LE/GHGE	GHGE/FEC	GHGE/UAA	GHGE/MVA	GHGE/FECT
$t < -t_{0.025}$ or $t > t_{0.025}$	yes	yes	yes	yes	yes	no
Statistical significance	We reject (H0). We are 95% confident that there is a statistically significant linear relationship between GHG emissions and GDP.	We reject (H0). We are 95% confident that there is a statistically significant linear relationship between the life expectancy and GHG emissions.	We reject (H0). We are 95% confident that there is a statistically significant linear relationship between the GHG emissions and the final energy consumption.	We reject (H0). We are 95% confident that there is a statistically significant linear relationship between the GHG emissions and the utilised agricultural area.	We reject (H0). We are 95% confident that there is a statistically significant linear relationship between the GHG emissions and the manufacturing value-added.	We fail to reject H0. There is no statistically significant linear relationship in the EU between GHG emissions and the final energy consumption in transport.

4 Conclusion

By trapping the heat in the atmosphere, GHG emissions significantly impact global warming, making the reduction of such emissions a significant topic on the EU Commission agenda. Therefore, the climate targets as they were set should be met by all member states accordingly. Thirteen EU countries met the target for 2020 back in 2018. Five European countries, Romania included, have met the previous target for 2030 since 2018; therefore, for these countries, reaching a 55% or even a 60% cut in GHG emissions by 2030 could be easier to achieve.

Even if the leading EU economies recorded significant cuts in GHG emissions per capita between 1990 and 2018, Germany, France, Italy and Spain remain the highest GHG emitters.

The econometrical analysis confirmed some of the findings of the studies mentioned in the literature review. Out of six analysed relationships involving GHG emissions, five turned out to be statistically significant at a level of confidence of 95%. The highest coefficient of determination has the relationship between life expectancy and GHG emissions, explaining 95.66% of the variation in life expectancy. The relationship with the highest coefficient of determination, in which GHG emissions was the dependent variable, is the one including final energy consumption (this relationship could explain 68,37% in the variation of GHG emissions), followed by the one with the utilised agricultural area and the one with manufacturing value-added.

The econometric analysis focused on indicators that reflect the economic activities involving burning processes, production and transport of fossil fuels, agricultural and industrial activities, specific chemical reactions, agricultural practices, and waste, which are the primary sources of GHG. Thus, the decision-makers could consider the results of this analysis when creating policies to cut GHG emissions.

References:

[1] Cohen, G., Jalles, J. T., Loungani, P., Marto, R., & Wang, G. (2019). Decoupling of emissions and GDP: Evidence from aggregate and provincial Chinese data. Energy Economics, 77, 105-118.

[2] EPA. (2020). Overview of Greenhouse Gases. Available at: https://www.epa.gov/enviro/greenhouse-gas-overview EPA. (2021). Global Greenhouse Gas Emissions Data. Available at: https://19january2021snapshot.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data_.html.

[3] European Commission. (2020). Impact Assessment on Stepping up Europe's 2030 Climate Ambition. Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1599 (2020)

[4] Farchi, S., De Sario, M., Lapucci, E., Davoli, M., & Michelozzi, P. (2017). Meat consumption reduction in Italian regions: health co-benefits and decreases in GHG emissions. PloS one, 12(8), e0182960.

[5] Frank, S., Havlík, P., Soussana, J. F., Levesque, A., Valin, H., Wollenberg, E., ... & Obersteiner, M. (2017). Reducing greenhouse gas emissions in agriculture without compromising food security? Environmental Research Letters, 12(10), 105004.

[6] Hamit-Haggar, M. (2012). Greenhouse gas emissions, energy consumption and economic growth: A panel cointegration analysis from Canadian industrial sector perspective. Energy Economics, 34(1), 358-364.

[7] Hong, T., Ji, C., Jang, M., & Park, H. (2014). Assessment model for energy consumption and greenhouse gas emissions during building construction. Journal of Management in Engineering, 30(2), 226-235.
[8] Change, I. C. (2014). Mitigation of climate change. Contribution of working group III to the fifth assessment report of the intergovernmental panel on climate change, 1454, 147.
[9] Khan, M. A., Khan, M. Z., Zaman, K., & Naz, L. (2014). Global estimates of energy consumption and greenhouse gas emissions. Renewable and Sustainable Energy Reviews, 29, 336-344.
[10] Matthew, O., Osabohien, R., Fasina, F., & Fasina, A. (2018). Greenhouse gas emissions and health outcomes in Nigeria: Empirical insight from ARDL technique. International Journal of Energy Economics and Policy, 8(3), 43-50.
[11] Rafaj, P., Schöpp, W., Russ, P., Heyes, C., & Amann, M. (2011). Co-benefits of post-2012 global GHG-mitigation policies.
[12] Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., ... & Smith, J. (2008). Greenhouse gas mitigation in agriculture. Philosophical transactions of the royal Society B: Biological Sciences, 363(1492), 789-813.
[13] Swiss RE Institute. (2020). Biodiversity and Ecosystem Services (BES) - a business case for the re/insurance industry. Available at: https://www.unisdr.org/preventionweb/files/73850_swissreinstituteexpertisepublicatio.pdf
[14] Tucker, M. (1995). Carbon dioxide emissions and global GDP. Ecological Economics, 15(3), 215-223.
[15] WMO. (2020). New climate predictions assess global temperatures in coming five years. 2020. Available at: https://public.wmo.int/en/media/press-release/new-climate-predictions-assess-global-temperatures-coming-five-years
[16] WWF. (2020). Living Planet Report 2020 - Bending the curve of biodiversity loss. Available at: https://f.hubspotusercontent20.net/hubfs/4783129/LPR/PDFs/ENGLISH-SUMMARY.pdf

The Role of the Triple Helix Model in Sustaining the Regional Economic Development[1]

GEORGETA ILIE
Institute for World Economy, Romanian Academy
13, Calea 13 Septembrie, 6th district, Bucharest
ROMANIA
g2009ilie@gmail.com

Abstract: This paper highlights the contribution of the triple helix model in sustaining the processes of economic development at the regional level. The first part presents the triple helix system components intensively analysed in the international literature in this field, emphasizing the main conditions that must be met for the development of this model. The second part focuses on the regional strategies developed around the triple helix model based on a set of successful interactions among academia, industry and authorities, such as clusters and special economic zones. Considering the almost three decades of theoretical and practical experiences, there are highlighted a few successful examples implemented in a few countries with different economic potential. This is a way to demonstrate that all these actors have believed and supported this partnership and now they are able to reap the positive effects. A series of arguments are offered in favour of supporting the development of local collaborative structures, such as clusters and special economic zones, including them into the regional development strategies. The last part of the paper reveals a successful collaborative example from Romania, where the model was developed in an extended quadruple form. Besides, there are revealed the forward steps and initiatives prepared to be taken in order to improve the conditions for the implementation of this collaborative model into Romanian environment.

Keywords: university, innovation, economic development collaborative, cluster, special economic zone

JEL Classification: I23, I25, O32, R58

1. Introduction

The knowledge creation and innovation eco-systems, a vibrant industry and a well-functioning government are the key ingredients of sustainable development (Gatune et al., 2018). Understanding this reality, in the 1990s the ***triple helix model*** was conceived and later developed, bringing together the most important actors in any society: ***universities, industries and governmental authorities*** in a spiral model of innovation covering multiple interrelationships in the complex process of knowledge capitalization (Etzkowitz, 2002).

In the current economic and social context, for any country, the being competitive depends on how the three main actors are organized and, most importantly, work together. More than that, the triple helix model is not just about working together on an ad hoc or on project basis. Their cooperation is supposed to be more institutional, structured and strategic. And at a certain level, the success of this model could be related with the fact of ***taking the role of the other by adopting new roles***. More exactly, companies are implied in educational processes (internships, training sessions, implication in developing curriculum hosted by universities) and the university develops entrepreneurial activities (*entrepreneurial university*). In the triple helix model, knowledge does not only flow from university laboratories to the business structures as the traditional model of innovation, but there are multiple links, flows and backflows between multiple partners that make up a complex construction of public, private and knowledge actors (Winden & Carvalho, 2019).

The triple helix model of innovation refers to a set of interactions to foster economic and social development, as defined in concepts such as the knowledge economy and knowledge society (Leydesdorff, 2012). The university is vital in generating knowledge and know-how that underpins innovations while the industry is the key in valorising the knowledge and innovations on the market. Both these efforts require considerable mobilization of resources. There is also need for markets to allow for exchange of goods and services and also

[1] The results of the research on which this paper is based have been previously presented at the international conference "*Challenges of Doing Business in the Global Economy, 2022 edition*".

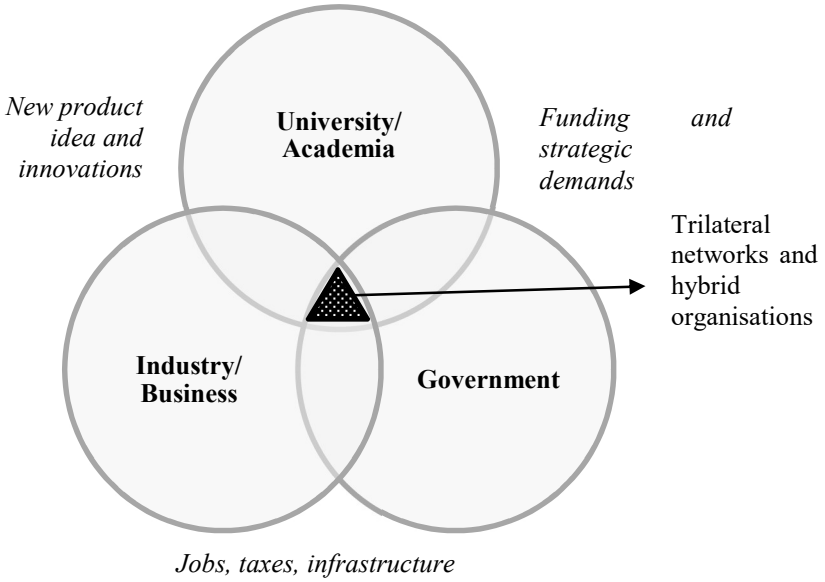
coordinate production activities through price signals. Governments play a crucial role in setting the regulation framework, facilitating the markets functioning and also incentivizing actors to participate in otherwise risky economic activities (Gatune et al., 2018).

Starting this model involves taking the initiative of one of the three actors. The driver of the triple helix can be any of the three main players. When *government* leads the process then this is a *top-down model,* where the policy drives the process, by formulating the overview and specifying the general objectives. When *industry or academia* drives, then a *bottom-up* process happens. But the two processes are not distinct as government can take the initiative of starting the process say through encouraging industry and then industry leaders can takeover. (Gatune et al., 2018).

2. The Triple Helix model: components and determinant conditions

The triple helix model is organized on the basis of a system consisting of: the three components (from three different areas: university, industry and government); the relationships among the components (through collaboration, technology transfer, conflict moderation, substitution and networking); the processes taking place into a common structure (related with generation, diffusion and application of knowledge and innovation) (Ranga & Etzkowitz, 2013). In order to illustrate the components of this model, the international specialized literature offers a specific graphical representation for the triple helix model, as the one presented in Figure 1.

Figure 1: The triple helix system: components and interactions



Source: Author, based on Ranga & Etzkowitz (2013).

Over time, the triple helix model, as a form of collaboration supporting the economic development, has shown that its processes of organization and operation require the provision of *three specific spaces*, built gradually, as follows:

- the *knowledge space* is about the concentration of related education, research and development activities in a certain geographical area, thus improving local conditions for innovation;

- the *consensus space* represents the environment in which individuals with different perspectives meet and interact representing businesses, organizations and institutions from the three institutional spheres and through mutual interaction are generating new ideas and innovative development strategies; the agreement is crucial in supporting the interaction among three powerful actors, as a key in generating trust and a shared vision, as well as in developing the regulation framework;

- the *innovation space* may result in the formation of hybrid organizations arising from the interaction of the three institutional structures and thus establishing of innovation clusters, business incubators, science and technological parks, research and development organizations (Ranga & Etzkowitz, 2013).

The relationship among the three main players here involved requires a strong communication, a mutual learning process to produce, diffuse, capitalize and regulate processes of generation and application of useful knowledge. The pragmatic relationship is an interactively concentrated effort embedded in shared values and consequently in productive projects.

Triple helix systems focus on the *open boundaries* among institutional components as a very valuable source of organizational creativity, encouraging individuals to move within and between spheres and to engage in recombining elements to create new types of creative structure. Networking in order to increase cohesion, destroying borders can be as important as the results of research and development (Etzkowitz, 2002)

Bringing the three dimensions together means the convergence and confluence of interests. Priorities have to be set not only on intellectual, rational and logical goals, but also on available resources, research agendas and an ex-ante assessment of the likelihood of success (Leydesdorff, 2012).

The development of the triple helix as an institutionalization process involves four phases, beginning with the recognition and understanding of needs, followed by internal transformation at the level of each participant in this model and the development of interactions between organizations, and ending with institutionalization. Going through these logical transformations requires the fulfilment of favourable tangible and intangible conditions (Cai et al., 2015). The *tangible conditions* that must be the basis for the development of the triple helix model are:

- competencies of universities in knowledge and technology generation and diffusion;
- absorptive capacity and demand of industry and innovator for knowledge and technology;
- supportive infrastructure;
- institutional entrepreneurs.

The *intangible conditions* are focused on general contextual factors and are as follows:

- *consensus on knowledge as the key to economic growth* (the model comes to create a framework of a regional collaboration of creating innovative technologies and products);
- *market orientated culture* (each player is concerned with pursuing their interests in the market);
- *process oriented knowledge management in knowledge production* (applying the specific principles and standards of quality management, creating the conditions for continuous improvement and efficiency);
- *intellectual property protection* (as one of the most sensitive issues in this collaborative project requiring specific means of guaranties);
- *civil society participation* (local initiatives and free mobility support the sources of innovation);
- *sense of competition* (this model based on an intensive partnership is performed in a way to support competitive market systems);
- *democracy in decision making* (needed at the level of each player).

Although these conditions are extremely challenging, there is a general acceptance that these favourable conditions are fruitful at the level of a regional innovation system, as we are going to highlight through several successful examples in the following chapters of this paper.

3. The triple helix model and its role in supporting the local economic development

The triple helix model is the most applicable and it generates effects at the level of local development, and in this particular case the clusters and special economic zones offer the best conditions.

Innovation takes place in an institutional, political and social context, where the innovation capacities should be approached as a geographical process and should be sustained through knowledge sharing regional communities. Innovation is easier when geographical concentration and proximity are present, and therefore the regional cluster and the special economic zone take on new dimensions in such processes (Gatune et al., 2018).

For the regional innovation system to be effective, the region needs not only scientific and technological institutions, but also tools to support innovation, such as institutions to promote concerted action and investment mechanisms, and therefore institutional support structures through regulations that favour innovation processes. It is also particularly important to have structures that link the regional to the national level. Bringing regional and national together is the key to exploiting national resources that can be substantial, and funding mechanisms often tend to be highly centralized at the national level. In designing concentrated spaces to ensure knowledge creation, innovation, consensus and cooperation, all these issues are essential (Rodrigues & Melo, 2013).

The decisive objective of a regional economic development policy is to create the conditions, infrastructure and resources that companies and communities rely on in order to be productive. Every successful company and every region begin with certain foundations — an educated population, concentration of skilled labour, dynamic networks of suppliers, strong infrastructure, basic research that can be capitalized on the market (Fuller et al., 2015).

The favourable conditions are crucial for common prosperity, which is at the heart of a successful economic development strategy. In our analysis, we highlight the ***clusters*** and ***special economic zones*** as two successful models that offer the best conditions for the application of this model and can generate remarkable results at the regional level, where they are implemented. What is noteworthy is that these structures have been implemented and have generated very remarkable results in developed and emerging countries. These have been noticed by the main actors in other countries, mainly in the developing countries that are looking for development solutions, and thus they have become role models. Projects in the same direction are currently under way in developing countries in Africa, which have seen this model as a solution to ensure that they use their valuable knowledge resources and to increase their chances of economic development.

3.1. Clusters – the suitable structure for implementing the triple helix model

Within the meaning of the classical definition, a ***cluster*** is a group of companies, as well as economic actors and related institutions that are located next to each other and that derive productive advantages from their proximity and mutual connections. Cluster analysis can help detect the region's strengths and economic challenges and identify realistic ways to shape the region's economic future (Cortright, 2006).

Therefore, the local or regional level is the best place to apply the triple helix model, as it offers the full potential for closer collaboration, which is the key to identifying innovative solutions that will later generate competitiveness. All this can be developed in innovative clusters or other collaborative structures that can lead the development of the region by increasing skills and creating industries. Industries can eventually generate companies that over time become world leaders and consequently the main drivers of economic development. Clusters increase the competitiveness of companies through accumulation economies. This is due to the presence of high competencies, providers of specialized services, improved market access and the flow of information (Gatune et al., 2018).

An inspirational successful triple helix project developed within a cluster structure in South Carolina

The triple helix innovation model is a point where industry, government and education come together in a common goal: to facilitate the generation of ideas and to use them in economic and social development.

There are many communities that recognize the importance of synergy among these key players, developing successful collaborations that can be inspirational models for actors involved in many locations around the world. Beyond the theoretical and idealistic dimension, these examples demonstrate that this model works and generates real effects for everyone implied and society.

South Carolina is the location of the world's largest BMW production facility, and some will say, the catalyst to making the region an automotive cluster of excellence. Besides, more than 250 other automotive companies, from suppliers to software providers, including American, French, German and Japanese auto giants, operate here being parts of this ever-growing industrial powerhouse.

In this very specialised and concentrated area there is an extraordinary need of a knowledge, specialised skills and talents channel to nurture the workforce. This need is extraordinary supported by Clemson University

that since 2007 has developed the ***Clemson University International Center for Automotive Research*** (CU-ICAR) with a very well targeted vision to be the premier automotive research, innovation and educational enterprise in the world.

Their strong and fruitful interaction is financially supported by the private and public sector. Since its inception, CU-ICAR has secured investments totalling USD 300 million, including more than USD 95 million from governmental agencies, allowing industry and university to focus on programmes, research and advancements within the industry.

Corporate decision-makers are seeking that level of collaboration, especially when setting up a new business structure in a new geographic region where the company doesn't have its own research, development and talent infrastructure. *Deep Orange*, a dedicated master programme developed by CU-ICAR, offers all the necessary educational and practical infrastructure from concept designing a vehicle to a market-ready prototype.

This master innovative program, through its strong education, research and industry collaboration, allows students to understand a wide range of automotive industry issues, provided in partnership with the main international manufacturers and industry partners, offering the latest perspective on vehicle design in terms of new technology (Caldwell, 2022).

This successful particular example demonstrates the way all three facets of the triple helix model work together being able to generate remarkable outcomes for every part implied, local community (university), industry and national development. This joint project was developed at the ***initiative of an industrial region to modernize itself with the impulse of a university***. Many other collaborative projects have been developed as a *university initiative to attract industry*, as were the cases with the development of the Stanford's science park around the university or the Research Triangle in North Carolina (the largest research park in the USA including: North Carolina State University, Duke University and University of North Carolina) (Leslie & Kargon, 1996).

3.2. Special economic zones – the proper location for developing the triple helix model

In Asian countries, the collaboration among the key actors is crucial for attracting foreign direct investment, creating innovation-driven industries and offering high value-added jobs. Understanding all these positive effects, the central authorities relaxed the control to local administrative institutions. At this level, the best conditions are offered by the ***special economic zones***.

The tech hub of Shenzhen in China

The ***tech hub of Shenzhen*** in China is an outstanding example of how world-leading companies can emerge from these ecosystems. The city is home to the headquarters of leading electric vehicle battery maker BYD and software giant Tencent, which has grown into a global behemoth since being founded by Pony Ma and four other Shenzhen University classmates in 1998.

Analysing the Shenzhen favourable environment for such a success, besides the special economic zone conditions, it is more the obvious the role of the ***Shenzhen University***, declaring itself as dedicated to serving the Shenzhen special economic zone (Yeo, 2022).

Weakening control of the central government by transferring to the local government authorities a number of economic prerogatives, especially in the areas of infrastructure construction, has allowed companies in the area to increase their production efficiency.

In this context, key players were encouraged to develop interactive links with each other. The Shenzhen government has created a favourable institutional environment to attract infrastructure construction, manufacturing and high-tech industries. The industry conducts research and development activities, enabling modernization and innovation. The university is involved in technology transfer, setting up new research spin-offs and other reform measures, including the promotion of university-industry links, the development of university-run enterprises, the construction of science parks and the management of multi-campus systems.

This is a successful model in the application of the triple helix model in Asia. Of course, this demonstrates and encourages central authorities to continue to give more freedom to local authorities to engage in models such as the one in Shenzhen. The industrial sector massively focused on innovation needs a stronger involvement of the authorities, the universities being also open to collaboration, so as to achieve the effectiveness of the model.

