COVID-19'S IMPACT ON THE NUTS2 ECONOMIES IN ROMANIA

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Abstract

The paper takes into consideration the impact of the Covid-19 pandemic and of the economic crisis on the NUTS2 public administrations in Romania. The authors propose a new econometric model able to offer concrete solution to the decision makers in order to realize the economic restart. The analysis covers all 8 NUTS2 regions and Romania and is based on statistical data during 2008-2020. These data were transposed on a matrix, obtaining trend curves of the financial performance dynamics (reflected by the obtained turnover) of the entities from the primary, secondary and tertiary sector, according to the CAEN code. The trend curves were analysed segmented by regions in order to obtain the economic evolution of each region. The main conclusion of the paper is that there is a powerful connection between the moment of the economic restarting and the dimension of the socio-economic costs in each NUTS2 region.

1. Introduction

The present study aims at a review of the economic activity in Romania from a regional perspective, considering the onset of the Covid-19 pandemic and subsequently entering a preceding stage of the economic crisis.

The analysis is based on the dynamics of the evolution of the pandemic in Romania, on the measures adopted by the authorities regarding the limitation of the disease spread at regional level and on the obtained effects by applying them, on the one hand, and on the dynamics of economic evolution during 2008-2019, the period that includes, from the financial indicators of the Romanian enterprises point of view, their financial achievements during the previous economic crisis, on the other hand.

Starting with February 2020, Romania was deeply affected by the Covid-19 pandemic, which resulted in a significant number of sick people (over 10,000), a significant number of deaths and a blocked economic activity following the declaration of a state of emergency and application of social distance measures.

Thus, we can appreciate that the exerted pressure on the regional budgets, already weakened by the political crisis at the end of 2019, generated a major currency deficit, a deficit that includes several components:

- The first component is related to the expenditures made by the regional and local authorities as a result of the ordered measures during the state of emergency, as social measures (population surveillance), health measures (ensuring the conditions for increasing the capacity of health units in the fight against the new virus) and of economic nature (ensuring payments for persons temporarily in technical unemployment), as well as carrying out economic support actions specific to the state of emergency (ensuring the fluency of air and road traffic, etc.).

- The second component concerns VAT refunds made during the economic crisis under more favourable conditions than usual and without fiscal control, an aspect that led to an increase in refunds more than double compared to the similar period of 2019. Moreover, these economic measures were accentuated by the decrease of the receipts from taxes and duties, as a result of the economic setback.

- The third component concerned the expenses with the regional and local administration, which was faced with an unprecedented situation, in the sense of the obligation to make unforeseen expenses in the fight to reduce the effects of the pandemic (providing sanitary materials for the population transiting public spaces, providing security and protection with the respect for social distance measures and ensuring the functionality of the administrative apparatus under the online conditions).

This previously highlighted picture requires the reanalysis of economic management in Romania, which registered a performance assimilated to a developing economy, at the end of 2019. After only a quarter of 2020, this performance turned into non-performance, the Romanian economy preparing for a stronger recession than in 2008.

The authors of this paper will analyse and propose a regional model of economic damage, a model that will be based on the pandemic component dynamics and on the economic recovery cycles subsequent to 2008.
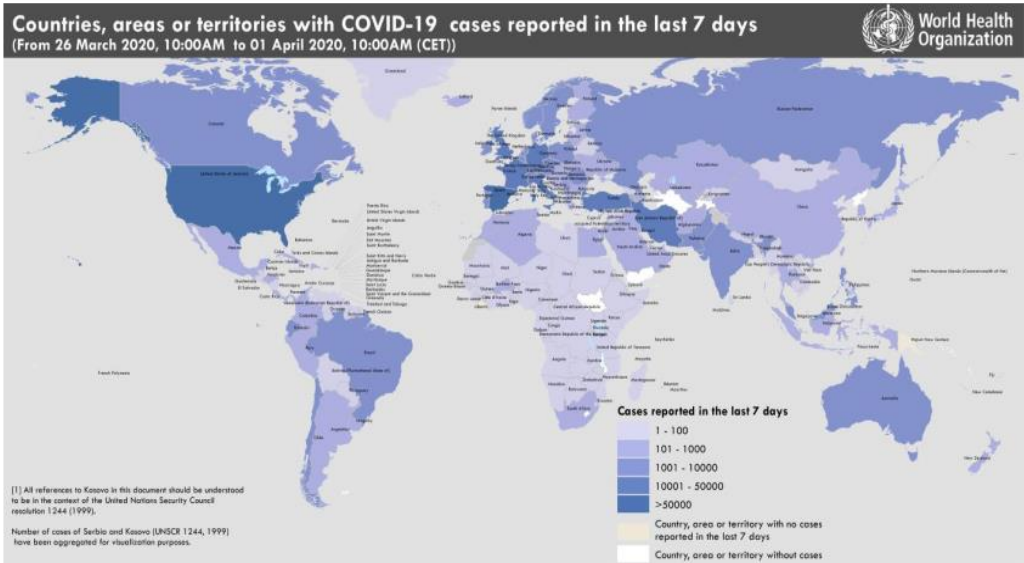
2. Literature review