These transformations would allow greater freedom and power to coordinate local industrial development. Thus, the local authorities are interested to attract new FDI for stimulating economic growth, and consequently the full achievement of the conditions for the triple helix model to generate its effects on economic development (Yeo, 2022).

Special economic zones benefiting from the presence of universities

Looking at the top special economic zones in the world, it is quite obvious that they all either host universities within or near them, which leads to the conclusion that universities are a key factor in their success,

and the triple helix model is perfectly applied. The following paragraphs provide some effective examples of how three very different special economic zones can all benefit from the presence of a university (Serlet, 2022).

Dubai Internet City is one of the best appreciated special economic zone in the world, located adjacent to the industrial clusters such as Dubai Media City and Dubai Knowledge Park, with an extraordinary expansion, famous for being the Middle East headquarters of the world's largest tech companies.

The home to 1,600 tenants, including some of the world's most well-known blue-chip IT companies, is located across the street from American University in Dubai, opened four years before the zone, providing companies located there with an endless supply of tech-savvy students from around the world.

This area is extremely open to this kind of partnership. In 2018, the British University of Dubai, the Triple Helix Association, and other four universities jointly organized the first Triple Helix international summit in the region, highlighting once again the role of government-university-industry in building cities and nations based on innovation.

Cayman Enterprise City is also home to the University College of the Cayman Islands. The area is completely full, with over 250 companies setting up a physical office presence there, including the law firm Dentons, the web-browser company Brave and the crypto-exchange Binance. The University has a strong role to play in providing specialists and organizing innovation-focused events.

Kigali Free Zone is home to the famously selective Carnegie Mellon University Africa. The zone has just over 100 tenants, including Volkswagen's self-driving car factory, Africa's first native smartphone company, Mara Phones, and Apex Biotechnology, a manufacturer of HIV and cancer medications.

Universities ensure the presence of energetic and creative young people, who during their studies and even later guarantee that the area remains in contact with current technological trends. In most areas with barren industrial parks or office buildings, universities have brought an extremely valuable addition, including the living spaces improvement, making them livelier and more oriented towards new smart technologies.

Universities act as magnets for entrepreneurs, almost all of them have entrepreneurship programs and organize start-up events. In all the examples mentioned here, universities have frequently held conferences that have attracted key figures in the global technology scene. Many national and local authorities around the world now understand this and are preparing projects based on future development within the structure created around the triple helix model (Serlet, 2022).

More recently, inspired by emerging economies such as the UAE, China and Singapore, and due to the fourth industrial revolution, the idea of bringing together government, business and academia together for development has been revived. ***Africa's Agenda 2063***, for example, has an IT–university flagship project that builds on the experience of the Pan African University which has existed since 2008 and operates alongside the African continental free trade area. The triple helix summits organized in the African and Arab ICT hubs hosted by African Leadership University aim to develop three million ethical leaders and entrepreneurs by 2035.

4. The helix model in its quadruple form applied in the Romanian business environment

The general framework for applying the triple helix model in the Romanian economy is very generous, given the large number of internationally recognized universities and research institutions, the innovative national companies and the international investors operating here, along with the authorities' policies focus on sustainable development, all of these enhanced by the Romania's status as an EU member state. However, considering the high potential of Romania, the key partners of the triple helix model are at the beginning of their collaboration with modest interactions so far in creating a consistent cooperation structure.

However, it can be seen that a triple helix model works successfully, within the ***Cluj IT Innovation Cluster.*** Since 2012, this cluster has brought together all the entities needed in meeting the extended model conditions, where *a fourth part is involved in facilitating the interaction among the main players*, as follows:

- *enterprises* from the ICT sector located in the metropolitan area of Cluj-Napoca:
- *universities with research activities*: the Technical University Cluj-Napoca and the Babeş-Bolyai University Cluj-Napoca;
- *public administration authorities*: the Cluj County Council and the Mayor of Cluj-Napoca;
- *catalyst organizations*: North-West Regional Development Agency, the Cluj Territorial Office for SMEs and Cooperation, the Transylvania branch of the Romanian Association for Electronic and

Software Industry, Transylvania Advanced Equipments and Technologies produced in Romania (Lazăr, 2013).

This collaborative project in the IT&C industry develops, connects, engages and promotes inspiring people and creative ideas in a continuous flow of innovative development.

Considering the *important role of communication among the players in this model, in many cases a new partner is needed and consequently added in a quadruple helix model, this last one acting as a catalyst* to facilitate interaction between the partner entities and even to generate future projects.

Seeing the high potential of Romanian economy, the ***Triple Helix Association of Romania*** (THAR) could be considered as a partner with an important role of facilitator able to offer a solid knowledge base on this collaborative model, helping the Romanian actors to develop effective triple helix interactions. THAR could help with promotion, peer learning and partnership development. Creating linkages by organising many events in order to bring together all these actors, THAR could be very important in promoting this model, facilitating an increasing interaction among them.

The THAR's activities range from the development and debate around top class scientific studies, by means of conferences, summits, and awards, following with the networking among both leading education and research institutions and stakeholders to foster a wide dissemination and uptake of the scientific findings by means of publications, and co-operation projects. There is also included here the support in translating academic models into practical achievements by enhancing international exchange of scholars and the education and training of students, researchers and practitioners.

The vision of THAR covers many communicational areas, such as:

- facilitation of (digital) competence building of industries, government, innovators and the third sector;
- joining the innovation networks to facilitate EduTech, LegalTech and FinTech;
- boosting Romania's capacity to attract research and innovation funds (e.g., EU);
- connecting the local innovation networks with global pools of investors
- producing an impactful research and technology transfer to the market;
- facilitating scale-up support;
- engaging society (including youth) in participatory governance to boost inclusion and representation (THR, 2022).

THAR could be one of the best facilitators to connect the three components of the model in the Romanian economy. From this point of view, the participation of foreign companies operating in the Romanian business environment can be a way to develop this model, given that these, through their international experience, can contribute to the application of this model.

A good contribution in this direction comes from the university level supported by the new *educational reforms* adopted at national level towards redefining the curricula and proactivity or interactivity. In this regard, the real support is provided by the creation of very strong university consortia and their internationalization strategies where the collaboration and exchanges of students, professors and researchers are very important in getting the experience and expertise for moving forward (Miron & Gherasim, 2018). All these transformational processes are vital in proceeding through the phases of this model previously mentioned in the paper. Therefore, in the Romanian situation, the *bottom-up model* seems to be more practical, where the universities and the representatives of domestic or international businesses identify themselves as the locomotive for the implementation of the triple or quadruple helix model.

5. Conclusions

The aim of the paper is to reveal that beyond the educational dimension, universities around the world are playing an increasingly active role in supporting economic projects, facilitating investment and business with a strong economic and social impact. In addition, this model is strongly supported by the development and use of technology, to increase business efficiency, but also to identify solutions in the context of current risks in the world economy. The elements presented in the paper advocate the inclusion of this model in the strategy of local development and further of attracting foreign direct investment, oriented mainly to the fields of high value-added services.

The future strategic plans of all the partners have to be creative, flexible, ambitious, forward thinking and agile, in order to take advantage of the current disruptive changes in higher education and industries.

To create unique opportunities for entrepreneurship and innovation, all the three players in the triple-helix model must work together for innovation to truly thrive for the benefit of society's progress. The elements of analysis presented in the paper advocate the application of the triple helix model at local or regional level, given the examples of real projects implemented in countries with different levels of development, resources and conditions.

All of these successful examples come to support further efforts in exploring the triple helix model which proves to be extremely versatile and can be adjusted to current needs and realities. In view of the latest global challenge, the COVID pandemic crisis, the Triple Helix Association has launched several calls since 2020 to create quadruple helix structures, implying also the society and citizens, in order to identify not only medical solutions, but also multiple response patterns to the Covid-19 pandemic for understanding weaknesses, strengths, and challenges, for national governance and innovation systems, drawing on political, social and economic dimensions (*A Study on Triple Helix Innovation to Address the COVID-19 Pandemic – A Skill and a Necessary Stage*) (THA, 2020).

References:

[1] Cai, Y., Pugh, R. & Liu, C. (2015). *Enabling conditions for regional triple helix systems.* https://www.triplehelixassociation.org/helice/volume-4-2015/helice-issue-4/triple-helix-scientific-news/enabling-conditions-for-regional-triple-helix-systems

[2] Caldwell, D. (2022). *Innovating the triple threat. Collaboration between universities and industry is key to successful innovation ecosystems*. https://www.fdiintelligence.com/article/80834

[3] Clemson University International Center for Automotive Research. https://cuicardeeporange.com/about/

[4] Cortright, J. (2006). *Making Sense of Clusters: Regional Competitiveness and Economic Development*. The Brookings Institution Metropolitan Policy Program. https://www.brookings.edu/wp-content/uploads/2016/06/20060313_Clusters.pdf

[5] Etzkowitz, H. (2002). *The Triple Helix of University -Industry -Government. Implications for Policy and Evaluation*. Science Policy Institute. https://www.donorth.co/appurtenancy/pdfs/etzkowitz_triple_helix.pdf

[6] Fuller, J., Mills, K. & Rivkin, J (2015). *A Real Path To Shared Prosperity in America How can our nation continue to grow while also providing a path to prosperity for more Americans?* Politico Magazine. https://www.politico.com/magazine/story/2015/09/a-real-path-to-shared-prosperity-in-america-213165

[7] Gatune, J., Deboer, D. & Mudde, H. (2018). *The Triple Helix As A Model for Economic Development, Maastricht School of Management*. https://www.wsrc.ps/portal/uploads/files/shares/The_Triple_Helix_Model_and__Local_Economic_Development.pdf

[8] Lazăr, S. (2013). *The development of the Cluj IT innovation cluster – an implementation of the triple helix model in Romania.* Triple Helix International Conference 2013. https://www.triplehelixconference.org/th/11/bic/docs/Papers/Lazar.pdf

[9] Leslie, S. & Kargon, R. (1996). Selling Silicon Valley: Frederick Terman's Model for Regional Advantage. *The Business History Review*. doi:10.2307/3117312

[10] Leydesdorff, L. (2012). *The Knowledge-Based Economy and the Triple Helix Model.* University of Amsterdam. https://www.leydesdorff.net/arist09/arist09.pdf

[11] Miron, D., Gherasim, I. A. (2018). *Linking the triple helix (university-industry-government) to the quadruple helix of university-industry-government – civil society in the field of international business and economics*. Proceedings of the International Conference on Business Excellence 12(1):612-625. DOI: 10.2478/picbe-2018-0055

[12] Ranga, M., Etzkowitz, H. (2013). *Triple Helix systems: an analytical framework for innovation policy and practice in the Knowledge Society*. http://temp.uefiscdi.ro/EDIGIREGION/Triple_Helix_Systems.pdf

[13] Rodrigues, C. & Melo, A.I. (2013). The *Triple Helix Model as Inspiration for Local Development Policies: An Experience-Based Perspective.* International Journal of Urban and Regional Research 37(5). DOI: 10.1111/j.1468-2427.2012.01117.x. https://www.researchgate.net/publication/264339108_The_Triple_Helix_Model_as_Inspiration_for_Local_Development_Policies_An_Experience-Based_Perspective

[14] Ryder, H. W. (2022). *Triple helix revival relies on infrastructure. The African and Arab regions need industrial development to get results from university collaboration.* https://www.fdiintelligence.com/article/80874

[15] Serlet, T. (2022). *How universities lead to successful SEZs. Free zones benefit from nurturing the next generation of professionals.* https://www.fdiintelligence.com/article/80777

[16] Shenzhen University. https://en.szu.edu.cn/About/About2.htm

[17] Triple Helix Association. (2020). https://www.triplehelixassociation.org/helice/volume-9-2020/helice-volume-9-issue-3/a-study-on-triple-helix-innovation-to-address-the-covid-19-pandemic-a-skill-and-a-necessary-stage

[18] Triple Helix Romania (2022), https://helix-connect.com/triple-helix-association/

[19] Winden, W. & Carvalho, L. (2019). *Triple Helix (3H): Where are Europe's cities standing?* https://urbact.eu/triple-helix-3h-where-are-europe%E2%80%99s-cities-standing
[20] Yeo, L. (2022). *Less regulation, more collaboration. Loosening government control will enable growth in Asia's triple-helix ecosystems*. https://www.fdiintelligence.com/article/80860

Intangible Assets – An Important Resource for Enterprise Performance Management

ANDREEA PAULA DUMITRU
Senior Lecturer Ph.D.
Faculty of Economics and Business Administration
Nicolae Titulescu University, Bucharest
Calea Văcărești nr.185, Sector 4, Bucharest
Romania
pauladumitru@univnt.ro

Abstract: *Along time, the goal of intangible assets became very important for the activity and prosperity of business. This matter is achieved as well as more and more the companies operate in a global economy which has as main base the digital revolution and information management. The increase of the immaterial investments percent requires evaluation and recognition criteria by knowledge, intelligence and human competence. But recently, the accounting standards were about to accord negligible attention or even totally ignored the appropriate modalities of report this category of assets. The accounting, obliged to bend to economic, financial and juridical logics, in a „Taylor" modality, presents an unreal image of the company economic life and particularly of investment activity. In a competitive environment, the reliability of future economic benefits, generated by investments, depends less on their material or immaterial nature and more on the characteristics of the market they operate on. These are just a few reflections which determined us to focus our attention to this thought-provoking domain of immaterial investments, appreciated as a potential for the company.*

Keywords: *intangible assets, immaterial investments, knowledge, competences*

1. Introduction. Socio-economic assumptions

New potent (able) that brought them "information age" led to considerable renewal of the ways in which business is carried out.

Major trends that have broad implications on the performance of firms are: economic activity will continue to internationalize, markets for consumer and intermediate goods will become more sophisticated, the pace of technological change will remain rapid.

In this context, the performance capability of a firm depends on more than one distinctive resource of any company, as an economic system, namely **knowledge.**

What differentiates one from the other is "its ability to use all types of knowledge – from the scientific and technical up to the social, economic and management"[1] to achieve something that has value market.

As an universal social resource, knowledge is not a resource of a firm. A crucial resource of any company is located outside so, as its economic results which are obtained by "exploitation of opportunities".

Deep changes taking place in today's world of business involving the movement of forces driving economic growth, from matter and energy to information and knowledge. The process of "dematerialization" of economic activity changes the source value toward design and innovation activity, knowledge management and organizational skills.

In this context, intangible investments are becoming more important than material investments, by spending more and more significant that a company engages in the design, innovation, training, organization, or exploring new market opportunities.

Business employing increasingly more spending in areas like research and development, staff training, production organization and marketing. These charges are intended to increase the competitive capacity of the company long term, creating value for shareholders.

Including all these costs in the category seems very risky investments because of uncertainty effects that entail:

[1] Drucker P. – "Management strategic", Editura Teora, București, 2001, p. 11

- Knowledge and skills, in large part, cannot be dissociated from human or material resources (equipment) that incorporates, is hardly controllable by the enterprise;
- Irreversible nature of the expenses involved in training and research, further up the productive sphere, with lasting effects (strategic) to give them the status of invested costs, the risks of non-recovery;
- "perishability" accumulated knowledge and skills is often in a discontinuous and unpredictable world, requiring reconsideration and updating constantly.

Growing importance of intangible investments in increasing business performance and competitiveness requires an approach and an appropriate accounting treatment for a relevant and reliable financial reporting.

2. Deficiencies of current accounting systems

Current accounting systems, whose tools and financial reporting practices are still strongly imbued taylorism, difficulties in identifying and measuring intangible investments.

The major difficulty comes from the absence of relationship "cause-effect" in recognition of intangible expenses such as investment and thus "activate" their balance sheet.

Balance sheet, by his role to represent the company's financial structure, offers, on the one hand, investors (or potential) ability to assess risk assessment estimated return on investment, and offers all guarantees of creditors, as legal protection, recovery amounts advanced temporarily. On the other hand, balance sheet, through the assets they represent, enables the potential capacity to provide liquidity entity.

Although dominated by conflicting demands, the accounting system should highlight the economic potential to support decision allows different categories of users.

Between the two components of financial statements there is a constant tension because they are interconnected and cannot serve different interests. The capital market is concerned primarily profit, at it is apparent from the income statement. If financial statements are primarily aimed at measuring earnings, this means that the balance will reflect "the results of the evaluation process residues"[2].

From this perspective, the accounting system pays excessive attention to short-term financial objectives, to assess business performance. The emphasis on the influence on the outcome of the exercise and financial reporting systems is justified by the speculative interests of managers. They, many times seeking to "invent" means to achieve levels of financial indicators assigned based on whether it is appreciated and the underlying activity remunerated.

The most dangerous consequence management by quantifying the financial indicators of short-term performance is encouraging that is type of behaviour to reduce the intangible investments and the precautionary principle should treat them as expenses in the period. It's vocation of the "informational asymmetry"[3], the precautionary principle may lead to harmful phenomena embellishment of images about wealth and business performance, which may represent an unfair attack on the relevance of accounting information.

For short-term objectives, to maximize value creation for shareholders (by maximizing the profit or loss) is sacrificing long-term performance. Strategic abdication of responsibilities aimed at a lasting effect, increase the value of the company (through innovation, new markets and products, training and motivation, customer loyalty). Adaptability and even threaten the survival of the enterprise.

It is obvious that these charges, which produce medium and long-term effects that can be regarded is immaterial investments, must have an appropriate accounting treatment.

Forced to obey certain logic while legal, economic, financial, accounting presents a distorted picture of the economic life of the company, neglecting or ignoring for too long the appropriate methods for recognizing and reporting of these investments, assets (property) intangible. As a consequence, practice has not evolved beyond the traditional rules of historical cost.

3. Recognition and evaluation of intangible assets

After a long discussion, an international accounting referential addressed for

[2] Epstein B., Mîrza A., - IFRS 2005 – Interpretarea și aplicarea Standardelor Internaționale de Contabilitate și Raportare Financiară, Editura BMT, Publishing House, București, 2005, p.32

[3] Feleagă N., Feleagă M – "Contabilitate financiară – o abordare europeană și internațională", vol.II, Editura InfoMega, București, 2005, p.111

the first time in detail the accounting for intangible assets by IAS 38 (enacted in 1998), and determining criteria for recognition, measurement bases and reporting requirements of such an assets.

Recognition of intangible assets requires compliance with the following key criteria:

- identifiable character of intangible assets;
- possibility of control over use of such property;
- their ability to generate benefits (economic benefits) of future credible assessment.

Character of an identifiable intangible assets requires it to be "distinguished from goodwill"[4]. Identification condition is satisfied if the intangible asset is separable (can sell, transfer, permit, lease or exchange and may distribute its future economic benefits, without undertaking to deprive future economic benefits from other assets used in the same activities). At the same time, intangible assets should flow from contractual or legal rights of another kind, whether those rights are transferable or separable from the entity or from other rights and obligations.

Identifiable intangible assets include patents, copyrights, licenses, software, marketing rights and know-how specialized. Feature that these elements have in common is nonexistent material substance, physical and having a useful life grater than one year, (determined or undetermined).

Certain intangible assets can be kept in or an object (support) physical: CD (in case of software), legal documentation (for a patent or a license). Clearing up confusion for their correct classification (as property, plant and equipment under IAS 16 or as an intangible asset after IAS 38) should appeal to professional reasoning to identify the relative importance or comparative basis, the most significant element.

For example, software that is part of the operating system (from a computer or computer equipment) is an essential component of that hardware and treated as tangible assets. If the software is not part of the hardware related equipment, it is treated as an intangible asset.

To ensure that only assets which are capitalized and deferred amounts recoverable in future periods is required, under international accounting referential, identification and recognition as more individualized items. This approach is useful because the residual value of acquisitions costs allocated is treated globally, in goodwill, whose impairment is less likely than an asset identified, thus providing less transparent to investors.

The ability to have control over the use of intangible assets: control involves the entity's ability to attract both benefits, future economic benefits arising from their involvement property.

Usually, the entity to obtain or protect their ability to control the legal rights as registered copyrights, patents, restrictions on trade agreements (if this is allowed) or legal coercion of employees to retain confidentiality.

In the absence of these rights, the entity cannot usually sufficient control of the economic benefits expected from teams of professionals and training programs and training and through specific technical or management skills.

Thus, considerable costs incurred for staff training, building a portfolio of customers, market share, customer or their fidelity can still be recognized as intangible assets, although these expenditures are investments in marketing and as "engines" that bring profits long-term.

"A balanced company is the research and development department and marketing at sharing responsibility to achieve a successful market-oriented innovation"[5]. In practice, however, characterized inter-relationships, often by rivalry and mutual distrust, determine missing several good opportunities.

Creating a foundation for constructive cooperation can only be in the interest of the company, but being aware that each carry a potential impact depending on customer satisfaction and thus to attract economic benefits for the firm.

Advantages (benefits) that may be associated with future economic intangible asset may take the form of revenue from selling products or services, savings, cost reductions and other economic benefits resulting from the use of intangible asset to the firm.

However, is recognition of an intangible asset conditional probability that the economic benefits attributable to it to return the entity. Evaluating the likelihood of the future economic benefits must be made on the basis of rational calculations that represent the best estimate for the set of economic conditions existing during the life of the asset.