Given the scale of the phenomenon, there is an intense concern among the academic community regarding the analysis of the effects of the Covid-19 pandemic and the induced economic crisis. As a result, over 20,000 articles were published on this topic only in 2020.
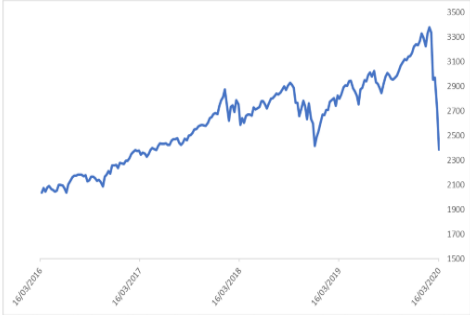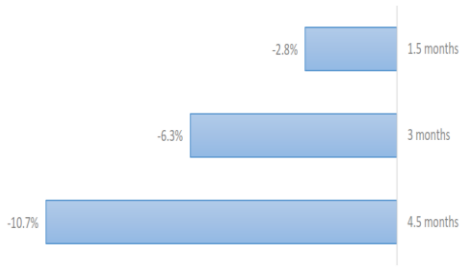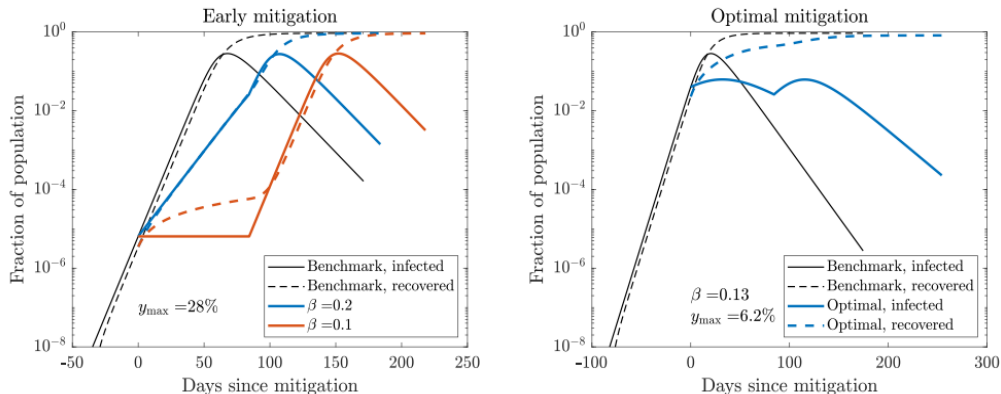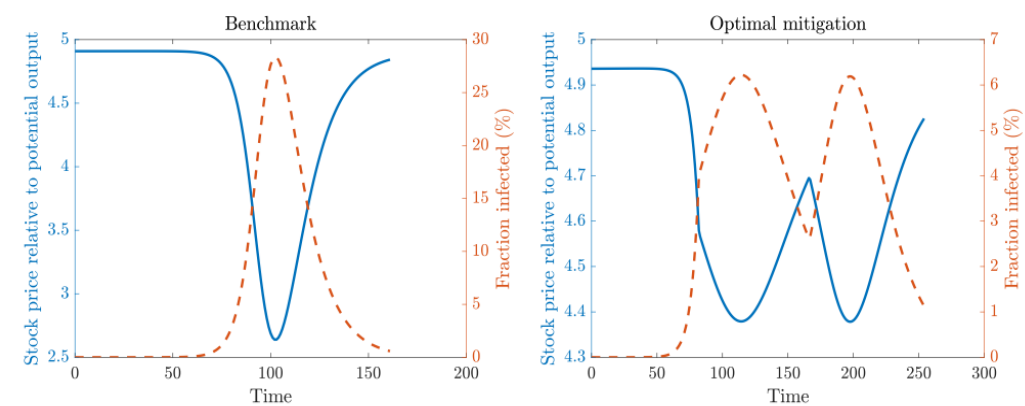
Most authors have studied the Covid-19 pandemic in terms of direct effects on population health and measures to minimize its spread. However, experts in economics and sustainable development have highlighted through classical and modern theories of economic growth the impact of the pandemic on national and / or regional economies, highlighting in some cases a relationship with the Markov chains of the spread of the economic recession induced by the pandemic. In other cases, forecasting or scenario-based methods have been applied to monitor the effects of shock waves on the regional or global economy.