---

[4] Standardele Internationale de Raportare Financiara, Interpretari la 1 ianuarie 2015, Partea A, Editura CECCAR, Bucuresti, 2015, p.144

[5] Kotler Ph. – Managementul marketingului, Editura Teora, Bucuresti, 2005, p.116

Use reasoning to assess the safety associated with its future economic gain intangible asset is based upon the evidence available to initial recognition, giving priority to external evidence. Calling at fair value, determined primarily by reference to an active market or, failing that, using the best available information involves determining the present value of cash flow, adjusted according to the probability of its realization and the time value of money. Even at a low probability of occurrence of cash flow, fair value is considered as can be determined, and the asset will be recognized.

At the international level referential rightly converge more and more opinions to reflect the probability assessment of an asset, instead of its use as a threshold criterion of recognition, which will lead to amendment of the framework.

Credible evaluation of intangible assets is contingent on how to obtain them, such as initial assessment is done at their cost of production.

For a separately acquired intangible asset, the price paid for getting to the expectations about the probability that future economic benefits associated with immobilization purchased to return the enterprise. In other words, the effect probability is represented in the cost of immobilization. Or acquisition cost includes purchase price, including tax and excise duty stranded plus costs directly attributable to the intentional use immobilization preparations (handwork including employee benefits, arising directly from bringing the asset to its operating condition, professional fees arising from the same end, the costs of testing the proper functioning of immobilization). As in the case of tangible assets (IAS 16), capitalization of costs ceases when the intangible asset is ready for its intended use.

In many case, are internally generated intangible assets. Baseline to which they are recognized as assets is difficult to determine due to the nature of these categories of property, for which many were committed to spending at the time of their recognition as an asset.

Expenditure on intangible assets are getting treated according to the stage where they are involved in their creation or in the research phase or stage of development.

The whole reasoning is based on credible evaluation of the project concept (as a set of joint actions and schedule for a particular purpose). Capitalization of expenses incurred in obtaining an intangible asset is subject to their reliable measurement using a customized project.

In the research phase of an internal project, expenditure on activities whose purpose is to obtain new knowledge, searching, delivering, evaluating and selecting alternatives. These costs are recognized as cost in the period were employed.

The development phase of an internal project involves expenses that can be capitalized of it is demonstrated the technical feasibility of completing, the intangible asset, intending to complete their ability to use or sell the restraint, the mechanism by which future benefits will likely evolve the ability to assess credible cost attributable to immobilization during its development.

In practice, the distinction between research costs and the phase of the development phase is, in many cases quite difficult.

Categories of assets that brand-names, may be difficult to estimate values that meet the criteria for their recognition as separate assets of internally generated goodwill. Not recognize them as assets is justified by the principle of prudence, capitalization of expenses involving failure to uncertainty rather than on evaluation methods with the volatile nature of their value. Hence the unequal treatment of acquired intangible assets from internally generated is not limited to their initial recognition, but it also regards their depreciation policy. The life of an intangible asset may be very long or even indefinite. Uncertainty justify caution to estimate the duration of her life, but life does not justify an unrealistically short. There may be both economic factors and legal factors that influence the life of an intangible asset. Economic factors determine the period in which the company will receive future economic benefits.

Legal factors may restrict the period in which the company controls access to those benefits. Life is the shortest of the periods determined by these factors, and the depreciated value of intangible assets will be allocated on a systematic basis over the term.

The life of an intangible asset is regarded as an undetermined time based on analysis of all factors (intended use of the asset by the enterprise, the typical life cycles, technology usage, commercial or other types of wear, stability domain, the expected actions of competitors, the costs of maintenance, control over the immobilization period, depending on the asset useful life that of another asset) there is no foreseeable limit to the period during which the asset is expected to generate net cash flows for the enterprise. In this case allegedly immobilization test for impairment under IAS 36, recoverable value comparing the carrying amount annually and whenever there is evidence that immobilization may be impaired.

4. Conclusions

The issue of recognition and evaluation of intangible assets, for which we tried to point out some defining elements, continues to incite controversy more so as, in a society marked by competition and change, the estimate of future benefits arising from investment depends less on the nature material or immaterial, and features more than the market within which it operates (the degree of competition, rapid technological change).

Relevance and reliability of accounting information claiming an appropriate accounting treatment, and international bodies (IASB and FASB) accounting standard – they put on their agenda a long-term joint project of accounting for intangible assets.

For now, the accounting regulations encourage (with out requiring) companies to disclose in the notes the categories of investments that have an impact on long-term performance of the company, but not above the threshold limiting their recognition as assets (IAS 38) in the balance sheet.

Accounting evolution is slow and there is always a gap between the volume of investments and intangible assets recognized immaterial, because you cannot make a reliable assessment of all components involved in the investment process.

References:

[1] Drucker, P.F. (2001) - Managementul strategic, Editura Teora, București;
[2] Epingard, P. (1999)- L'investissment immaterial, coeur d'une économie fondée sur le savoir, CNRS Editions Paris;
[3] Epstein B., Mirza Abbas Ali, Willey (2015). *IFRS 2015* – Interpretarea și aplicarea Standardelor Internaþionale de Contabilitate și Raportare Financiarã, Editura BMT Publishing House, București;
[4] Feleagã, N., Feleagã Malciu, Liliana (2005) - Contabilitate financiarã - o abordare europeanã și internaționalã, vol. I, Editura InfoMega, București;
[5] Kotler, Ph. (2005) - Managementul marketingului, Editura Teora, București;
[6] *** Standardele Internationale de Raportare Financiarã (IFRS), inclusiv Standardele Internaționale de Contabilitate (IAS) și Interpretãri la 1 ianuarie 2015, Editura CECCAR, București.

Accelerating the Digitization Process in the Public Sector

NICOLETA GEORGETA PANAIT
Lecturer, PhD.
Faculty of Economics and Business Administration
„Nicolae Titulescu" University of Bucharest
npanait@univnt.ro

MĂDĂLINA ANTOANETA RĂDOI
Associate Professor, PhD.
Faculty of Economics and Business Administration,
"Nicolae Titulescu" University of Bucharest
radoimadalina@univnt.ro

Abstract: The main objective of digitalisation is to contribute to the profound transformation of the economy, public administration and society, increasing performance and efficiency in the public sector, by creating new types of value based on digitalisation, innovation and digital technologies. The study aims to present and become aware of the reality in Romania regarding the lack of interoperability of IT systems in public administration, the low level of integration of digital technology by the business environment, the level of digitalization skills of the population, etc. According to reports and statistics, Romania ranks last in most of the analysis indicators on the degree of digitization in the European Union. Small and medium-sized companies that have been cross the barrier of technology have had the best chance of identifying new business opportunities during the pandemic. In this context, it is necessary for public administrations to adapt to new realities and to develop not only services that lead to simplification of processes and increase the speed of execution of works, but especially to improve interaction with citizens, by reducing bureaucracy and providing digital solutions. That they can solve most of their problems without having to make unnecessary trips to state institutions. From the appearance of the pandemic until now, we can conclude that this uncertain and completely atypical period still had a positive impact for Romania, namely the accelerated digitalization both in private companies and in the state administration.

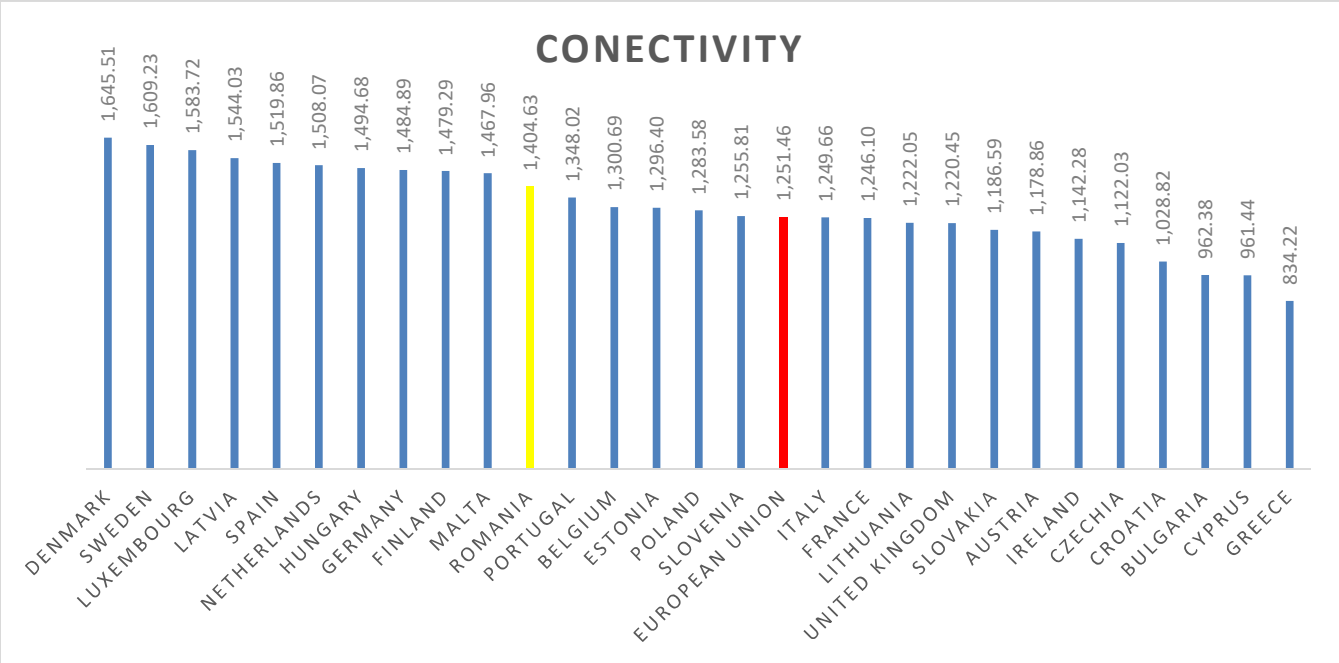
Keywords: digitalization, public services, integration of digital technology, economic growth, public administrations, Romanian Digitization Authority

1. Introduction

Starting with the end of 2019, the digitization process has become one of Romania's main priorities, laying the foundations of a central authority, the Romanian Digitization Authority (ADR), with the main objective of coordinating the process of digital transformation of the Romanian economy and society. This objective represents a fundamental element in order to implement the new development model of Romania and to achieve convergence with the more advanced European states.

The Authority for the Digitization of Romania (ADR) was established in 2020. It functions as a structure with legal personality subordinated to the Government and aims at: the digitization of the public sector; developing and ensuring interoperability between public authorities and institutions; development of computer authentication systems and interconnection of public computer systems; development of electronic public services; implementation at national level of information systems that provide eGovernment services; operation of information systems providing eGovernment services; elaboration and implementation of regulations on specific activities of government by electronic means in accordance with European and national strategies in the field of digitization; the operation of interfaces between the computer systems of public institutions and citizens or the business environment, being a gateway to their electronic public services provided by the public administration; implementation of digital services that capitalize on technical mechanisms for certifying authenticity and ensuring data protection; implementation of specific technologies and models of shared exploitation of IT resources, to support the implementation and provision of digital services including on the basis of cloud platforms; implementation and operation of access mechanisms to digital services in a regime of

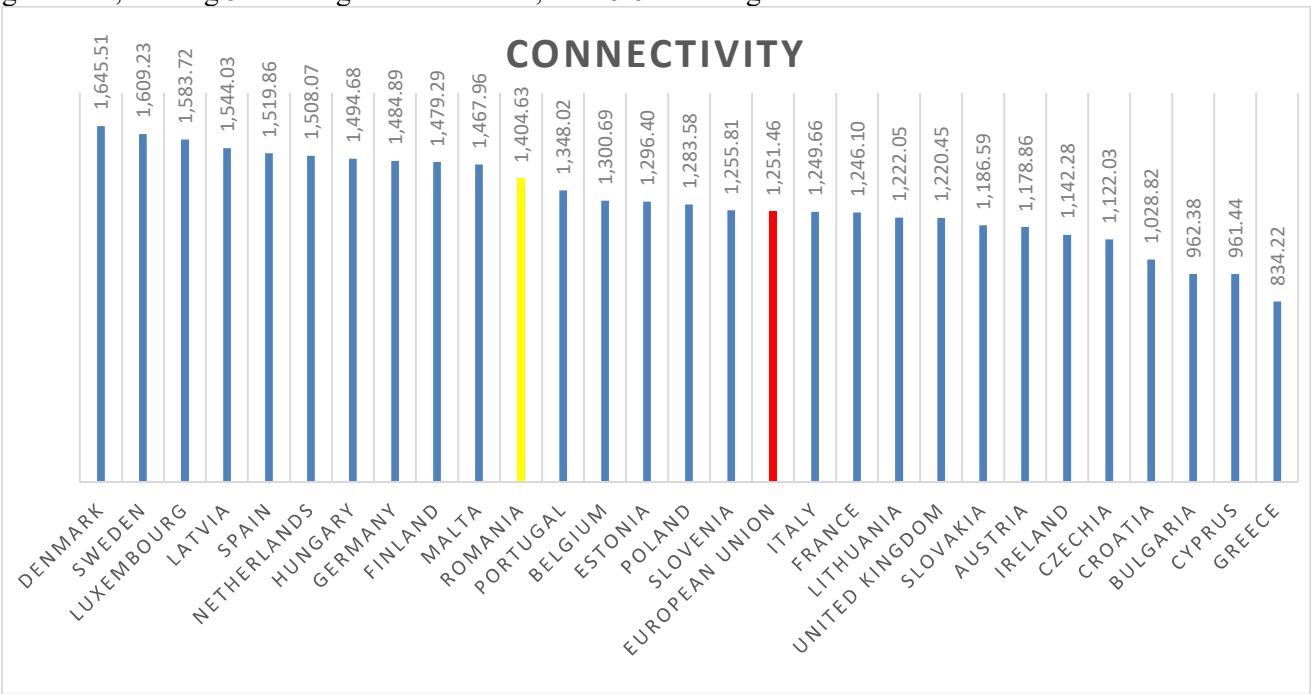
mobility and independence from access technology, in order to maximize their addressability; ensuring cyber security for the public sector; implementation of artificial intelligence in the public sector.
According to DESI indicators, Romania ranks 11th in terms of connectivity. In 2019, Romania improved its results in terms of coverage, but stagnated in terms of use.



Source: DESI

Table 1. DESI values for Connectivity in European countries

In terms of digital skills, Romania ranks 27th out of 28 EU countries. Less than a third of 16- to 74-year-olds have basic digital skills, and only 35% have basic software skills. Romania has good results in terms of ICT graduates, ranking 5th among Member States, with 5.6% of all graduates.

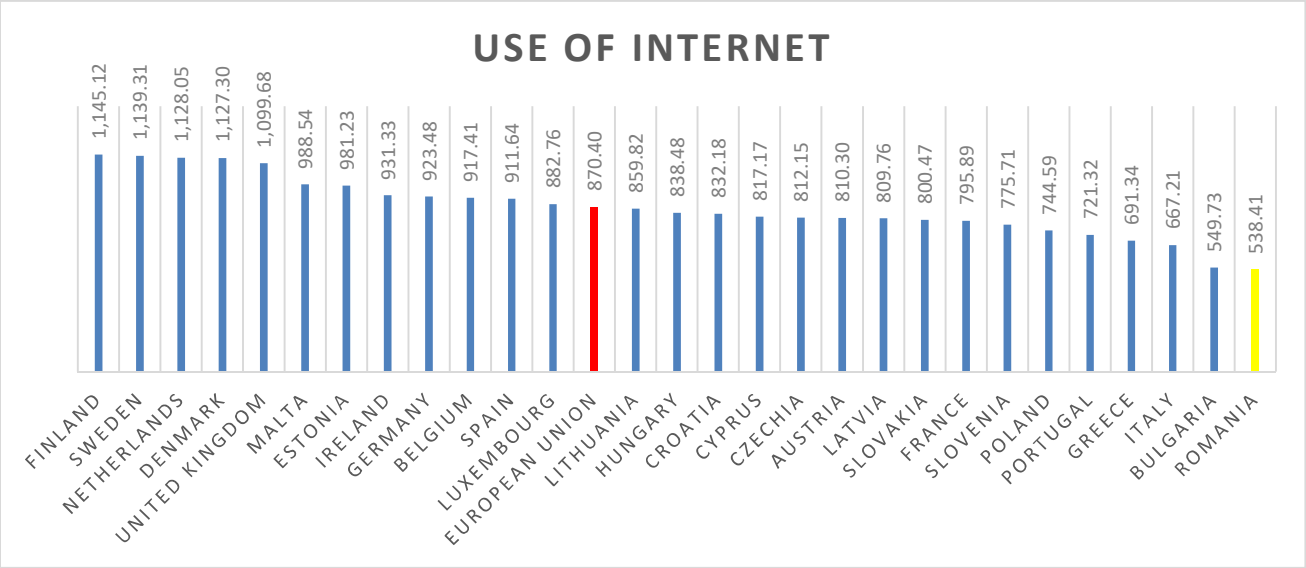


Source: DESI

Table 2. DESI values for Human Capital in Europe country

Regarding the use of internet services, Romania has the lowest level of use compared to EU member states. However, there are two online activities in which Romania ranks first in the use of social networks (82%,

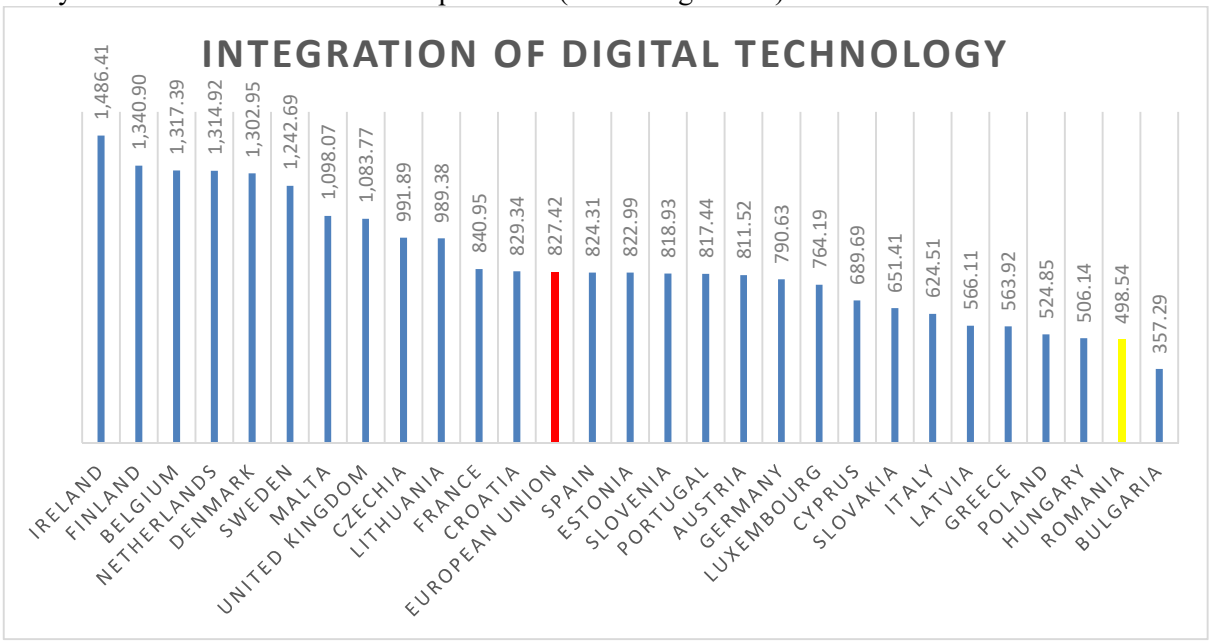
compared to an EU average of 65%) and video calls (67%; EU average: 60%). In contrast, the use of online banking (11%), shopping (29%), reading news (55%), as well as the consumption of music, videos and online games (63%) are the lowest among EU Member States. , mainly due to a lack of confidence in digital technology. The low level of use of online banking services is also due to the fact that more than two out of five Romanian adlts (42%) (16) do not have a bank account



Source: DESI

Table 3. Connectivity value on Europe country - DESI values for Use of Internet in European countries

Romania ranks 28th among EU countries in terms of the integration of digital technology by the business environment, well below the EU average. 23% of Romanian companies exchange information electronically, while only 8% use social communication platforms (EU average: 25%).