A synthesis of some representative works in the field is presented in a critical way in the Table 1.

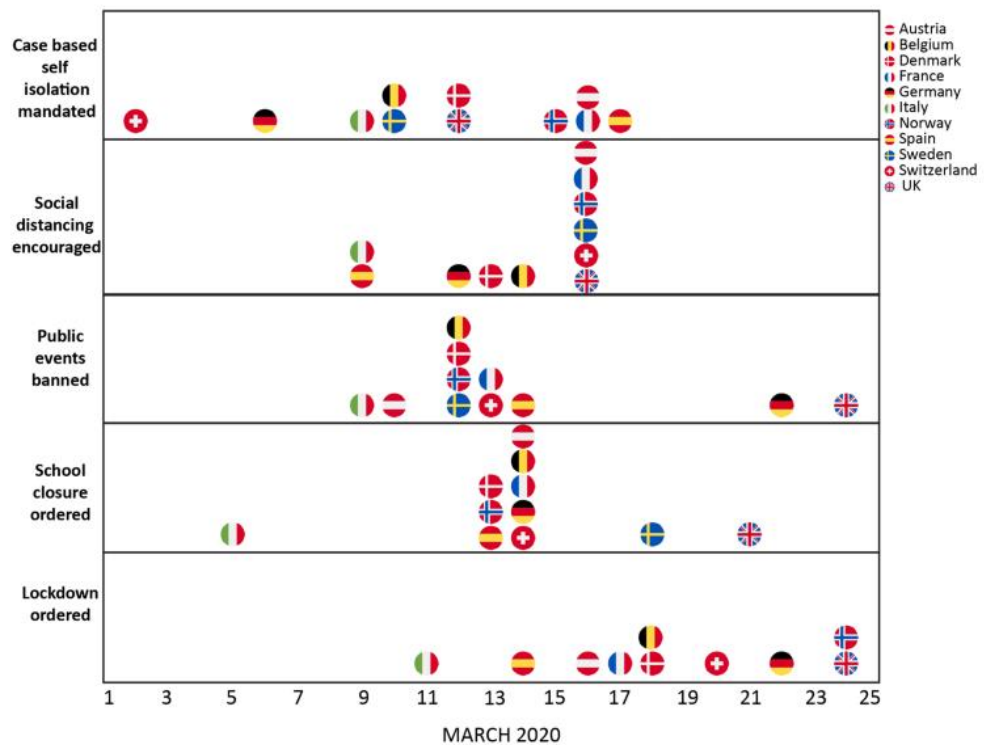**Table 1.** Literature review

#	Authors	Model's characteristics	Authors' criticism
1.	Atkeson (2020)	The author analyses the parallelism between the Covid-19 pandemic and the economic crisis, realising econometric models for correlating phenomena and practically using the classical theory of economic cycles based on the Markov chains (see Figure 1 below).	Proposing several scenarios and models of economic evolution, the author dilutes the implementable practical effect of the study. However, the study is current, relevant and interesting in terms of approach.
		Figure 1. Cumulative Cases as a fraction of the population over 18 months under different values of $R_t=R_0$ held constant over the entire 18-month time period 	
2.	WHO (2020)	The organization's official report presents the global impact of the pandemic and recommends several public health measures that can be adopted to limit the spread of the pandemic.	From a statistical point of view, this communication has a more informative role in raising awareness of the need to adopt

#	Authors	Model's characteristics	Authors' criticism
			social distance measures in order to interrupt the pandemic chain. Moreover, the resilience and the social support are propagated for providing food to isolated or quarantined persons, with the mention that these measures have already been adopted by Romania during the state of emergency.
		Figure 2. Countries, areas and territories with Covid-19 cases reported in the last 7 days (from 26 March 2020, 10:00 AM to 01 April 2020, 10:00 AM (CET)).	
3.	Fernandes (2020)	The author analyses the economic effects of the Covid-19 pandemic on the global economy in a stratified way, starting from the relevant history regarding the major pandemics of the last century (global influence 2018, Ebola 2013-2016) and indicating the aspects preceding the global recession which , in the author's opinion, is inevitable. The structure of the study includes the study of capital markets and economic doping that generate increases in stock volatility. Subsequently, the author develops models based on the method of scenarios on the economic impact of the Covid-19 pandemic, which can negatively affect global GDP by up to 15%.	The author analyses the economic impact focused on a very short period of time (maximum 6 months), which significantly diminishes the scientific correctness of the conclusions (see the figures below).
		Figure 3. S&P 500 performance over the last 4 years	**Figure 4.** Estimated GDP growth in 2020 under the different scenarios (Median)

#	Authors	Model's characteristics	Authors' criticism
4.	Toda (2020)	The author develops his own epidemic model (SIR) designed to assess the dynamics of diseases and cures among the population affected by the pandemic and its economic impact. Moreover, the author proposes measures to limit the spread of the pandemic, measures that in the optimal version should flatten the trend curves to a pandemic point closer to the beginning of 2020 if these measures had been adopted non-uniformly (see Figures 5 and 6).	The author realistically captures the economic aspects subsequent to the pandemic crisis and promotes a model whose applicability is limited from a spatial point of view to case studies and not to a global / approach solution.

Figure 5. Dynamics of epidemic with mitigation measures

Figure 6. Asset prices during epidemic

5.	Flaxman *et al.* (2020)	The authors conduct a study on the main measures and impact of non-pharma interventions on limiting the spread of the	The non-pharma measures are analysed in a timed way, among which the social distance, the economic stoppage in the