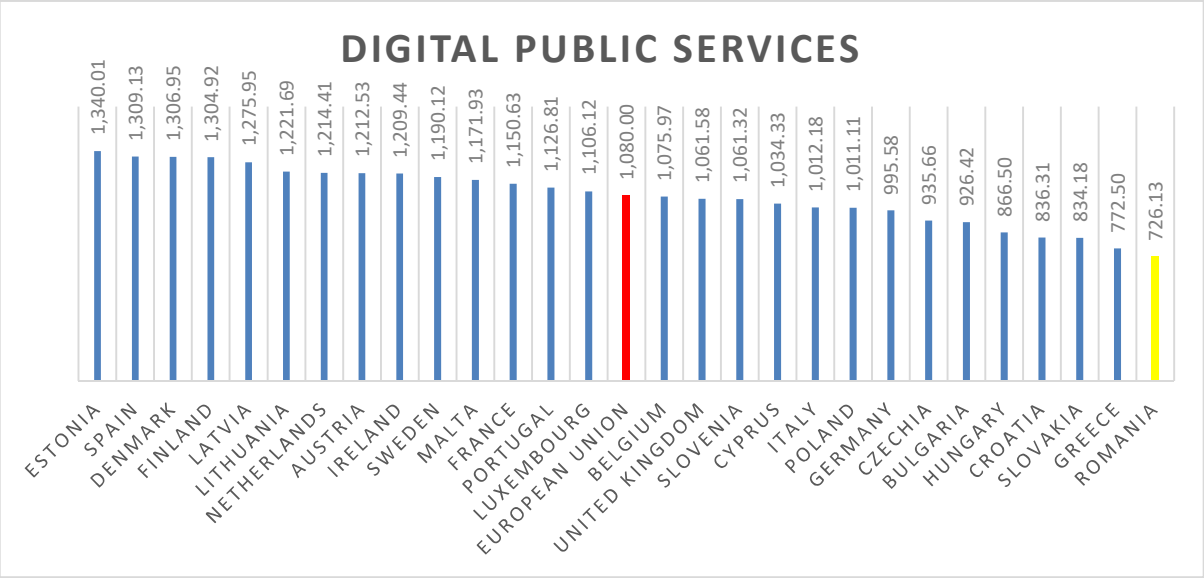
Source: DESI

Table 4. DESI values for Integration of Digital Technology in European countries

Romania has the lowest performance in terms of digital public services, it is at the bottom of the ranking in the EU. In fact, the only online interaction between public authorities and the population is the submission of forms, according to the latest DESI report.

In contrast, Romania ranks 8th in terms of users of e-government services, with 82% of Internet users, compared to the EU average of 67%. However, this high level of online interaction between public authorities

and the population only targets internet users who have to submit forms. The low scores obtained on pre-filled forms and services performed entirely online, in which the country ranks 28th, indicate a systemic problem in terms of the quality and usability of the services provided. There was no improvement of digital public services for enterprises, Romania being on the last place in this respect as well.



Source: DESI

Table 5. DESI values for Digital Public Services Technology in European countries

The causes that led to a weak development of electronic public services in Romania were: the lack of an efficient and effective IT architecture, the lack of information systems necessary for central public institutions for the operationalization of electronic public services; the inadequacy of e-government and human resources specialists in the IT departments of public institutions and authorities and, consequently, the skills needed to develop and maintain electronic public services and the lack of a uniform and effective legislative and procedural framework to support electronic public services.

In Romania, a series of IT platforms available to citizens are currently active:
Online Trade Register (ONRC portal);

- The court portal (portal.just.ro);
- The system of the National Agency for Cadastre and Real Estate Advertising for issuing land book extracts (ancpi.ro);
- The national electronic system for online payment of taxes (ghiseul.ro).

Starting with 2020, the listed IT platforms have been streamlined and expanded, as well as other relevant platforms at national level, to strengthen e-government (PCUe), web platforms and applications have been created to provide correct support and information for citizens. and Covid-19 pandemic management companies. Among the IT systems implemented by ADR, in the event of the COVID 19 pandemic, are:

- https://stirioficiale.ro/informatii - the official page of the government regarding the real information in the fight against Covid 19;
- https://cetrebuiesafac.ro/ - the official website of the government with information on how citizens should act if they have symptoms or are sick;
- https://www.datelazi.ro/ - the official page of the government with official data about the official situation about the disease situation, centralized by regions;
- https://aici.gov.ro/ - the official page of the government for uploading online the documents intended for registration, addressed to public institutions that do not have their own online registration system;

- https://diasporahub.ro/ - the official page of the government for Romanian citizens and support groups from abroad in emergency situations;

- https://rohelp.ro/ro/ - the official page of the government for non-profit organizations actively involved in limiting the effects of the Covid-19 pandemic.

2. Streamlining the institutions of the public system

In the public administrations in the last year the process of implementation of some digitization projects of the institutions providing public services has been accelerated and administrative processes have been streamlined, in relation to the citizens, the business environment and inter-institutional.

Implement the "once only" principle and the interoperability architecture based on an API management provided by all public institutions that have national data registers. The aim is to identify all the basic registers and create a mechanism for amending this list, ensuring the technical infrastructure so that access to the basic registers can be achieved quickly, securely and flexibly, ensuring the confidentiality of data;
In parallel, the electronic signature of public administration officials will be generalized and used by all population, so that they can communicate digitally with companies, reducing reaction time and early correction of possible mistakes.

Introduction of an electronic identity system that will allow full remote interaction with the public administration, with the clear effect of reducing costs, using a unique identity and an SSO (single Sign On) authentication mechanism, including enrolment on this online identification platform being able to be done remotely. The result will be a system that allows zero interaction at the counter for citizens from the moment of enrolment, achieving a reduction in the costs of implementing new platforms and a high level of security for all public services offered online. This e-identity scheme will be notified at EU level and integrated with the European cross-border communication node eIDAS. The national electronic identity system will be open, ready to integrate new types of identities and including to ensure the transition to systems that involve the use of SSI (Self-sovereign identity) mechanisms;

Effective operationalization of a single electronic contact point for citizens and companies by restoring the PCUe and integrating it with the national payment system, ghiseul.ro, in a single platform for citizens. By including all available electronic services and making it accessible through the national e-identity scheme, according to the European regulatory framework, public electronic services will be available and accessible and cross-border based on the eIDAS node. In addition, this approach will generate an increase in the visibility of public services, having as main effect the decrease of the time for the search for information by the companies and the resolution of the different cases.

3. Economic digitalization

For Romania, the potential economic benefits of digitalization would bring a contribution of 42 billion Euros to GDP by 2025. The Romanian economy is dominated by 99% of small and medium enterprises, the speed with which they can be digitized and the digitization that they can achieve, being two elements with far-reaching effects on Romania's competitiveness on the European and global market. Due to the rapid growth of the technology industry at EU level (five times faster than the rest of the European economy in terms of gross value added), digital technologies are disruptively impacting the market dynamics at an increasing speed, creating unprecedented opportunities for European and implicitly Romanian SMEs, enabling companies to innovate, grow and compete using new models and solutions in previous generations of technologies.

Industry can benefit from an indirect effect of digitalization, but with a major impact on the ability of companies to converge on the principles of the digital economy through new business models, business models and a new managerial vision in a new paradigm based on digital innovations and technologies.

The poor level of economic digitalization is also caused by the fact that the process of digital transformation of SMEs has often been misunderstood and reduced to numerous financing programs, assimilated only to simple purchases of IT systems and equipment.

The digital transformation process involves fundamental changes on different levels of a business:

- at process level (use of an increased percentage of automation in production and integration of data in processes and supply chains, leading to increased productivity and resource efficiency),

- at product level (incorporation of ICT in as many product categories as possible) and last but not least
- at the level of business models (smart and connected products lead and adapt to changes in customer behaviour).

The digital economy has the potential to generate major changes and opportunities in a wide variety of fields, such as administrative, social, educational, medical, but also in emerging fields. Increasing Romania's potential to create and innovate digital technologies and, on the other hand, to adopt and use them will generate strategic value on several levels.

The Romanian economy must make a transition as fast as possible to the new economy (Digital Economy) capitalizing on all the advantages of the new industrial revolution. Most SMEs in Romania (1/3 of European SMEs) invest mainly in digital products that allow business optimization, operations, such as Customer Relationship Management (CRM) or Enterprise Resource Planning (ERP), focusing -is on optimizing existing models and processes, without a substantiated business analysis, a simplification of processes, data collection or the use of emerging technologies such as Artificial Intelligence, Cloud Computing, IoT, Blockchain, etc. The fields with the greatest potential for automation in Romania and where we can get the greatest impact are: agriculture, manufacturing, trade and transport.

The European Investment Bank shows that approximately 70% of European SMEs that have implemented a digitization project have used the infrastructure of the regional innovation hub in the region in which they operate, whether or not the SME has a digital profile. Thus, the European Digital Innovation Hubs are the main trans-European tool and vector that the European Commission together with the Member States envisages to drive both innovation and the digitalisation of the economy and the digitalisation of European public administration. Designed as public-private partnerships for digital development, these hubs will be funded mainly through the Digital Europe Program and European Regional Development Fund allocations at the level of each European region and will network to achieve the above-mentioned objectives. up. The Digital Innovation Hubs will highlight the technological and regional innovation potential to develop digital technologies and tools for fields with a high degree of adoption: industry, public administration, agriculture, healthcare, etc.

The strategic role of the Digital Innovation Hubs is also to define from a geostrategic point of view the role of Romania on a European map, but also a global one of digitalization and technological innovation. Digital Innovation Hubs will become strategic vectors, connected in the European network of Digital Innovation Hubs capable of generating and transferring know-how and generating value in the economy and society.

4. The level of digital education of the population

An important aspect for government action is the development of digital skills in all segments of the population and the workforce. According to the Society and Digital Economy Index published by the European Commission (DESI), here too Romania is at the end of the European ranking, with less than 30% of the population having basic digital skills.

In 2020, the COVID-19 crisis has led education and training institutions around the world to move to distance / online teaching. In a few weeks, the educational landscape in Europe and around the world has changed fundamentally. Teachers, students and parents were forced to adapt quickly to the situation.

For Romania, the COVID-19 pandemic highlighted significant gaps and deficiencies in terms of digital skills, connectivity and the use of technologies in education. In addition, according to the latest Index of the Digital Economy and Society, 42% of Europeans do not have basic digital skills, and the European labor market faces a significant shortage of digital experts. Moreover, the COVID-19 crisis has drawn attention both to the opportunities and risks of online life and to the need for a better and safer digital environment for all, especially for young people under 18.

At EU level, the European Commission, according to the European Competence Agenda for Sustainable Competitiveness, Social Equity and Resilience), has the following objectives: strengthening sustainable competitiveness; ensuring social equity; increasing social resilience; promoting lifelong learning; job skills training; resilience of the economy at EU level.

In the case of Romania, the issues followed by government measures to improve digital skills in education will be the following: investments will be made in the basic digital skills of teachers in regular training programs and in the transfer of IT resources to problem areas and evaluation and modifying the school curriculum to include

both age and school-specific digitization hours and the implementation of a digitized teaching mode for all subjects.

5. Conclusions

Through specific mechanisms and activities, it will be necessary to ensure the increase of Romania's capacity to develop and integrate digital innovations and technologies in order to digitize for several fields and sectors of activity, to increase the global visibility, but also to capitalize on the strategic potential that Romania he has it in the IT&C field. These actions will contribute to increasing the quality of life of citizens and reducing costs for companies, by simplifying the interaction with state institutions.

The changes that took place, such as the obligation imposed on public institutions by GEO 38/2020 to accept documents in electronic form and digitally signed, the possibility to send documents and make payments online through the ghiseul.ro or here.gov.ro platforms - represents only the digitization of some services, and not of the administration, which implies a rethinking of processes, interaction, services, etc.

References:

[1] C. Lianu, R. Bucea-Manea-Tonis, R. Bucea-Manea-Tonis, S. C. Dobre, C. Lianu - Innovation and digitalization from a managerial perspective, Economic Publishing House, 2020

[2] John Coleman - Parents and digital technology. How to raise the connected generation, Heral Publishing House, 2017

[3] N. Isăilă - The use of information technology in the economic environment, University Publishing House, 2012

[4] Kagermann, H., W. Wahlster and J. Helbig, eds., 2013: Recommendations for implementing the strategic initiative Industrie 4.0: Final report of the Industrie 4.0 Working Group

[5] Heiner Lasi, Hans-Georg Kemper, Peter Fettke, Thomas Feld, Michael Hoffmann: Industry 4.0. In: Business & Information Systems Engineering 4 (6), pp. 239-242

[6] Marr, Bernard. "Why Everyone Must Get Ready For The 4th Industrial Revolution". Forbes. Retrieved 2018-02-14.

[7] Mueller, Egon; Chen, Xiao-Li; Riedel, Ralph (2017). „Challenges and Requirements for the Application of Industry 4.0: A Special Insight with the Usage of Cyber-Physical System". Chinese Journal of Mechanical Engineering. 30 (5): 1050–1057. doi:10.1007/s10033- 017-0164-7.

[8] Lin, K.C.; Shyu, J.Z.; Ding, K. A Cross-Strait Comparison of Innovation Policy under Industry 4.0 and Sustainability Development Transition. Sustainability 2017, 9, 786.

[9] Wang, S.; Wan, J.; Li, D.; Zhang, C. Implementing smart factory of industrie 4.0: An outlook. Int. J. Distrib. Sens. Netw. 2016, 12, 3159805.

[10] Aquilani, B.; Silvestri, C.; Ruggieri, A. Sustainability, TQM and value co-creation processes: The role of critical success factors. Sustainability 2016, 8, 995.

[11] Kliestik, T.; Misankova, M.; Valaskova, K.; Svabova, L. Bankruptcy Prevention: New Effort to Reflect on Legal and Social Changes. Sci. Eng. Ethics 2018, 24, 791–808.

[12] Kliestikova, J.; Misankova, M.; Kliestik, T. Bankruptcy in Slovakia: International comparison of the creditor's position. Oecon. Copernic. 2017, 8, 221–237.

[13] https://ec.europa.eu/info/strategy/priorities-2019-2024/ europe-fit-digital-age_ro

[14] ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi

[15] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12453-Digital-Education-Action-Plan/public-consultation

[16] www.consilium.europa. eu/ro/policies/a-digital-future-for-europe/

[17] https://eufordigital.eu/ro/digitising-industry-best-practices-to-promote-the-digital-transformation-of-smes-in-traditional-sectors-of-the-economy/

The Impact of Social Media on Brand Value Growth

MIHAELA IOANA GURĂU
PhD candidate Romanian Academy
School of Advanced Studies of the Romanian Academy
mihaela_gi@yahoo.com

IVONA STOICA (RĂPAN)
Assoc. Prof., PhD, Senior Researcher
Institute of National Economy, Romanian Academy
stradivonas@gmail.com

MARIANA GURĂU
Lecturer, Ph.D.
Faculty of Economics and Business Administration
„Nicolae Titulescu" University of Bucharest
marianagurau@univnt.ro

Abstract: The phenomenon of social media marketing (SMM) has only been developed in the last decade and focuses mainly on the impact that social networks have on consumer behavior. Despite the fact that each social media network has its own characteristics, the ubiquitous impact on economic life can create a chain of consequences that cause interactions between networks, ending up as one network exerts its influence on the others. The approach adopted in this research brings new perspectives for the literature by analyzing how an influencer *works on building their own* branding*, which helps him to be asked by other businesses for promotion and, why not, to help build other brands. We will therefore highlight how* influencers *can harness the potency of social networks and profit in favor of their own image.*

Keywords: brand value growth, social media marketing, branding, social media

1. Introduction

In recent years we have witnessed the rapid growth of social networks, which have become important centers of social activity and information pipelines. The identification of social influence in these social networks has become the center of information generation. The increasing amount of information circulating through online social networks is forcing the participants of these networks to fight for attention and influence through diversified social messages, by adopting economic, religious, sustainability and political opinions.

Consequently, identifying the influential users among them and quantifying their influence becomes an important problem with the application in viral marketing, in the dissemination of information, in the search and discovery of reliable information that will influence the prediction of rankings.

Social influence through online social networks (OSN) is very well exploited as a new and innovative marketing tool and is defined by (Senevirathna, et al. 2021) as "the ability of a user's action to affect the actions of other users. We refer to such events as relationships of social influence. However, in most cases these relationships are asymmetrical. A person who influences other users is called *an influencer*, and the person influenced is called influenced."

The influence of social media has been widely studied in many areas, including the fields of marketing, political science, human behavior and communication.

However, in the context of marketing on social networks, little is known about the somewhat cascading influence, or rather the snowball effect that social networks have on the "brand" that a good social media user (also known as *an influencer*) creates for himself, especially when he displays with the art of subtlety the products he promotes on a social network.

In analyzing the influence of social networks on users' decisions, one must take into account the specifics of the analyzed networks but also of the users' profile knowing that different users exert different influences in

different ways, and the influence is correlated with the specific attributes of the user and the content. A content-related attribute could be to start a new post, contribute to a post, or share an existing post.

2. The role of social networks in increasing brand value

The dynamic and interactive functions of social networks make them an ideal channel for followers to engage in dialogue communication with opinion formers. Communicators can post messages designed to initiate conversational responses and get replies to messages from stakeholders interested in the topic, and thus encourage close ties with their followers. For example, on Facebook, Intagram, Youtube, Tik Tok you can initiate conversations in the comments section of each post. Also, by using @ can be evoked the person whose *username* is *denied*.

2.1. Theories of uses and satisfactions

Theories of uses and gratifications theory (UGT) (Katz, Blumler and Gurevitch, 1974) is a framework that explains how and why people actively search for certain types of media, theories that successfully apply to social media users. People receive satisfaction through social networks, they satisfy their informational, social and recreational needs.

In recent years, we have witnessed the rapid growth of online social networks, which have become important centers of social activity and information pipelines. Identifying social influence in these platforms can give us meaningful information to better understand the interaction behaviors between online users. However, it is difficult to quantitatively measure the influence among users, since many key factors cannot be noticed conveniently. More recent papers focus mainly on the development of theoretical models based on explicit causal knowledge. However, such knowledge is usually not available and often needs to be discovered.

The worldwide use of several social networks and the investments that companies make to promote their products and services through social networks have led researchers to study the interactions between these networks. (Phua, Jin and Kim 2017) have found that Instagram users have the biggest commitment compared to Facebook. Such a finding is also supported by the strategy of many economic entities to use Instagram as a "showcase" of presentation of the products or services offered.

With the rapid increase in the use of online social networks, social platforms now represent a large part of daily communication and play a major role in the dissemination of information throughout society. (Senevirathna, and others 2021) classifies the actions of social media users into three types:

(1) initiating a conversation or post ,

(2) contribution to an existing conversation or post, or

(3) sharing an existing post between conversations without changing the content.

Studies on the influence of social networks claim that the influence of a user is the same in all types of action. However, in reality, there are differences in how users influence others through initiation, contribution and sharing actions. Ignoring these differences in behavioral influence can prevent a comprehensive understanding of the real role of social influence in a wide variety of scenarios, including the propagation of information and maximization of influence, the transfer of knowledge in a community, and the development of projects such as online influence campaigns or online brand involvement at different stages of consumer purchasing decision.

For example, in online marketing campaigns, some users may create original content, some users may contribute to content created by others, and other users may spread the content to others through sharing. If a marketing firm is interested in controlling or interacting with this information shared, they may want to identify different users based on the role they play and how that user affects other users. Therefore, in this study, rather than modeling influence as a single entity, we modeled influence as its effect on the turnover of the business that an influencer has developed as a result of the promotion of products or services of companies in various fields of activity with the exploration of the cascading effects of social influence.

2.2. The role of social networks in increasing brand value

Currently, the evolution of *social media* platforms plays an important role in all areas of life, finding them deeply involved in issues of shaping tastes in consumer choices. Information circulates very quickly through Instagram, TikTok, Facebook, Twitter, vlogs, and events that affect any of the areas of economic and social life reach consumers in real time. In addition, the *social media* user generation is modern and open to everything new, with high tolerance and increased interest in making a better world.

The role of social networks in influencing the decisions of their followers, decisions related to choices, behavior, consumption, is one that is difficult to determine and absolutely uneven. (Saike, and others 2013) notes that "identifying influence in online social networks is difficult due to several confusing factors such as homophilia, unnoticed heterogeneity , simultaneity, factors that vary over time and other contextual effects. "

Studying the literature I did not find any study on *the branding* of a social media user who has a large number of followers – *influencer* – and who uses his influence in two senses: promoting products and services of other companies in an original way and working subtly on the development of his own brand. There are papers that analyze how some companies grow (Romao, and others 2019) as a result of using social networks for the purpose of promoting their own products. The article "aims to understand how interactions across multiple social networks influence the visibility of the most relevant social network of a luxury brand that acts as a showcase (Instagram)."

The approach adopted in this research brings new perspectives for the literature by analyzing how an *influencer* works on building their own *branding*, which helps him to be asked by other businesses for promotion and, why not, to help build other brands. We will therefore highlight how *influencers* can harness the potency of social networks and profit in favor of their own image.

Therefore, the following two research questions arise: (1) is there an influence of reciprocity between the development of one's own brand, reflected in the turnover, and the number of followers and their reactions to the posts of an influencer? (2) is it possible to reveal which characteristics contribute most to such an influence?

3. Case study "The impact of social networks on brand value growth"

In order to analyze the increase in the brand value of an economic entity whose object of activity is the provision of media representation services by promoting products and services (to some beneficiaries) through our own social networks, we have collected data on the evolution of the number of followers, the number of comments and the number of likes (likes) of the Instagram account that the company uses for media representation services.

We considered that these are the independent variables that influence the turnover of the firm, as a dependent variable. In order to be able to obtain relevant results, we used the monthly data on the listed elements, over a period of 41 months, which are relevant given the rapid increase in turnover, but also in the number of followers in a fairly short time that made there were big differences from month to month.

By analyzing these data, it is desired to identify the evolution trend of the turnover in the foreseeable future.

3.1. Purpose of the Study

This study aims at econometric modeling of social-media parameters, such as: the number of posts, the number of followers, the number of comments and the number of monthly likes, on the turnover from advertising services, as a dependent variable.

3.2. Assumptions

The hypotheses studied are:

H1: There are significant causal relationships between the elements involved in the study;

H2: The equation of link between the evolution of turnover and the social media elements studied, estimated in the long term, is statistically significant.

3.3. Presentation of the data used

We analyzed the turnover of the company of a content creator and we used as data the evolution of the number of its followers, the evolution of the number of likes and comentaries, the number of postations per Instagram from January 2018 to December 2021. The data was taken from the internet (source: https://socialblade.com/youtube/c//monthly).

In order to test the long-term relationship between *turnover* (CA) and *Instagram / Month Posts* (POINS), *Instagram Followers* (UINST), respectively *The Number of Likes* (LIKE) and *Comments* (COMENT), we will start by testing the stationaryness of the data series used.

3.4. Stationary testing

Series: Turnover (CA)

The ADF and KPSS tests of the root drive are shown in the following tables:

Table 1. ADF drive root test for "Turnover" series

Null Hypothesis: CA has a unit root

Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.189228	0.0281
Test critical values:	1% level	-3.605593	
	5% level	-2.936942	
	10% level	-2.606857	

*MacKinnon (1996) one-sided p-values.

The probability attached to the null hypothesis (CA has a drive root) is 0.028, below the standard threshold of 5%. According to the ADF test, we accept the hypothesis that *the CA series is stationary*.

Table 2. KPSS drive root test for "Turnover" series

Null Hypothesis: CA is stationary
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.850853
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

The KPSS test *rejects the situation of stationaryness* (the statistics of the test, 0.8508, are greater than the value corresponding to the threshold of 5%, respectively, 0.463).

The ADF and KPSS therapies provide contradictory results (moreover, Ng-Perron tests reject the unit root hypothesis, and the ERS Point Optimal test does not support that hypothesis).

Conflicting results may be due to the small number of comments available (41).

Instead, all tests reject the unit root hypothesis for the series calculated in the first difference. In view of the previous analyses, we consider as a working hypothesis, that the Turnover series is non-existential, integrated by order I.

Series: Instagram Followers (UINST)

The ADF and KPSS tests of the root drive are shown in the following tables:

Table 3. ADF drive root test for the series "Followers on Instagram"

Null Hypothesis: UINST has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.914180	0.0526
Test critical values:	1% level	-3.605593	
	5% level	-2.936942	
	10% level	-2.606857	

*MacKinnon (1996) one-sided p-values.

According to the ADF test, the probability attached to the null hypothesis (CA has a drive root) is 0.0526 slightly above the standard threshold of 5%.

Table 4. KPSS drive root test for the series "Instagram Followers"

Null Hypothesis: UINST is stationary
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.787896
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

The KPSS test *rejects the stationary hypothesis* (the statistics of the test, 0.7879, is higher than the value corresponding to the threshold of 5%, respectively, 0.463).

All tests reject the unit root hypothesis for the series calculated in the first difference. We accept the hypothesis that *the UINST series is non-stationary*, integrated by the first order.

Series: Number of likes (LIKE)

The ADF and KPSS tests of the root drive are shown in the following tables:

Table 5. ADF drive root test for the series "Number of likes""

Null Hypothesis: LIKE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.351894	0.1615
Test critical values:	1% level	-3.605593	

	5% level	-2.936942
	10 % level	-2.606857

*MacKinnon (1996) one-sided p-values.

According to the ADF test, the probability attached to the null hypothesis (CA?? or LIKE?? has a drive root is 0.1615, above the standard threshold of 5%. The test does not reject the assumption that *the LIKE series is non-stationary*. As the value of the statistic is slightly above the 10% threshold, we also apply the KPSS test.

Table 6. KPSS test of the root of the drive for the series "Number of likes"

Null Hypothesis: LIKE is stationary
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

			LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic			0.413097
Asymptotic critical values*:		1% level	0.739000
		5% level	0.463000
		10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

The KPSS test does not reject the hypothesis that *the LIKE series is stationary* (the value of the statistics is 0.413, lower than 5%). The results of the application of ADF and KPSS are contradictory, we have applied other tests: Phillips-Perron and Ng-Perron do not reject the unit root hypothesis.

Instead, all tests reject the unit root hypothesis for the series calculated in the first difference. We accept the hypothesis that *the LIKE series is non-stationary*, integrated by the first order.

Series: Comments (COMENT)

The ADF and KPSS tests of the root drive are shown in the following tables:

Table 7. ADF test of the root drive for series "Comments"

Null Hypothesis: COMENT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.511746	0.1203
Test critical values:	-3.605593	-4.205004	
	-2.936942	-3.526609	
	-2.606857	-3.194611	

*MacKinnon (1996) one-sided p-values.

According to the ADF test, the probability attached to the null hypothesis (CA has a drive root) is 0.1203 above the standard threshold of 5%.

Table 8. KPSS test of the root drive for the series "Comments"

Null Hypothesis: LIKE is stationary
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

			L M-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic			0.608296
Asymptotic critical values*:		1% level	0.739000
		5% level	0.463000
		10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

The statistics of the KPSS test shall be above the value corresponding to the 5% threshold. I reject, the assumption that *the COMENT series is stationary*. All tests reject the unit root hypothesis for the series calculated in the first difference. Consequently, we accept the hypothesis that *the series "Comments" is non-stationary*, integrated by the first order.

Series: Instagram Posts / Moon (POINS)

The ADF test is shown in the following table:

Table 9. ADF drive root test for "Instagram Posts/ Month" series

Null Hypothesis: POINS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on AIC, maxlag=9)

			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-6.192091	0.0000
Test critical values:		1% level	-3.605593	
		5% level	-2.936942	
		10% level	-2.606857	

*MacKinnon (1996) one-sided p-values.

The probability attached to the null hypothesis (POINS has a drive root) is < 0.0001. According to the ADF test, we accept the hypothesis that *the POINS series is stationary*. We also apply the KPSS test:

Table 10. KPSS Drive Root Test for Instagram/Month Posts Series"

Null Hypothesis: LIKE is stationary
Exogenous: Constant

Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

			LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic			0.277543
Asymptotic critical values*:		1% level	0.739000
		5% level	0.463000
		10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

The statistics of the KPSS test are below the value corresponding to the threshold of 5%. We do not reject the hypothesis that *the series "Instagram Posts / Moon" is stationary*. Consequently, we accept the hypothesis that the series "Instagram Posts / Moon" is stationary.

3.5. Causation tests

Based on the results of the stationary analyses, we apply the Granger causation test for the d(CA), d(UINST), d(LIKE) d(COMENT) and POINS series. The results are as follows:

Table 11. Granger causation tests

Pairwise Granger Causality Tests
Sample: 2018M01 2021M12
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
D(UINST) does not Granger Cause D(CA)	38	3.44743	0.0431
D(CA) does not Granger Cause D(UINST)		1.50867	0.2361
D(LIKE) does not Granger Cause D(CA)	38	3.04064	0.0602
D(CA) does not Granger Cause D(LIKE)		0.31388	0.7328
D(COMENT) does not Granger Cause D(CA)	38	3.39468	0.0770
D(CA) does not Granger Cause D(COMENT)		0.08938	0.9147
POINS does not Granger Cause D(CA)	38	3.74954	0.0485
D(CA) does not Granger Cause POINS		2.22607	0.1239
D(LIKE) does not Granger Cause D(UINST)	38	3.97455	0.0380
D(UINST) does not Granger Cause D(LIKE)		0.05143	0.9499

D(COMENT) does not Granger Cause D(UINST)	3 8	1.83547	0.1755
D(UINST) does not Granger Cause D(COMENT)		0.41928	0.6610
POINS does not Granger Cause D(UINST)	3 8	0.77253	0.4700
D(UINST) does not Granger Cause POINS		0.13081	0.8778
D(COMENT) does not Granger Cause D(LIKE)	3 8	0.27740	0.7595
D(LIKE) does not Granger Cause D(COMENT)		0.82149	0.4486
POINS does not Granger Cause D(LIKE)	3 8	0.14403	0.8664
D(LIKE) does not Granger Cause POINS		3.06844	0.0600
POINS does not Granger Cause D(COMENT)	3 8	0.83183	0.4442
D(COMENT) does not Granger Cause POINS		0.70952	0.4992

The tests do not identify granger causal relationships between the change in the analyzed variables. In these conditions, we do not calculate models between stationary variables by differentiation, but we test the possibility of the existence of co-integration relations between the integrated variables of the first order.

3.6. Cointegration model

We built a model of cointegration between the non-stationary variables. The result is shown in the following table:

Table 12. Granger causation tests

Vector Error Correction Estimates
Sample (adjusted): 2018M03 2021M05
Included observations: 39 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq 1
CA(-1)	1.000000
POINS(-1)	-1849.188 (834.416) [-2.21615]
UINST(-1)	-0.931930 (0.18893) [-4.93279]

LIKE(-1)	-2.499821				
	(2.37961)				
	[-1.05052]				
COMENT(-1)		296.9825			
		(105.484)			
		[2.81541]			
C		179863.1			

Error Correction:	D(CANS)	D(POIST)	D(UIN)	D(LIKENT)	D(COME
CointEq1	-0.905836	0.000182	0.030251	-0.008899	-0.000581
	(0.18187)	(6.9E-05)	(0.01351)	(0.01441)	(0.00043)
	[-4.98070]	[2.22804]	[0.61777]	[-1.35733]	[-1.35733]
D(CA(-1))	0.447559	2.86E-05	-0.010106	0.000793	0.000443
	(0.17691)	(6.8E-05)	(0.01321)	(0.01409)	(0.00042)
	[2.52988]	[0.42352]	[-0.76440]	[0.05660]	[1.06418]
D(POINS(-1))	-510.6003	-0.320146	9.747109	-11.79288	0.993904
	(395.706)	(0.15108)	(29.5712)	(31.5432)	(0.93082)
	[-1.29035]	[-2.11889]	[0.32961]	[0.37625]	[1.06777]
D(UINST(-1))	2.988052	-0.000126	0.310086	0.081658	-0.000994
	(2.03332)	(0.00075)	(0.15196)	(0.16101)	(0.00478)
	[1.46955]	[-0.16291]	[2.04067]	[0.50702]	[-0.20788]
D(LIKE(-1))	0.711383	-0.000696	0.167912	-0.365247	0.006965
	(2.34180)	(0.00081)	(0.17509)	(0.18549)	(0.00551)
	[0.30378]	[-0.77825]	[0.95946]	[1.96910]	[1.26443]
D(COMENT(-1))	77.94467	-0.034647	-3.794939	6.271766	-0.371883
	(79.7421)	(0.03046)	(5.95923)	(6.31628)	(0.18758)
	[0.97746]	[-1.13792]	[-0.63681]	[0.99296]	[-1.98255]
C	-7801.565	0.502790	1839.909	-120.7850	5.321064
	(6658.98)	(2.54256)	(497.636)	(527.446)	(15.6640)
	[-1.17159]	[0.19772]	[3.69746]	[-0.22900]	[0.33970]

R-squared	0.460644	0.449645	0.297563	0.123279	0.275386
Adj. R-squared	0.359535	0.346435	0.165820	-0.041125	0.139521
Sum sq. resids	1.26E+10	1840.435	705009.34	792001.1	69851.25
S.E. equation	19861.77	7.583780	1484.315	1573.212	46.72100
F-statistic	4.555008	4.357189	2.259030	0.749811	2.026909
Log likelihood	-437.4465	-130.4955	-336.2863	-338.5552	-201.4046
Akaike AIC	22.79249	7.051043	17.60478	17.72013	10.68741
Schwarz SC	23.09037	7.349601	17.90337	18.01901	10.98600
Mean dependent	1826.100	0.000010	2686.464	98.02500	2.948718
S.D. dependent	24817.32	9.380861	1625.130	1541.871	50.36652

Determinant resid covariance (dof adj.)	1.35E+26
Determinant resid covariance	5.01E+25
Log likelihood	-1430.641
Akaike information criterion	75.41749
Schwarz criterion	77.12371
Number of coefficients	40

4. Conclusions

Researchers increasingly address the subject of the influence of social networks on followers, a new current is about to make its way into their concerns, namely the concept of influence / passivity. A serious disadvantage of such an approach is the requirement of explicit causal knowledge, which is extremely rare in many scenarios and due to the fact that passivity also extends beyond the field of knowledge, that is, those users of social networks who are characterized by passivity, as a rule, are not receptive to scientific studies either and do not respond to questionnaires, the main study tools in the field.

The analysis of these data identified the trend of evolution of the turnover in the foreseeable future. In order to analyze the increase in the brand value of an economic entity whose object of activity is the provision of media representation services by promoting products and services (to some beneficiaries) through our own social networks, we have collected data on the evolution of the number of followers, the number of comments and the number of likes (likes) of the Instagram account that the company uses for media representation services, considering that these are the independent variables that influence the turnover of the firm as a dependent variable.

Starting from the results of the stationary analysis, and as a result of the application of the Granger type causal test for the series d(CA), d(UINST), d(LIKE) d(COMENT) and POINS, we have reached the result that shows us that the co-integration coefficient is negative (-0.905836) and is significantly different from zero, which means that the co-integration equation is stable in the long term. The long-term relationship is: CA = 1848.188· POINS + 0.93163· UINST + 2.49982· LIKE – – 296.9825· COMMENT – 179863.1 This means that, in the long run, there is a stable positive relationship between turnover (CF) and Instagram / Month Posts (POINS), Instagram followers (UINST), respectively The number of likes (LIKEs) and a negative relationship between turnover (CF) and Comments (COMENT).

References:

[1] Jula, Dorin. 2020 - 2021. *Econometrie în EViews. Note de curs, Centrul de Modelare macroeconomică,* . INCE-SCOSAAR, București.

[2] Jula, Dorin, și Nicolae Marius Jula. 2020. *Econometrie (ediția a 3-a).* Bucuresti: Mustang.

[3] Katz, E, J. G. Blumler, și Gurevitch, M. 1974. „Utilization of Mass Communication by the Individual." *The Uses of Mass Communications: Current Perspectives on Gratifications Research; Beverly Hills: Sage Publications.* 19-31.
[4] Krause, Amanda, A North, și Brody Heritage. 2014. „The uses and gratifications of using Facebook music listening applications." *Computers in Human Behavior 39* 71 - 77.
[5] Lovejoy, Kristen, și Gregory D. Saxton. 2012. *Information, Community, and Action: How Nonprofit Organizations Use Social Media.* Journal of Computer-Mediated Communication.
[6] Phua, Joe, Seunga Jin, și Jihoon (Jay) Kim. 2017. „Uses and gratifications of social networking sites for bridging and bonding social capital: A comparison of Facebook, Twitter, Instagram, and Snapchat." *Computers in Human Behavior, 72* 115 - 122.
[7] Porter, Lance V., Kaye D Sweetser, Deborah S. Chung, și Eunseong Kim. 2007. „Blog power: Examining the effects of practitioner blog use on power in public relations." 92-95. Public Relations Review.
[8] Romao, Maria Tereza, Sergio Moro, Paulo Rita, și Pedro Ramos. 2019. „Leveraging a luxury fashion brand through social media." *European Research on Management and Business Economics 25* 15 - 22.
[9] Romero, Daniel, Wojciech Galuba, Sitaram Asur, și Bernardo Huberman. 2011. „Influence and Passivity in Social Media." *Machine Learning and Knowledge Discovery in Databases. ECML PKDD* 18 - 33.
[10] Saike, He, Xiaolong Zheng, Daniel Zeng, Kainan Cui, Zhu Zhang, și Chuan Luo. 2013. „Identifying Peer Influence in Online Social Networks." *Intelligence and Security Informatics* 47 - 61.
[11] Senevirathna, Chathurani, Chathika Gunaratne, William Rand, Chathura Jayalath, și Ivan Garibay. 2021. „Influence Cascades: Entropy-Based Characterization of Behavioral Influence Patterns in Social Media." *Microsoft Academic, Volume: 23, Issue: 2,* 160.

A Marketing Experiment Regarding the Importance of Price Discounts when Booking a Vacation Abroad during Covid-19 Pandemic

OTILIA-ELENA PLATON
Ph.D. Postdoctoral Researcher
The Bucharest University of Economic Studies
Piata Romana, no. 6, Bucharest
ROMANIA
otilia.platon@mk.ase.ro

Abstract: When deciding to book a vacation abroad, consumers take into consideration many factors, such as the hotel facilities, its location, the attractiveness of the presentation images, the price and, more recently, the safety measures taken during the COVID-19 pandemic. It is important to understand the role of price in this decision and especially of the price discounts that are often displayed in tourist ads. Starting from this idea, a marketing experiment was created and it aimed to investigate the extent to which the price discount will influence the respondents' perception towards the attractiveness of a vacation offer. The research used a sample of 40 random subjects, males and females, aged between 21 and 27 years. The participants were divided into two equal and similar groups: 20 participants in the control group and 20 participants in the experimental group. The research design used for this marketing experiment was "before-after with control group". The information regarding the price was manipulated and used as the independent variable for this experiment. The research results showed that the assumption that a certain accommodation will be perceived as being more attractive if the price discount is presented to consumers proved to be correct.

Key-Words: experiment, consumer behavior, price, discount, COVID-19.

JEL Classification: M31.

1 Introduction

During the last two years the tourism industry has largely suffered due to COVID-19 pandemic. This year however tourist destinations are expecting a rise in the number of tourists since the travel restrictions are eased. Many forecasts are indicating that the number of travelers will match or even exceed levels in the pre-pandemic days. A large number of hoteliers are "currently competing to make promotions through advertising and price discounts to attract local people to vacations" (Yusnita, Saufi & Handayani, 2021, 81).

According to a Statista (2020) survey conducted in December 2020 "around 76 percent of travelers worldwide expect that companies will attempt to boost travel sales with the help of special offers and discounts after the pandemic. At the same time, over 50 percent agreed that travel prices will be higher after the pandemic." Starting from this idea, a marketing experiment was created and it aimed to investigate the extent to which the price discount will influence the respondents' perception towards the attractiveness of a vacation offer. Different studies published in the scientific literature show that "discounts have a significant effect on buying interest" (Yusnita, Saufi & Handayani, 2021, 82). According to the study conducted by Yusnita, Saufi & Handayani (2021, 88), "price discounts have proven to have a significant effect on interest in staying at hotels during the Covid-19 pandemic. The more attractive the discounted price given, the stronger someone's interest in staying at the hotel. The results of the study show that price discounts are able to encourage consumer's interest to stay at hotels even during the Covid-19 pandemic."

2 Experimental research

Experimental research is a scientific approach to research, where *one or more independent variables* are manipulated and applied to *a dependent variable* in order to measure their effect on the latter (Cătoiu et al., 2009). In other words, experimental research is the primary approach used to examine the causal (cause-effect) relationships between two or more variables.

In general, a marketing experiment has two fundamental objectives:

1. Discovering the causal relationship between various marketing variables;
2. Measuring the effect that an independent (explanatory) variable has on a dependent (explained) marketing variable.

True experimental research designs are those where researchers have complete control over the extraneous variables and can predict confidently that the observed effect on the dependable variable is only due to the manipulation of the independent variable. In a true experiment, three conditions need to be satisfied:

- the true experimental research design must contain at least *a variable that can be manipulated by the researcher (an independent variable)*.
- the true experimental research design must contain *a control group*, which won't be subject to changes, and *an experimental group*, which will experience the changed variables.
- the true experimental research design must contain *a random distribution of the subjects*.

In order to achieve these objectives it is necessary to choose an appropriate research design and to develop an experimental research. The classification of experimental designs includes (Cătoiu et al., 2009):

- "after-only without control group" design
- "before-after without control group" design
- "after-only with control group" design
- "before-after with control group" design
- "Solomon four-group" design

The "before-after with control group" research design involves establishing two random samples or groups of respondents: an experimental group, that would be exposed to the independent variable, and a control group, that would not be subjected to the independent variable under study. The two groups would be matched. That is, the two samples would be identical in all important respects. Measurements are taken from both groups before the experimental variable is introduced. The control group is not subjected to the experimental variable. Afterwards measures are taken from both groups. The idea is that any confounding factors would impact equally on both groups and therefore any differences in the data drawn from the two groups can be attributed to the experimental variable.