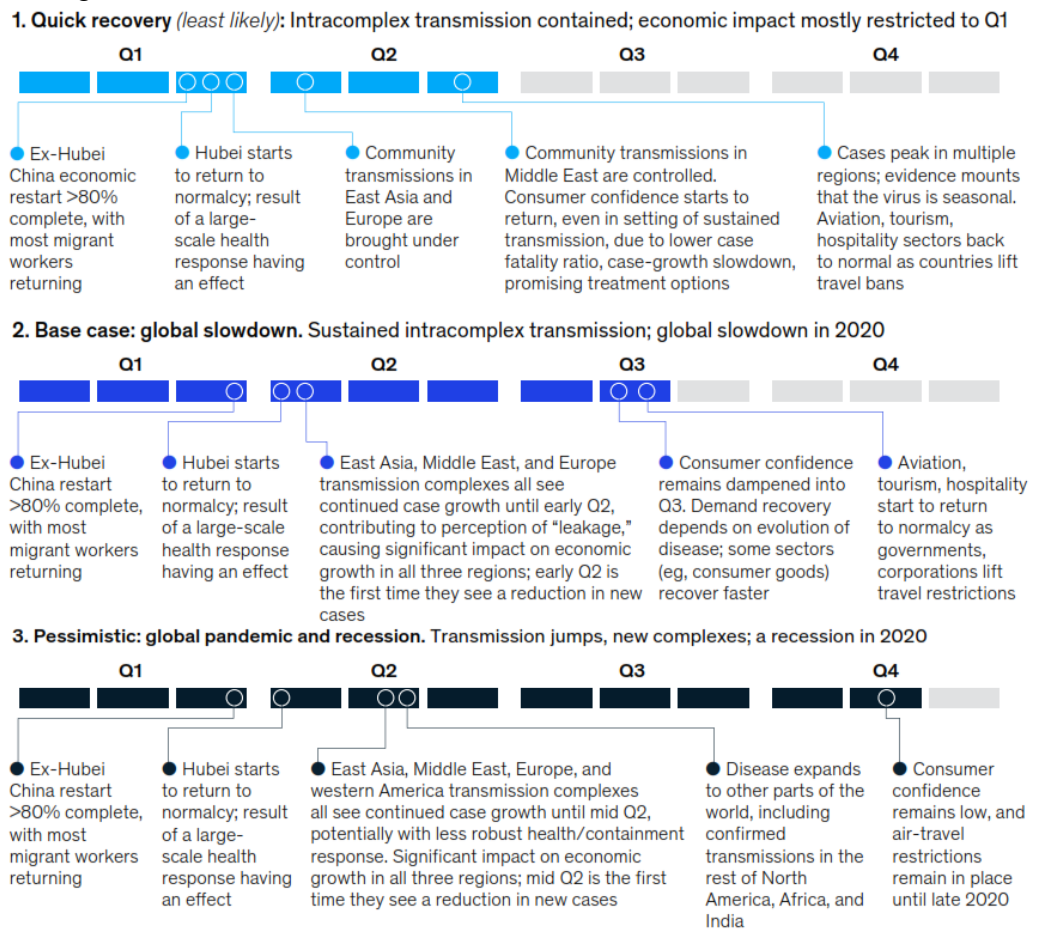| #	Authors	Model's characteristics	Authors' criticism
		pandemic in 11 European countries, of which 8 are Member States.	secondary and tertiary sectors, the stoppage of the educational process by traditional means, etc. The effects of the study are vaguely disseminated by limiting to the common casuistry of the 11 European developed economies, without analysing the effects on the developing economies, as well.

Figure 7. Intervention timings for the 11 European countries included in the analysis

| 6. | Craven, Mysore, and Wilson (2020) | The authors analyse the implications of the pandemic on the business environment. They use the scenario method according to which there are 3 economic possibilities of recovery. One of these is optimistic, according to which the business environment will have the possibility to return to normal activity after Q2 2020. The second scenario is one of crisis maintained until Q3 2020 and is based on slowdown due to restrictive measures put in place to spread the virus and reduce the slope of consumption. The third scenario refers to Q4 2020 and provides global spread of the | The authors establish a limited number (7) of immediate action measures for economic agents, measures that, in our opinion, do not cover all significant aspects of economic activity. There are vulnerabilities which are not analysed in the study. |

#	Authors	Model's characteristics	Authors' criticism
		pandemic and the global recession, with the limitation of the global transfer of goods and people and the application of severe measures to limit the spread of the virus through economic doping and strict social distancing.	
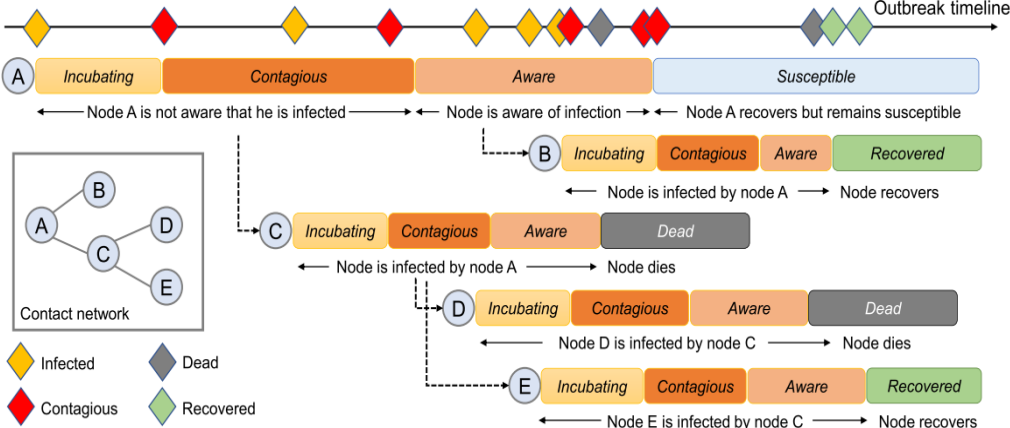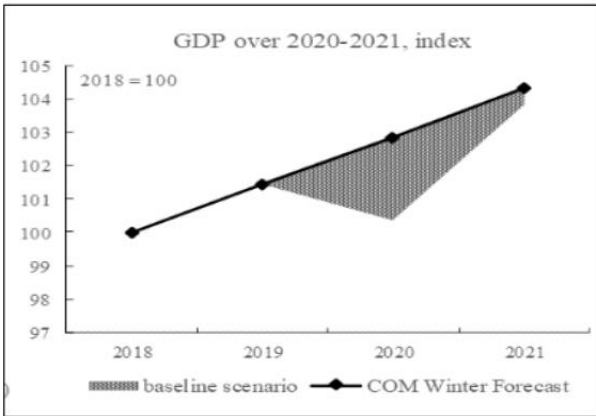
Figure 8. Scenarios to be considered by businesses as part of their contingency planning

| 7. | Gentilini, Almenfi, and Orton (2020) | In early April 2020, 106 countries around the world adopted social protection measures and job programs as a result of the Covid-19 pandemic. The number of states is increasing by 26% per week while the total number of social protection programs has increased over the same period from 283-418 (241 for social assistance, | The article demonstrates in detail the social measures adopted by each country, specifying the unit amount of the provided assistance. For Romania, it reaches 5163 lei average taxable value for social |

#	Authors	Model's characteristics	Authors' criticism
		116 for social insurance and 61 labour market specific measures).	assistance and the corresponding share for social insurance from the 5163 lei / person. Moreover, for the labour market are nominated the online steps taken by the authorities, especially online continuing education courses with unemployed or technical unemployed people who have the digital infrastructure for these courses. The study is current, well based on the reference segment and is a benchmark in estimating the social impact of the pandemic in terms of social protection measures adopted by the global economy, being individualized for each state.

Figure 9. Countries with planned or ongoing social protection responses to Covid-19 (as of April 3, 2020)

#	Authors	Model's characteristics	Authors' criticism
8.	Topir-ceanu, Udrescu, and Marcu-lescu (2020)	The authors develop a model for evaluating the centralized and the decentralized isolation strategies and their impact on the dynamics of the Covid-19 pandemic.	The authors present the modal nodes of the randomized isolation model in the descriptive variant, obtaining statistically relevant results for the proposed SICARS model. The model covers only two aspects of the set of measures taken to limit the effects of the

#	Authors	Model's characteristics	Authors' criticism
			pandemic, which is an obvious limitation of its applicability.

Figure 10. Example of an outbreak process according to the SICARS model, when used over a hypothetical contact network with five nodes (A-E), starting with infected node A.

#	Authors	Model's characteristics	Authors' criticism
9.	Câm-peanu (2020)	The author's analysis focuses on the restrictions, losses and economic incentives granted to limit the effects of the pandemic. The author estimates that the economic developments across Europe on the pandemic incidence are pessimistic, in the sense of reducing economic growth and relaunching the economy starting with 2021. The author proposes coordination measures (economic-administrative, economic-financial and economic-social) for adapting to the economic crisis.	The study has a medium impact, considering a conjunctural situation, without building an economic stabilization strategy or proposing viable economic alternatives.

Figure 11. The estimated impact of COVID-19 pandemic on the EU economy: GDP forecast 2020-2021.

Following the literature review, we found the diversity of the approaches to the research topic in this paper. In the view of these approaches, we consider appropriate the research topic, namely the statistical evaluation of the pandemic impact on the regional economies in Romania.

3. Method

The authors of this scientific approach have centralized the NUTS2 statistical data on financial performance on the national economy activities in dynamics during 2008-2019 (INS Tempo On-line, 2020). These data were transposed on a matrix, obtaining trend curves of the financial performance dynamics (reflected by the obtained turnover) of the entities from the primary, secondary and tertiary sector, according to the NACE code. The trend curves were analysed segmented by regions in order to obtain the economic evolution of each region.

3.1. A spatial analysis of the Covid-19 cases in Romania

Another stage in this scientific approach was the dynamic analysis of the spread of the Covid-19 pandemic in Romania at the regional level, data that were centralized by Wikipedia (2020).