The "before-after with control group" design can be represented, with the help of notations, as follows (Cătoiu et al., 2009):

Experimental group:	R1 Yb X Ya
Control group:	R2 Yb -X Ya

Where: Ya (experimental group) – Yb (experimental group) = E + U (1)
E – the effect of the explanatory (experimental) independent variable
U – the effects of other variables (in this case it is always considered that U≠0)
And: Ya (control group) – Yb (control group) = U (2)
U – the effects of other variables (in this case it is always considered that U≠0)
Therefore:
Ya (experimental group) – Yb (experimental group) = E + Ya (control group) – Yb (control group)
(we replaced U from the first equation (1) with U from the second equation (2))
E = [Ya (experimental group) – Yb (experimental group)] – [Ya (control group) – Yb (control group)]

The notations used in experimental research are:

X	the explanatory (experimental) independent variable which is manipulated by the researcher
-X	the explanatory (experimental) independent variable which is not manipulated by the researcher, but varies naturally
Ya	the dependent variable measured **after** the explanatory (experimental) independent variable was manipulated by the researcher (post-test)
Yb	the dependent variable measured **before** the explanatory (experimental) independent variable was manipulated by the researcher (pre-test)
R	random sample

3 The research methodology

The research problem is represented by the fact that when consumers are faced with the decision to book a vacation abroad they form their attitudes and perceptions based on numerous factors, one of the most important factors being the price.

Experimental research design is concerned with examination of the effect of one or more independent variables on one or more dependent variables, where the independent variable is manipulated through treatment or interventions, and the effect of those interventions is observed on the dependent variable.

For this marketing experiment two vacation offers from Greece have been selected. These have been identified as *accommodation A* and *accommodation B*. The vacation offers were presented using an image and some details, such as: the score from the evaluations of other clients and the number of reviews received, the all-inclusive options, the free cancellation policy, the free Wi-Fi facilities and the safety measures taken during the COVID-19 pandemic. The information regarding the price was manipulated and used as the independent variable for this experiment. The explanatory (experimental) independent variable was represented by the price discounts and the dependent variable measured in this experiment was the attractiveness of the vacation offer.

The purpose of the study was to discover the causal relationship between the price discounts and the attractiveness of a vacation offer for clients. The objective of the study was to measure the effect that the independent/explanatory variable (the price discounts) has on the dependent/explained variable (the attractiveness of the vacation offer). Also, the objective of the study was to determine whether there is a difference in choices between the consumers that are exposed to discounts and those not exposed to discounts.

Therefore, the research hypotheses were the following:

- The discount will influence the participants' perception towards the attractiveness of a vacation.
- Accommodation A will be perceived as being more attractive if the discount is not presented.
- Accommodation B will be perceived as being more attractive if the discount is presented.

The research design used for this marketing experiment was "before-after with control group".

The sample for this experiment consisted of 40 random subjects, males and females, aged between 21 and 27 years. The participants were divided into two equal and similar groups: 20 participants in the control group and 20 participants in the experimental group. The experimental group is the group of subjects that receives the experimental treatment. The control group is the group of subjects not receiving the same manipulation as the experimental group.

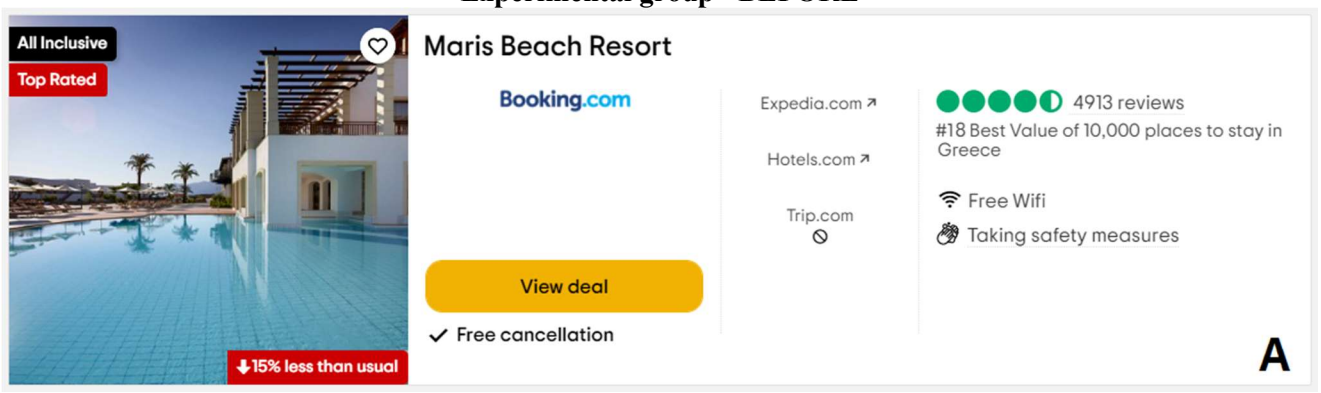
The data was collected using two online surveys, one for the experimental group and one for the control group. The questionnaire used to collect the data consisted of 10 questions. The participants to this study were asked to not return to a previous page in their online questionnaire, to not change their previous answers and to give answers as sincerely as possible.

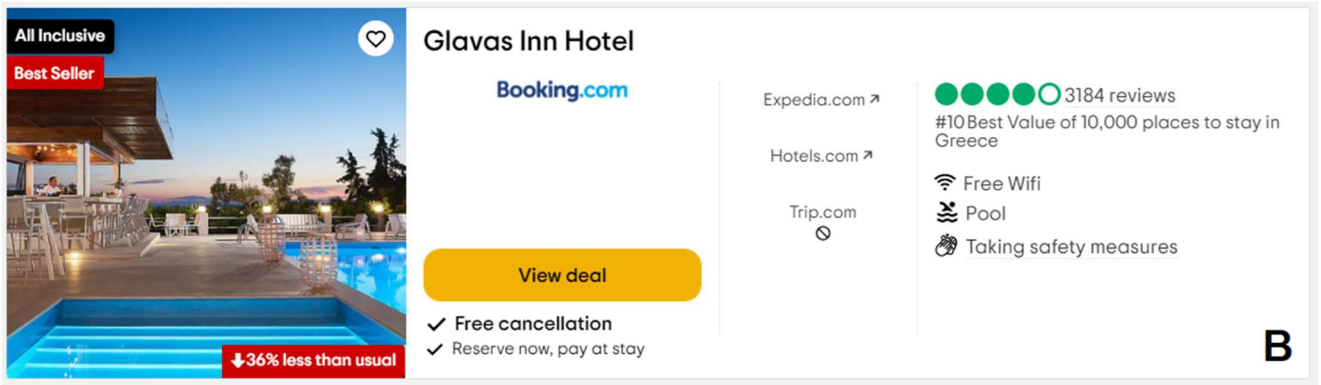
The participants from the experimental group received an initial set of images with the two vacation offers (for the "before" measurements) in which the following information could be observed: for accommodation A the hotel presentation included the text "15% less than usual", and for accommodation B the hotel presentation included the text "36% less than usual". The experimental group received a second set of images with the two vacation offers (for the "after" measurements) in which the participants could see the prices as follows: for accommodation A the hotel presentation included the text "special price: ~~Euro 1495~~ Euro 1299" and for accommodation B the hotel presentation included the text "special price: ~~Euro 1902~~ Euro 1399", showing that the accommodations are offering a special price discount.

The participants from the control group received an initial set of images with the two vacation offers (for the "before" measurements) with no information regarding any price discounts. The control group received a second set of images with the two vacation offers (for the "after" measurements) in which the participants could see the prices as follows: for accommodation A the hotel presentation included the text "special price: Euro 1299" and for accommodation B the hotel presentation included the text "special price: Euro 1399". All sets of images are presented in Figure 1.

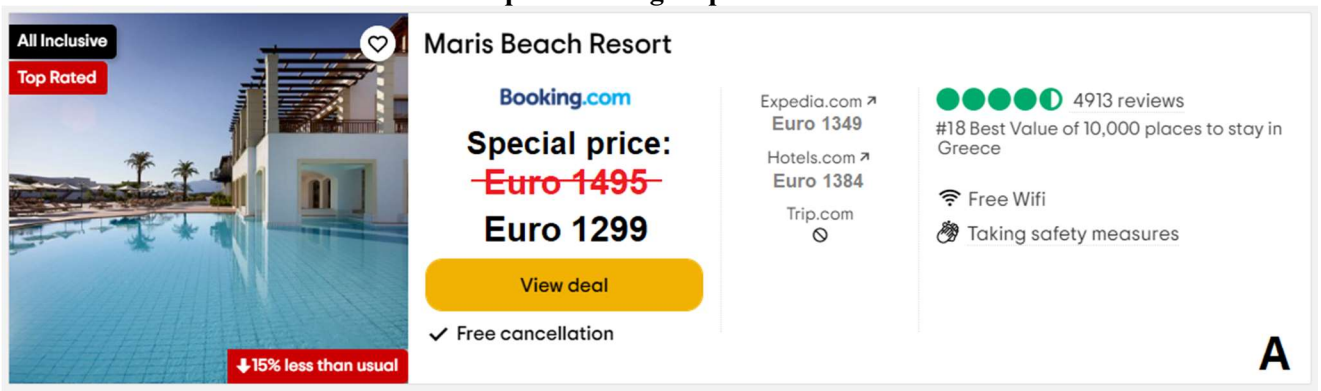
Figure 1. Sets of images used in the marketing experiment

Experimental group - BEFORE

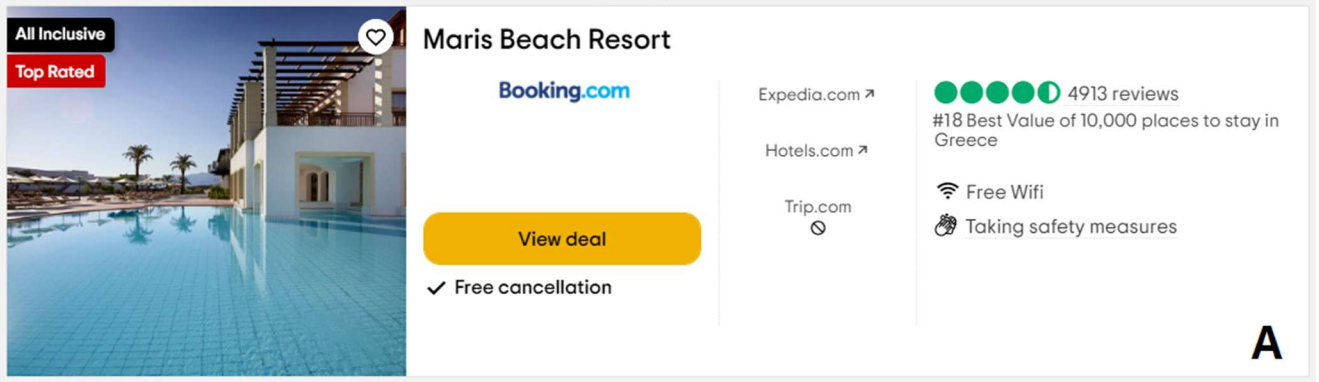


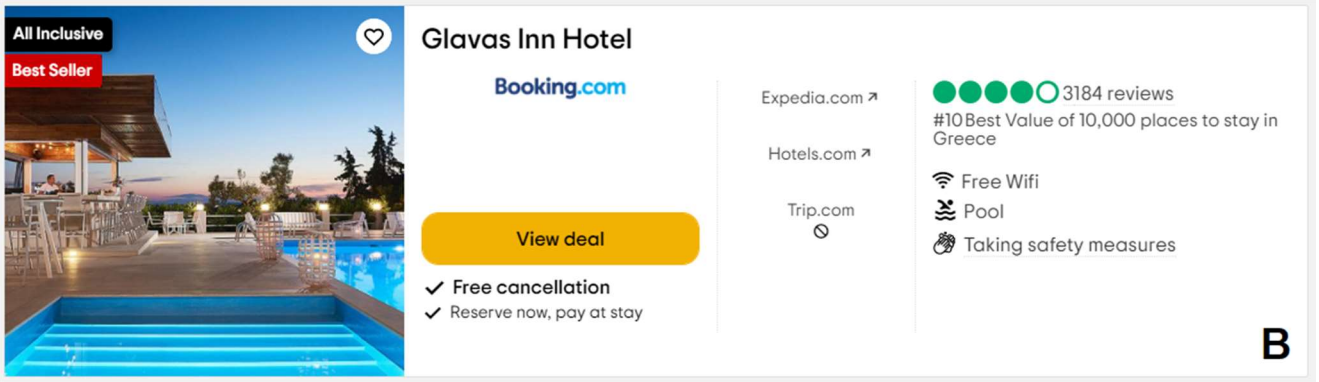


Experimental group - AFTER

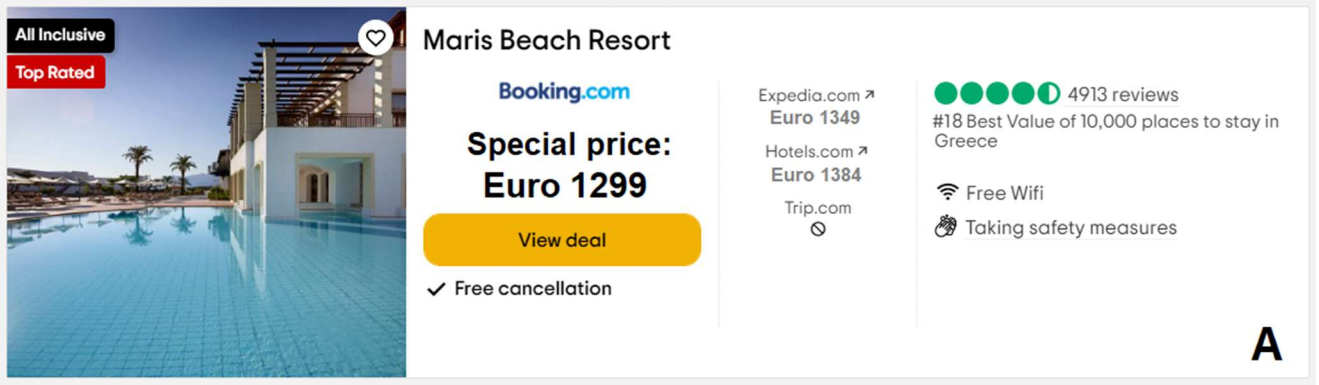


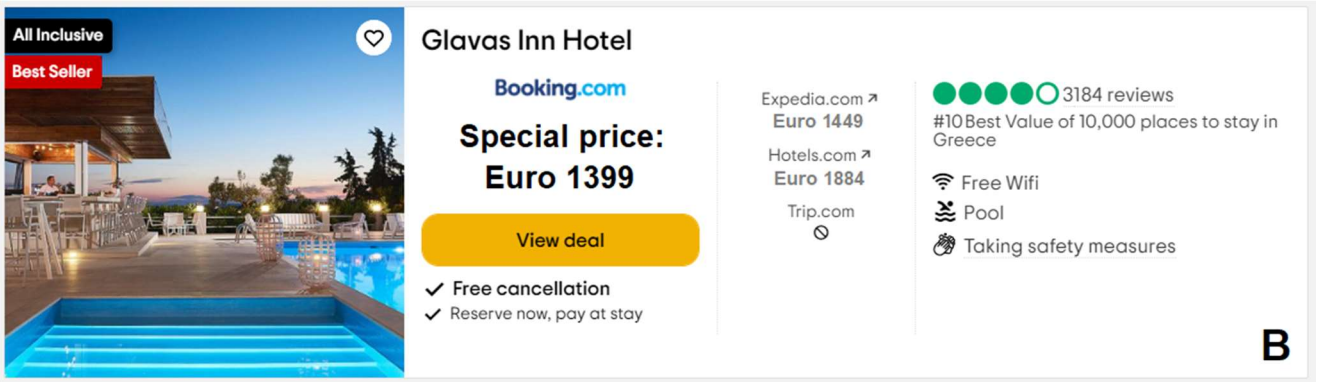
Control group - BEFORE





Control group - AFTER





4 Research data analysis

The experimental group was formed of 7 men and 13 women, aged from 21 to 27 years old. The control group was formed of 10 men and 10 women, aged from 21 to 24 years old.

The participants from both groups were first asked to mention (using a scale from 1 to 5, where 1 means to a very small extent, and 5 means to a very large extent) to what extent each of the following elements will influence the attractiveness of an accommodation when making the decision to book a vacation abroad. The results were:

	Average score	
	Experimental group	**Control group**
All-inclusive options	3	4.05
Free cancellation before check-in	3.7	4.15
Free Wi-Fi	3.9	4.6
Special price offer	3.85	4.25
High ratings / reviews	4.6	4.5
Attractive presentation images	4.1	4.45
Safety measures taken during Covid-19	3.5	3.85

According to the results, high ratings / reviews, attractive presentation images and free Wi-Fi are among the most important factors that will influence the attractiveness of an accommodation when making the decision to book a vacation abroad. The special price offers are also important, but according to the results, they are more important for the participants in the control group.

Next, the participants from both groups were asked to look at the images depicting the two vacation offers (A and B) in Greece. They were informed that both accommodations are located on the same island, close to each other and are classified as 5 star hotels. After seeing the first and the second set of pictures (Figure 1), the participants were asked to mention which vacation offer they find to be more attractive. The results were:

Experimental group			
Before		After	
A	B	A	B
40%	60%	45%	55%

Control group			
Before		After	
A	B	A	B
20%	80%	35%	65%

All the participants selected accommodation B both before and after they analyzed the sets of pictures that they received in the questionnaire.

Not taking into consideration a specific budget, the participants were asked to mention which vacation offer they would choose. The results were:

Experimental group			
Before		After	
A	B	A	B
40%	60%	40%	60%

Control group			
Before		After	
A	B	A	B
20%	80%	30%	70%

All the participants selected accommodation B both before and after they analyzed the sets of pictures that they received in the questionnaire.

Asked which vacation offer they think has the best price offer, the participants responded as follows:

Accommodation	Results	
	Experimental group	Control group
A	50%	65%
B	50%	35%

The members of the experimental group considered that both accommodation A and B have a good price offer. The members of the control group considered that accommodation A has the best price offer.

Assuming that their vacation budget is around 1200 Euros, the participants were asked to mention how willing they would be to book each accommodation (using a scale from 1 to 5, where 1 means not willing at all, and 5 means completely willing):

Accommodation	Average score	
	Experimental group	Control group
A	3.75	4
B	2.85	3.8

Constrained by a certain budget, the members of the experimental group declared that they would choose accommodation A with a greater chance. The members of the control group declared that they would also choose accommodation A, but accommodation B received a similar average score.

Not taking into consideration a specific budget, the respondents were asked to mention to what extent each of the following elements influences the attractiveness of accommodations A and B (using a scale from 1 to 5, where 1 means to a very small extent, and 5 means to a very large extent). The results were:

Accommodation A	Average score	
	Experimental group	Control group
All-inclusive options	3.45	4.4
Free cancellation before check-in	4.25	4.3
Free Wi-Fi	4	4.5
Special price offer	3.95	4.25
High ratings / reviews	4.6	4.55
Attractive presentation image	4.3	4.2
Safety measures taken during Covid-19	3.45	3.8

Accommodation B	Average score	
	Experimental group	Control group
All-inclusive options	3.45	4.5
Free cancellation before check-in	4.15	4.3
Free Wi-Fi	4.1	4.5
Special price offer	3.95	4.25
High ratings / reviews	4.3	4.55
Attractive presentation image	4.25	4.35
Safety measures taken during Covid-19	3.45	3.75

For both accommodations, the high ratings / reviews were the most important factor. In addition, the attractive presentation image was an important influencing factor. The option of free cancellation before check-in and the free Wi-Fi were the following influencing factors. Interestingly, the special price offer was more important for the control group who did not received the images with the discounts displayed in the offer. Also, the all-inclusive options were considered to be more important by the members in the control group. The safety measures taken during Covid-19 were the least important factor that influences the attractiveness of accommodations.

5 Conclusions

The purpose of this research was to investigate the extent to which the price discount will influence the participants' perception towards the attractiveness of a vacation.

The initial hypothesis that accommodation A will be perceived as being more attractive if the discount is not presented was incorrect since the majority of respondents from the control group selected accommodation B. Even though the members of the control group considered that accommodation A has the best price offer, they would choose accommodation B. Constrained by a certain budget, the members of the control group declared that they would choose accommodation A, but accommodation B received a close average score.

The initial hypothesis that accommodation B will be perceived as being more attractive if the discount is presented was correct since the majority of respondents from the experimental group selected accommodation B.

The experiment is not conclusive because the decision to choose a certain holiday offer is strongly influenced by other factors, not only by the price. According to this research the high ratings / reviews, the attractive presentation image, the option of free cancellation before check-in and the free Wi-Fi are important influencing factors. A conclusive experiment should measure in detail the influence of all these factors.

References:

[1] Cătoiu, I. (eds), Balan C., Balaure, V., Orzan, Gh. Popescu, IC (2009). *Cercetari de marketing (tratat)*. Bucharest: Uranus.

[2] Statista (2020). Expected influence of the coronavirus (COVID-19) pandemic on travel prices in selected countries worldwide in 2020, https://www.statista.com/statistics/1220781/coronavirus-covid-19-travel-price-influence-worldwide/

[3] Yusnita, E.; Saufi, A.; Handayani, B. (2021). The Effect of Advertising and Price Discounts on the Interest of Tourists to Stay at Hotel (Staycation) During the Covid-19 Pandemic with Health Risk Perception as Moderating Variable. *International Journal of Multiculturaland Multireligious Understanding*, vol. 8, issue 9, pp. 80-90.