The centralized data reflect the fact that the Covid-19 pandemic, still on the un-stabilized curve in Romania, has mainly affected regions whose social customs propagate social proximity and where crowds are predominant (see Figure 12).

The values of the economic efficiency matrix split by NUTS2 regions and by CAEN activities were adjusted for the 4 quarters of 2020, with determined coefficients based on the analysis of the economic impact of the pandemic and the onset of the economic crisis. The 2-4 quarters of 2020 subjected to the phenomenon of economic restart were weighted with timed economic growth coefficients depending on the impact of the measures to support the economic recovery which was estimated by the authors.
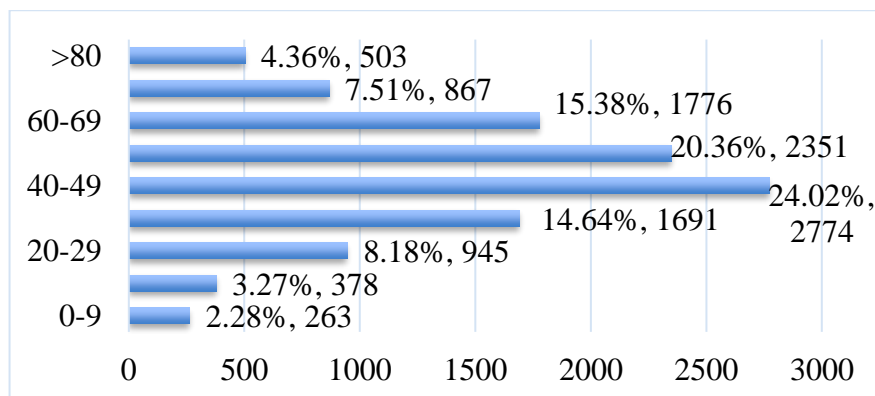
Figure 12. Spatial distribution of people infected with Covid-19 (persons)
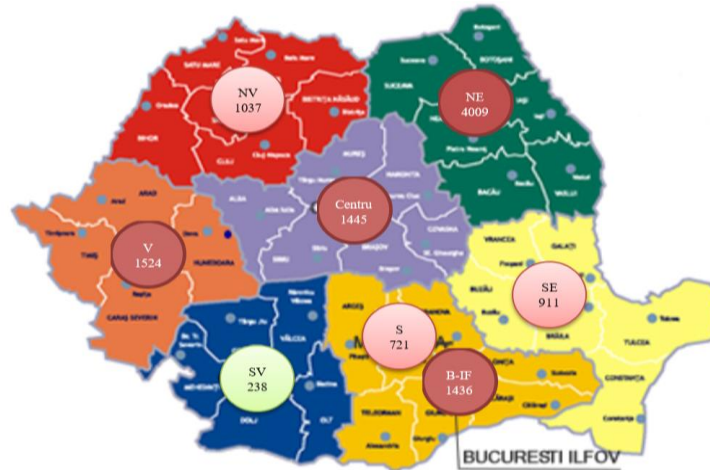
From the social point of view, the age levels of the mainly affected people (over 50% of the total number of people) are 40-49 years, respectively 50-59 years (see Figure 13). Unfortunately, there are no official regional statistics on the diseases distribution by age groups. This statistic would have been useful for the research in order to perform differentiated regional modelling, the authors being forced to limit themselves to the national statistics.

Figure 13. The structure of the infected population by Covid-19 in Romania

These age groups are more exposed to economic risk, especially unemployment, and are not favoured by pension legislation.

3.2. Economic impact

The economic component identified in the Introduction as part of the action plan to limit the effects of the Covid-19 pandemic is based on the measures to mitigate the financial crisis, including the social protection measures during the pandemic and after the end of the state of emergency. The impact of the economic component consists in the weakening of the budgetary balance, the increase

of the deficit target and the entry into economic recession. These include the economic stoppage of the activity of the secondary and tertiary sectors due to the pandemic and partially after the end of the state of emergency. The authors estimated, based on their own forecast economic calculation, the vulnerability coefficients. The table of the weighting coefficients of the economic efficiency matrix for 2020 with quarterly series is presented in Figure 14. The results obtained are based on a report of the Romanian National Institute of Statistics (INS, 2020).