Determinants of the Migration Decision from Romania

ANDREEA-OANA ENACHE
PhD, Institute of National Economy
Romanian Academy
enache_oanaa@yahoo.com

Abstract: The economic and social changes in the world have brought significant changes to the demographic phenomena of the last 40 years, the countries most affected by these changes being the ex-communist countries. Forms of migration are often perceived as a measure of the weighting of large-scale demographic effects, reducing the rate of aging worldwide. However, the idea of cultural diversity is not easy to manage, as migrants may not be able to adapt to living conditions in their destination countries. Globally, the illegal migration phenomenon is discouraged by the provision of multiple accommodation facilities in the host country, for immigrants, attracting highly qualified people, who can be easily integrated into the labor market and local communities in the destination country. As a result of these developments, the demographic outlook for Romania is not the most optimistic, so several experts estimate dramatic future developments for the country's population. The determinants of migration can be of several types, and in this paper will be considered the individual actions of analysis of migrants.

Key-Words: migration, emigrants, immigrants, earning, registered unemployed, econometric estimation, hypothesis testing

JEL Classification: F_{20}, F_{22}, F_{24}, B_{22}, B_{23}.

1 Introduction

The origin of the word migration comes from the Latin language, where it had several meanings. In the past, migration was defined as a form of mass movement of tribes from one territory to another, based on economic, social, political or natural considerations.

Currently, migration has many aspects related to moving or changing the place of residence of an individual or group of people, by changing their domicile and place of work, all of which are determined by social, political, economic or natural factors.

According to the International Organization for Migration's annual report for 2010, the number of people who decide to migrate has been estimated at 220 million by 2013 and 405 million by 2050, respectively.

Although the modern migration phenomenon is based on political and social connotations, such as wars and political conflicts or natural and environmental disasters, most of the time, economic aspects are the trigger for global migration.

These financial inequalities are due to large differences in people's incomes for similar extra paid work in other parts of the world.

Another factor that contributes to the decision to emigrate is the lack of specialists in the fields sought. Thus, developed countries are recipients of highly qualified people for areas less accessed by the internal population.

This aspect of migration leads to a deficit in the market of the country of origin of the migrant, where material opportunities, those of affirmation in the career, or of the standard of living, are not as great as in the country of destination.

Another type of migration that attracts a large number of researchers is that of the domestic environment. This occurs between the areas of origin of the population, from the rural area to the urban area, in the case of the states in the industrialization phase. The phenomenon can occur vice versa, the migration of the population being registered from the urban area to the rural area, in the case of developed countries. This paper aims to analyze the migration phenomenon and the migration decision as a result of several individual analysis actions, by verifying the significance of the specific individual effects (βi), by the Hausman test and the fixed effects by redundancy tests.

2 Literature review

In the literature, the migratory phenomenon is defined in several ways, but several specialists believe that it is a form of mobility of individuals, from one territory to another, crossing administrative boundaries to settle for a period delimited by time or for an indefinite period, in order to have access to economic, social and environmental resources in the destination area (Roman, 2010).

At the same time, the effects of migration help to create a dynamic balance on the natural increase of a country's population, so that the demographic balance is restored by slowing down the aging rate and increasing the birth rate (Newell, 1988).

The migratory phenomenon contributes to the cultural changes generated in correlation with the effects of globalization felt worldwide (Zelinsky, 1966), which involves in its dynamics and social and political economic factors, through the differences between the two types of population structures. Social, linguistic, political, environmental, and religious aspects create differences between cultures, but with the magnitude of the migration phenomenon, these differences tend to diminish (Trewartha, 1969). The idea of restricting socio-cultural barriers can create both advantages and disadvantages for the population. The positive effects are observed by attracting highly trained migrants in areas that require a large number of specialists, the term brain drain is met, but they can also create problems by eliminating the national heritage values specific to the host country.

Viewed from another perspective, the migration decision may be based on Maslow's needs pyramid theory. An individual may migrate out of a desire to solve certain problems, such as physiological (food, water and environment), security, social, development and self-sufficiency.

Therefore, the migratory phenomenon sums up a multitude of influencing factors, resources and effects, which contribute to the increase of migratory flows, with changes in meaning and intensity. The implications of migration in this conglomeration of forces must be carefully managed by the states involved, as they can lead to socio-economic problems. The countries of origin, through the loss of brains, can slow down the pace of economic growth and technological advancement, but also the natural increase of life and the birth rate will be decreasing. The benefits observed due to migration in the countries of origin mainly refer to the amount of remittances sent by them as external capital flows.

3 Methodology

In order to analyze the problem of migration in Romania, data will be used on the number of emigrants and permanent immigrants, the average monthly nominal earnings and the number of registered unemployed; all these data are collected from the website of the National Institute of Statistics of Romania, as follows:

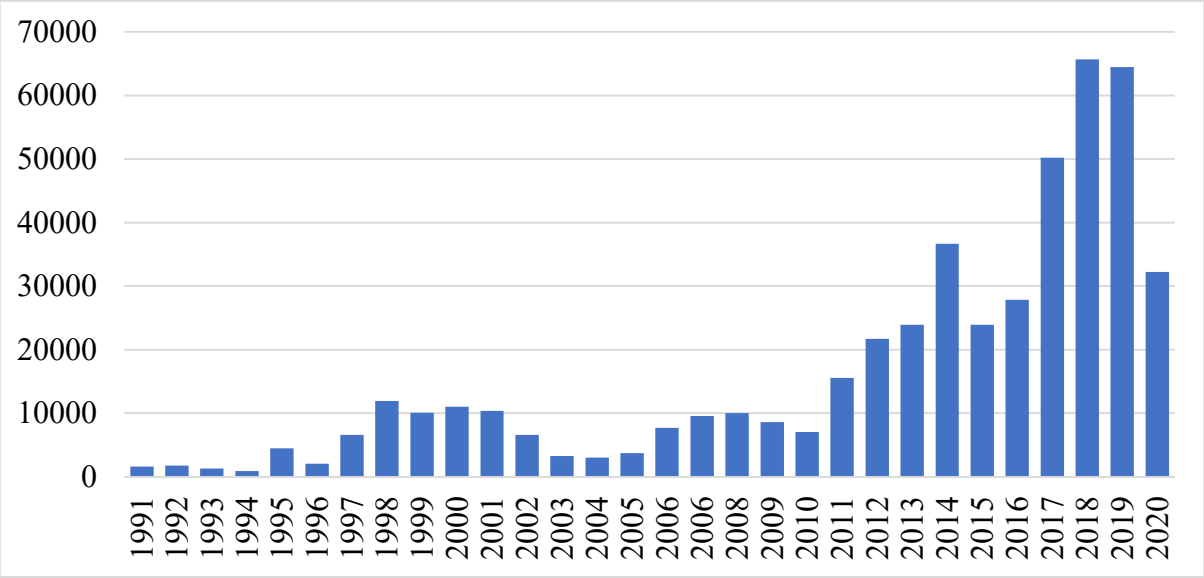
- Permanent immigrants by sex, macro-regions, development regions and counties of arrival, number of persons, 1991-2020;
- Definitive emigrants by sex, macro-regions, development regions and counties of departure, number of persons, 1990-2020;
- Average monthly net nominal earnings per activity of the national economy at the level of CANE Rev.1 section, categories of employees, macro-regions, development regions and counties (1990-2008) and CANE-Rev. 2 (2008-2020);
- Unemployed registered at the end of the month, by categories of unemployed, sex, macro-regions, regions and counties of development, total registered unemployed (compensated and unpaid), number of persons.

The number of unemployed is calculated and taken into account at the end of the year, because the data on the number of migrants and income are also presented annually.

3.1. Definitive immigrants

Are immigrants with change of residence analysed by sex, macro-regions, development regions and counties of arrival areas, according to the definition of the National Institute of Statistics, persons (of Romanian citizenship) who immigrate to Romania. Immigration is the act by which a person renounces his domicile on the territory of another state and establishes his domicile in Romania.

Figure 1. Total number of permanent immigrants



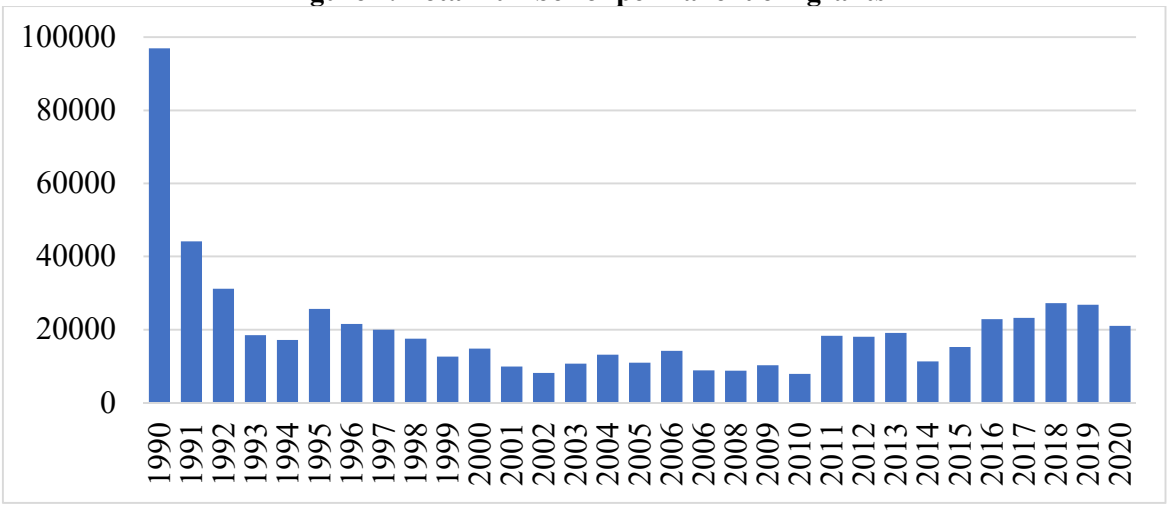
Source: National Institute of Statistics, TempoOnline, table POP310A

At the national level, the total number of permanent immigrants has increased especially after 2011, reaching over 65,000 people in 2018 (Figure 1).

3.2. Definitive emigrants

They are analyzed by sex, macro-regions, development regions and counties of departure represent, according to the INS definition, persons (of Romanian citizenship) who emigrate abroad. Emigration is the act by which a person renounces his domicile in Romania and establishes his domicile on the territory of another state.

Figure 2. Total number of permanent emigrants



Source: National Institute of Statistics, Tempo Online, table POP309A

The number of permanent emigrants reached a maximum (of almost 100 thousand people) in 1990, then, after 1992, it stabilizes at values between 20-30 thousand people per year (Figure 2).

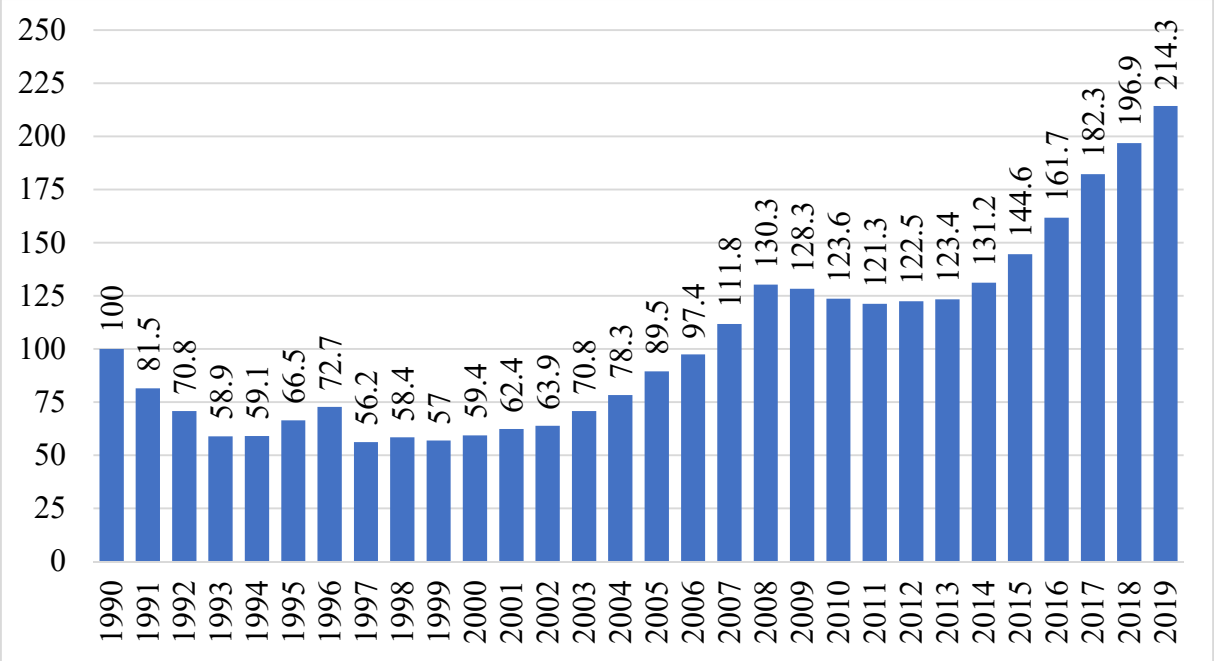
3.3. Average monthly net nominal earnings

It is registered on activities of the national economy at the level of CANE Rev.1 section, categories of employees, macro-regions, development regions and counties, is obtained, according to the INS methodology by subtracting from the gross nominal earnings of: tax, employees' contribution social security contributions, individual state social insurance contributions and employees' contributions to the unemployment insurance

budget. Starting with 2018, the net nominal earnings are obtained by deducting from the gross nominal earnings of: tax, social security contribution due by employees and social health insurance contribution due by employees.

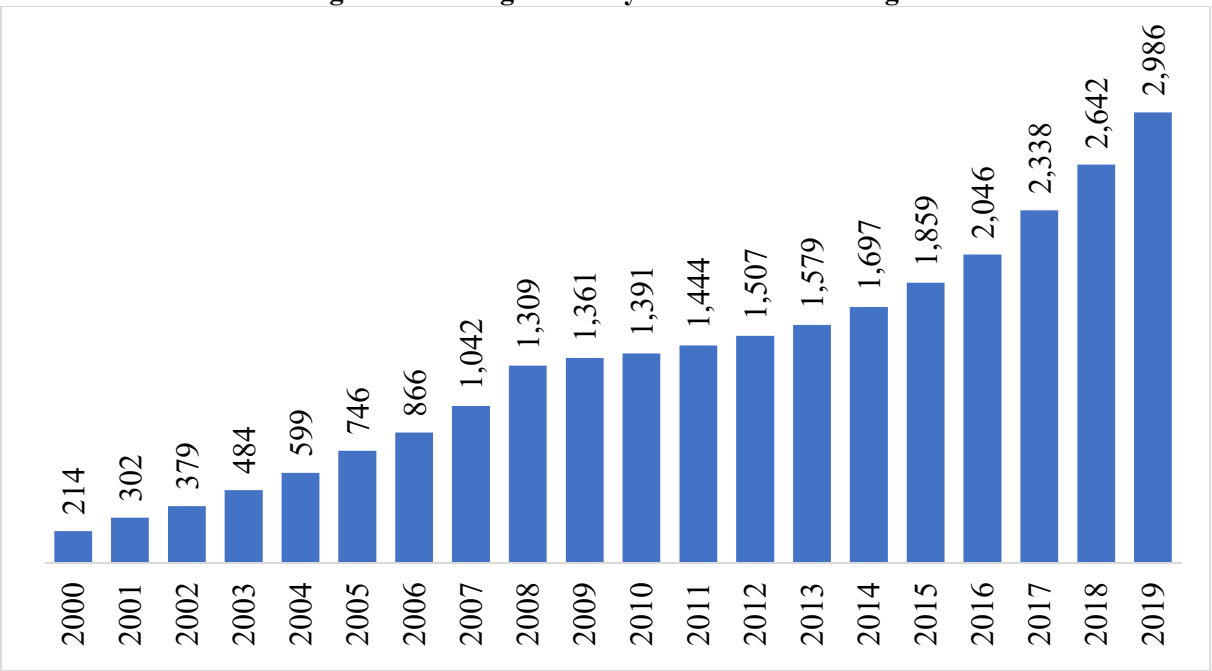
The average net monthly earnings are the ratio between the net amounts paid to employees by economic agents in the reference month, regardless of the period for which they are due, and the average number of employees. The average number of employees is a simple arithmetic average calculated based on the daily staff of employees in that month.

Figure 3. Indices of real earnings,% compared to 1990



Source: National Institute of Statistics, Tempo Online, table FOM110A

Figure 4. Average monthly net nominal earnings



Source: National Institute of Statistics, Tempo Online, tables FOM106A and FOM106E

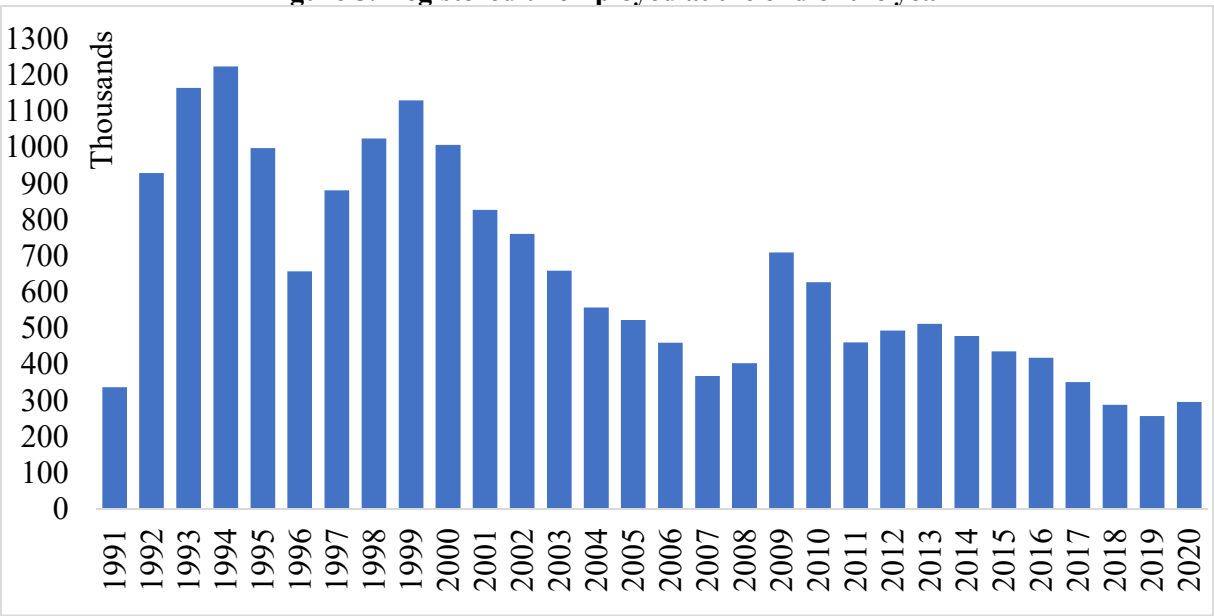
Employees who are not full-time employees are included in the average number in proportion to the working time provided for in the employment contract. Only the persons who have been paid for that month are included in the number of employees taken into account. Not taken into account: employees on unpaid leave, on

strike, posted to work abroad and those whose employment contract / employment relationship has been suspended.

3.4. Registered unemployed

They are by categories of unemployed, sex, macro-regions, development regions and counties refer to the total number of unemployed registered with the National Agency for Employment, according to law no. 76/2002 on unemployment insurance systems and employment stimulation.

Figure 5. Registered unemployed at the end of the year



Source: National Institute of Statistics, Tempo Online, table SOM101B

For the purposes of the new law, the registered unemployed person is the person who cumulatively meets the following conditions:

a) is looking for a job from the age of at least 16 and until the retirement conditions are met;
b) the state of health and the physical and mental capacities make her fit to perform a job;
c) does not have a job, does not earn income or earns from activities authorized by law, income lower than the value of the reference social indicator of unemployment insurance and employment stimulation, in force;
d) is available to start work in the next period if a job is found;
e) is registered with the National Agency for Employment.

They are assimilated to the unemployed and graduates of educational institutions and graduates of special schools for people with disabilities, aged at least 16 years, who, in a period of 60 days after graduation, failed to get a job according to professional training.

4 Conclusion

Migration is the meeting of early times, which accompanied the development of human societies, and its size, shape and intensity, as well as other characteristics being quantified by a multitude of indicators.

Migration, as well as temporary migration, is a definitive response to the evolution of society, economies and the social environment. People have always migrated across borders, making intercultural exchanges and better living conditions.

As disadvantages of migration, we can consider the depopulation of some areas / regions, the uprooting of families and the psychological problems that can affect children left at home.

Migration is a phenomenon specific to the process of globalization. Global migration falls into several categories: low-skilled labor migration, illegal migration, international business travel, human trafficking and smuggling, political asylum and refugee protection, and so on. a.m.d, the most irregular indicator being labor migration.

References:

[2] Anghel, R. G., Istavn H.: Sociology of migration. Romanian theories and case studies, Polirom Publishing House (2009)
[3] Ciocănescu, E. A .: External migration: from the country of origin Romania, to the countries of destination in the European Union area - a brief analysis for the years 1998 - 2009,
[4] Statistical Magazine of Romania, no. 7/2011, (2011), accessed at [http://www.revistadestatistica.ro/wp-content/uploads/2014/02/RRS_7_2011_A6_en.pdf]
[5] Feraru, P. D .: Migration and development: socio-economic aspects and trends, Lumen Publishing House (2011)
[6] International Organization for Migration (IOM): World Migration 2003 - Managing Migration: Challenges and Responses for People on the Move, Geneva (2003)
[7] Jula, D., Jula, N. M.: Econometrics of time series., Mustang Publishing House, Bucharest (2019)
[8] Jula, D., Jula, N. M.: Econometrics, Mustang Publishing House, Bucharest (2019)
[9] National Institute of Statistics: International Migration of Romania (2014)
[10] Newell, C.: Methods and Models in Demography - Belhaven Press, London (1988)
[11] Roman, M., Voicu, C.: Some socio-economic effects of labor migration on the countries of emigration. The case of Romania., Theoretical and applied economics, Volume XVII, Nr. 7 (548), pp. 50-65, Romania (2010)
[12] Roman, M., Zizi G., Roman, M., Popa, A., Ileanu, B. V.: The Romanian emigration. Economic and demographic implications, ASE Publishing House (2012)
[13] Sandu, D., Radu, C., Constantinescu, M., Ciobanu, O.: A country report on romanian migration aboard: stocks and flows after 1989, (2004) study for www.migrationonline.cz
[14] Sandu, D.: Temporary residence abroad. The economic migration of Romanians 1990 - 2006, Polirom Publishing House, Iași (2007)
[15] Stănculescu, M., Stoiciu, V., Alexe, I., Moțoc, L .: The impact of the economic crisis on the migration of the Romanian labor force, Friedrich Ebert Stiftung, Bucharest (2011) accessed at http://www.fes.ro/ media / images / publications / Impactul_crizei.pdf
[16] Stoica, I.: The Temptation of Migration. Necessity and opportunity in a globalized world, Military Publishing House (2011)
[17] Trewartha, G. T.: A Geography of Population: World Pattern, John Wiley & Sons, Inc., New York (1969)
[18] Voineagu, V., Țițan, E., Ghiță, S., Boboc, C., Todose, D.: Statistics. Theoretical bases and applications, Economic Publishing House (2007)
[19] Zelinsky, W.: A Prologue to Population Geography, Prentice Hall, Englewood Cliffs, New Jersey (1966) Author (Year). *Title of the Book*. Publishing House.

The Migration Phenomenon in the Context of Sustainable Development

ANDREEA-OANA ENACHE
PhD, Institute of National Economy
Romanian Academy
enache_oanaa@yahoo.com

Abstract: In the literature, researchers approach the field of migration as a phenomenon that is common and must be viewed and analyzed from a structural point of view, in order to have an overview of it.
A fundamental characteristic of the population is the right to move from one place to another, this being a right implemented and recognized worldwide, since 1948, by the adoption of the Universal Declaration of Human Rights, after the formation of the United Nations in 1945. The fundamental principles of the United Nations are to promote and encourage "respect for human rights and fundamental freedoms, regardless of race, sex, language or religion".

Key-Words: migration, emigrants, immigrants, sustainable development, brain drain, remittances

JEL Classification: F_{20}, F_{22}, F_{24}, Q_{00}, Q_{01}.

1 Introduction

The World Commission on Environment and Development presents in the Brundtland Report of 1987 the concept of sustainable development as "development aimed at meeting the needs of the present, without making changes in the future of future generations, to meet their own needs" .

Directly linked to the concept of sustainable development is both the concept of “needs” (especially focusing on the subsistence needs of the low-income population) and the technological concept, which is the key element in supporting the field of research and development on the environment, which aims to ensure the present and the future (Brundtland Report, 1987).

Therefore, this concept is widely encountered and covers all processes and methods of economic and social development that are based mainly on ensuring the balance between the elements of social, economic and ecological nature and environmental issues.

The concept of sustainable development is enshrined in the Second Earth Summit, held in 1992 in Rio de Janeiro, which led to the knowledge of this term globally, thus expanding its dimensions.

The concept of sustainable development aims to pursue and find a stable theoretical pylon in order to be able to enact decisions in any circumstance, taking into account the relationship between man and the environment, whether we are talking about the natural environment, economic environment or social environment.

Initially, the term sustainable development was used to define the ecological crisis, which was the answer to the great industrial exploitation of natural resources and the continuous change of the environment. At present, sustainable development influences aspects of human quality of life, both economically and socially, as well as the concern of states for justice and equity.

2 Literature review

The definition given by the World Commission on Environment and Development in the Brundtland Report places particular emphasis on environmental conservation and the prudent consumption of non-renewable natural resources (Piore, 1979). These aspects will be strengthened by defining pylons that underlie the achievement of sustainable development goals (Feraru, 2011).

The structure of the concept of sustainable development is based on a three-dimensional approach, based on three pylons:

1. The economic pylon, which has in view the economic growth, stability and encouragement of research and innovation, in order to pass on a sustainable heritage to future generations;

2. The social pylon, which supports the living standards of the population and social progress, both in the field of public health and culture, national heritage and education;
3. The environmental pylon, which supports the conservation, consolidation and protection of natural resources, creating biodiversity and avoiding pollution.

Sustainable development is one of the fundamental objectives of the European Union and aims to continuously improve the means to meet the needs of present and especially future generations, through a direct correlation of the three pylons, economic, social and environmental (Boboc, 2014).

At EU level, this concept becomes a real goal with the entry into force in 1997, when it was added to the Maastricht Treaty. Later, in 4 years, the Sustainable Development Strategy was promulgated in Gotheborg, to which was added the external dimension, a year later, in Barcelona, and later, in 2006, the Sustainable Development Strategy of the European Union was adopted. in the revised form.

Agenda 21 is a United Nations plan of action on sustainable development, launched at the Earth Summit in 2012. The original form of the agenda refers to the issues of the 21st century, revised at subsequent UN conferences. Its overall goal is to achieve sustainable global development, and as a major specific objective of Agenda 21 it is desired that each local government develop its own local agenda 21.

In order for a country to commit to meeting the objectives of the agenda, it is necessary to adopt or improve its behavior in accordance with all 5 fundamental principles underlying the action plan.

Since 2015, the Sustainable Development Goals have been included in the new agenda, marking the 70th anniversary of the founding of the United Nations, 193 world leaders have adopted the 2030 Agenda and the 17 Sustainable Development Goals (SDGs). This is a global program of action that continues the steps taken in the 2021 Agenda, having a universal character. The objectives of this agenda are the informal title of Global Objectives, which sets out an ambitious path for the next 15 years, in order to combat extreme poverty, hunger, eliminate inequality and protect the land by 2030.

The Concept of Sustainable Development Goals (SDGs) was born at the United Nations Conference on Sustainable Development (Rio + 20) in 2012. (Figure 1)

Figure 1. Sustainable Development Goals

Source: Agenda 2030, United Nations

The basic criteria for this concept were set in 1993 by the EU. These criteria are as follows:
- Quality assurance of life;
- Ensuring access to natural resources;
- Sustainable maintenance of the environment.

The strategic management of the term sustainable development takes into account both the design of long-term objectives and the correlation with short- and medium-term objectives, as well as the implementation of a set of criteria adopted effectively at the international level (Zaman, 2007).

3 Methodology

Global assessments show that approximately 270 million international migrants were registered at the time of 2019, 36.3% more than in 2000, ie approximately 98 million people.

The forecasts for the 2000s were much more modest than the statistical data recorded, the size of migratory flows being higher, with a growth rate much higher than anticipated at that time, if we refer to the estimates of the World Migration Report, from 2003, which projected the number of international migrants to about 230 million people in 2050, the growth rate being much lower.

Table 1. International stock of migrants in the total population (both sexes)

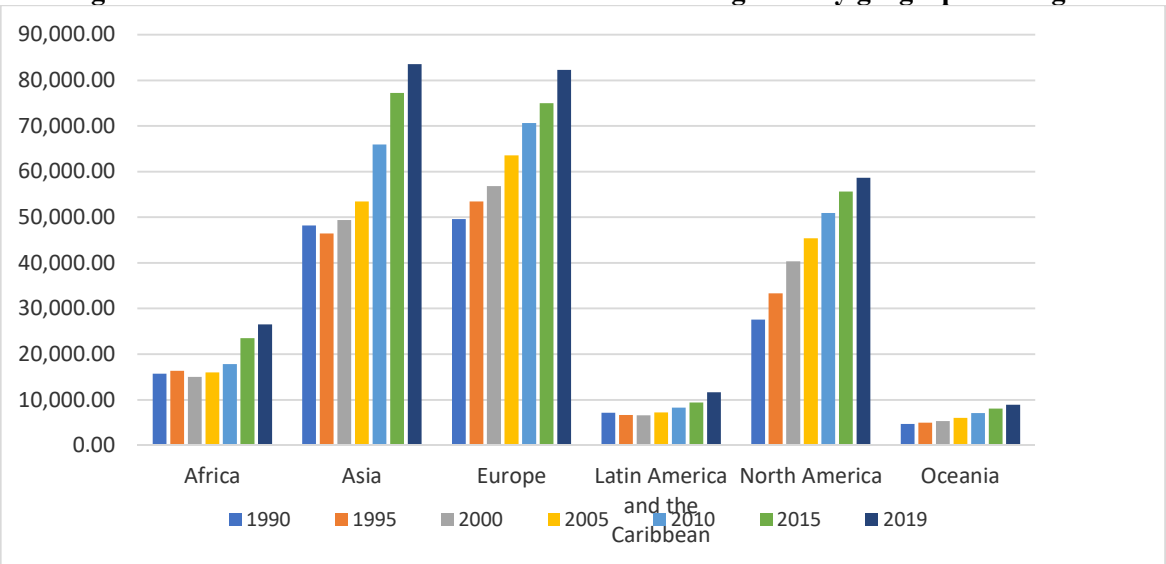
Geographical regions	1990	1995	2000	2005	2010	2015	2019
Africa	15.689,7	16.357,1	15.051,7	15.969,8	17.804,2	23.476,3	26.529,3
Asia	48.209,9	46.418,0	49.394,3	53.439,3	65.938,7	77.231,8	83.559,2
Europe	49.608,2	53.489,8	56.858,8	63.594,8	70.678,0	75.008,2	82.304,5
Latin America and the Caribbean	7.161,4	6.688,7	6.570,7	7.224,9	8.262,4	9.441,7	11.673,3
North America	27.610,4	33.340,9	40.351,7	45.363,3	50.970,9	55.633,4	58.647,8
Oceania	4.731,8	5.022,3	5.361,2	6.023,4	7.127,7	8.069,9	8.927,9

Source: United Nation website, Department of Economic and Social Affairs, Population Dynamics, Workbook: UN_MigrantStockTotal_2019

The World Migration Report's analysis shows that out of a total of about 270 million international migrants, more than half of them are men, with a share of about 52%. Most of these migrants were between the ages of 20 and 64, and most of them were in the under-45 segment.

After the 2000s, migration took another form, in the interest of professional development, which explains the young segment of international migration (Roman, 2012). The mobility of people with higher education, also known as "brain drain", has both positive and negative effects for both countries involved. The countries of origin, which have high migratory flows, are trying to find more leverage to maintain and create new jobs of interest to generations of graduates with higher education and long-term education, which will give them the chance to develop, evolve and prosperous in their own country, without having to study or earn a higher income elsewhere (Vasile, 2012).

Figure 2. Distribution of the international stock of migrants by geographical region



Source: author processing, site data: United Nation, Department of Economic and Social Affairs, Population Dynamics, Workbook: UN_MigrantStockTotal_2019, The data in Table 1

Thus, in the graph above, it can be seen that most of the migrants went to Europe and Asia, where the level of development is high, with a high degree of technology, which allows the absorption of large masses of

specialists. Highly skilled labor is a supporting factor in supporting the inclination of external mobility and the characteristics of the destination countries (Vasile, 2012).

Developed countries create opportunities for development for people with a high professional level, the well-known high level, out of a desire to attract a "brain" to create the economic potential of the destination countries.

The main effect of migration for the country of origin is the loss of a significant proportion of highly skilled labor. On the one hand, the country of origin will no longer be able to benefit from investments in human resources, on the other hand, the emigration of specialists may lead to the development of technological development, economic growth, wages and employment in certain sectors of the work activity (Vasile, 2014).

Another important aspect of the 2030 Agenda is the inclusion and recognition of the migration phenomenon as a dimension of development. Thus, the Global Action Plan covers future issues related to migration, but also refers to its contribution to sustainable development, as well as to the specific uncertainties encountered by migrants. Therefore, the 2030 Agenda becomes a framework for multi-disciplinary and cross-sectoral interest, where the impact of the migration phenomenon can be analyzed in relation to any other issue in the development sector.

At the World Summit for Social Development in 2005, the three pylons underpinning the philosophy and social science of sustainable development were developed. The Brundtland Report described sustainability as "a development that seeks to meet the needs of the present without affecting the needs of future generations", which is also the general definition of the concept of "sustainable development".

Therefore, in order to have a balanced and developed future, the principles of the present concept must be applied correctly and effectively.

The economic pylon is the most difficult and complex issue, because an economically sustainable way must be found that does not affect companies and, by extrapolation, jobs and the ability to integrate into the labor market in the future. Incentives must also be given to companies and organizations in order to become sustainable.

The supply and demand market is essentially consumer-friendly, and the appearance of modern life entails the use of many resources. Economic development is the ability to give consumers everything they want, without causing problems in people's quality of life, in a broad sense.

3.1 Pylons of sustainable development in the context of migration

The economic pylon of sustainable development, to which the social and environmental one is added in a complementary and independent way, has several objectives and priorities.

A first fundamental macroeconomic objective is the permanent increase of the gross domestic product in the country, based on the application of the program, which will determine the achievement of the average GDP per capita standard of the European Union countries in the near future (Zaman, 2007).

The management of the sustainability of the sustainable economic growth in Romania, aims to keep the annual inflation rate at a maximum threshold of 5%, this being the one that will be given the most attention. Inflation is the factor that influences the economic, social and environmental environment, but also the one that brings changes in the degree of uncertainty and risk, especially in the case of natural disasters.

A third important objective of the economic pylon of sustainable development refers to guaranteeing a high level of available employment and reducing the unemployment rate to a maximum of 5%, especially by developing a public-private partnership, which will generate new jobs with high productivity and to support the application of income redistribution mechanisms, avoiding disadvantageous spending on social assistance.

The elaboration of strategic and coordination activities for the economic pylon of sustainable development, at national level, is a concern of the countries that are in different stages of the processes of elaboration, implementation, monitoring and evaluation of the national sustainable development strategy, in response to the recommendations made. at the Earth Summit in Johannesburg.

This is the most difficult and complex issue, as an economically sustainable way must be found that does not affect business and by extension, jobs and employability in the future. Incentives must also be given to businesses and organizations to make them sustainable.

The social pylon has many facets, but the most important are the awareness and legislation that detects the protection of public health against pollution and other harmful factors created by companies. Developed countries have created strong controls, with strict legislation to ensure human health. These measures are intended to maintain access to basic resources without compromising the quality of life of the population.

The primary element of the social pylon is education. Encouraging the population to participate in the creation of ecological solutions and training them on the effects of environmental protection, but also warning about the vulnerabilities of the environment.

The second most important element, tangent to the economic pylon, is related to actions designed to encourage technological advancement through advanced techniques in research and development, but protecting the environment.

The environmental pylon is about protecting the natural environment, through advanced recycling techniques, reducing the consumption of carbon dioxide and energy, by reducing electronic devices, by reducing water consumption, and so on. Corporations must comply with sustainable regulations imposed by the state in order to prevent pollution and combat emissions in the evening. The introduction of incentives for the installation of renewable energy sources, both for individuals and legal entities, as well as the creation of sustainable sustainable development, this pylon being essentially the main concern of the future of mankind.

3.2 The link between the migration phenomenon and the concept of sustainable development

The 2030 Agenda broadly examines the link between the phenomenon of migration and the concept of sustainable development, so that a number of interdependencies are highlighted, namely:

a) In order to achieve the goals of sustainable development, migration must contribute to their achievement, as it is a powerful tool for reducing and combating poverty, so that migrants in the host countries can cover the labor force needs, contributing to the country's budget by paying taxes. afferent; Emigrants can also increase their level of wealth for themselves and their families left in their home countries, as well as their professional status. Unfortunately, for those with a low level of training, the possibility of being illegally exploited in various sectors is a big one. For this reason, Agenda 2030 provides for the implementation of a plan for the identification, analysis and improvement of jobs in sectors with a possible background (agriculture, construction, transport), by promoting sustained, inclusive and sustainable growth, full and productive employment and employment. decent for everyone.

b) International migrants support the distribution of services, both as workers and as consumers; In relation to the educational access and development and vocational training of the emigrant and / or his family, if necessary, they help to meet the characteristics of the labor market, increase the contribution and consumption on the local market and increase the remittances sent to the country of origin. A percentage of health services are supported by the migrant sector, through their contributions as legal workers. At the same time, there may be negative effects of the migration phenomenon in relation to the national service system, when it comes to an unexpected, large-scale exodus. The education and sanitation systems can be disrupted by refugees, they can create tensions in the host community, and they can also extend as pressure on utilities, water and sanitation, for example.

c) Domestic or international migration, in response to the supply of large cities that are in a continuous technological rise; In the 21st century, technological developments are leading to rapid urbanization in emerging countries, which attracts migrants. The "pull factors" theory is the one that underlies the decision to migrate, by creating job opportunities, better living conditions, educational development, personal security and access to medical services. When urban migration is well managed, there are positive effects on economic and social dynamics, leading to an increase in the capacity of urban migrants to cope with the shocks and pressures encountered.

d) Poor visibility of the quantification, determination and analysis of the structure of migratory flows limits the understanding of their needs and reduces the responsibility of governments; The 2030 Agenda proposes two specific objectives to support the development of efficient, accountable and transparent institutions that migrants can turn to. The aim is to rapidly improve databases on the number of migrants, in all developing countries, less developed countries or island states, in order to have access to databases disaggregated into several categories, such as demographics (age, gender, ethnicity, race), depending on income, migratory status, or geographical location of origin. Following these data, it will be possible to implement concrete policies and programs to support migratory flows.

4 Conclusion

All these approaches show that migration is an essential mechanism in achieving the objectives of sustainable development, this being a multidimensional phenomenon, regardless of whether we are referring to domestic or international migration. Their mobility is often voluntary, and through the application of global

support policies, migration will be encouraged and supported in order for the two parties involved to work together.

References:

[20] Feraru, P. D .: Migration and development: socio-economic aspects and trends, Lumen Publishing House (2011)
[21] International Organization for Migration (IOM): World Migration 2003 - Managing Migration: Challenges and Responses for People on the Move, Geneva (2003)
[22] Boboc, Cristina., Vasile, Valentina., Ghiță, Simona., Covrig, Mihaela., „Romanian Labour Migration: Employees Perspective", Procedia Economics and Finance 10 (2014) 244 – 248
[23] Roman, M., Zizi G., Roman, M., Popa, A., Ileanu, B. V.: The Romanian emigration. Economic and demographic implications, ASE Publishing House (2012)
[24] Piore, M. J., (1979), Birds of passage: migrant labor and industrial societies, Cambridge, Cambridge University Press
[25] Stănculescu, M., Stoiciu, V., Alexe, I., Moțoc, L .: The impact of the economic crisis on the migration of the Romanian labor force, Friedrich Ebert Stiftung, Bucharest (2011) accessed at http://www.fes.ro/ media / images / publications / Impactul_crizei.pdf
[26] Vasile, Valentina, „Crisis impact on employment and mobility model of the Romanian university graduates", Procedia Economics and Finance 3 (2012), pp. 315 – 324
[27] Vasile, Valentina, „Labour mobility impact on sending countries. Romanian EU workers case study", Procedia Economics and Finance 8 (2014) 737 – 746
[28] Voineagu, V., Țițan, E., Ghiță, S., Boboc, C., Todose, D.: Statistics. Theoretical bases and applications, Economic Publishing House (2007)
[29] Zaman, Gh., Gherasim Z., 2007. *Criterii şi principii ale dezvoltării durabile din punctul de vedere al resurselor acesteia*, pag. 139-140
[30] Brundtland Report, http://www.un-documents.net/our-common-future.pdf , pag. 5-6
[31] Earth Summit: Agenda 21, https://sustainabledevelopment.un.org/outcomedocuments/agenda21, pag. 9-11
[32] Ministry of Foreign Affairs, https://www.mae.ro/node/35919
[33] National Institute of Statistics: International Migration of Romania (2014)
[34] United Nations (UN), Fundamental principles of the organization.