The regressive vulnerability coefficients covering the average quarterly vulnerability range of 30% for 2020 were estimated, assessed on the basis of the assumptions in the INS Report on the probable economic recession for companies by 2020, forecast by managers by up to 25% (20% of respondents), 50% (33% of respondents) or more (47% of respondents).

Figure 14. Covid-19's impact on Romanian economy (Q1-Q4 2020)
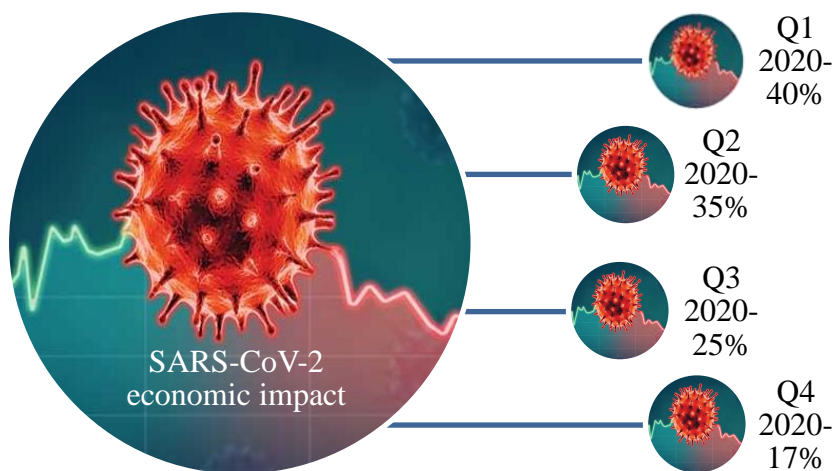
Source: Authors' contribution using INS (2020)

According to the centralized data of the Romanian National Institute of Statistics available on-line (INS Tempo On-line, 2020) the economic structure of the activity in Romania (by NACE code) reflects that on the first positions are ranked the activities from wholesale and retail (41% of the total turnover achieved in Romania in 2019) and from the processing industry (27%). These industries are mainly destined to slightly qualified or unskilled labour, but with good physical condition and health (especially young people). As a result, the segment of the population aged between 40-60 years involves a double discovery regarding the social protection, both through the component of risk of illness, and through the reduced capacity of insertion on the labour market.

This phenomenon overlaps with the current "layoffs" due to the temporary closure during the state of emergency of the activity of economic agents in the secondary and tertiary sectors, estimating

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for the next period (after the cessation of the state of emergency) a difficult reabsorption of this socio-economic category surplus labour supply, including in the European context (Romania is facing to the phenomenon of reverse migration).

3.3. Economic restart

Another factor not to be neglected in the balance of the economic restart is the super-digitalization of the economy imposed by the spread of the pandemic on the globe. In this case, people between 40-60 years have a disadvantage compared to younger people, in the sense of acquiring the digital and linguistic skills necessary to adapt to the digital economy.

All these above presented aspects lead to the definition of the following *research objectives*:
O1: To demonstrate that there is a direct proportional relationship between the economic recovery curve from 2009-2012 and that of the economic restart started in 2020 (after Q1).
O2: To demonstrate that the regional segmentation of the economic recovery is in direct dependence with the territorial distribution of the Covid-19 pandemic, but also with the structure of the regional economy.
O3: To demonstrate that the economic restart trend is directly influenced by the socio-economic evolution of the disadvantaged population segment, respectively people aged 40-60 years.

According to the set objectives, the following *working hypotheses* are established:
H1: The distance between the slope of the linear trend curve related to the economic recovery and the slope of the economic restart after the state of emergency due to Covid-19 pandemic is minimal if the period of the state of emergency is minimal.
H2: The territorial distribution of the pandemic influences the economic regression of the agents in the territory and it is even greater as the structure of the regional economy is more oriented towards the secondary sector of the economy.
H3: The deeper the economic crisis, the greater the pressure on the regional budget, by activating social measures related to the social protection of people aged 40-60 years.

In order to demonstrate the working hypotheses, a statistical model based on the ARIMA method under SPSS25 software was developed, with the following mathematically defined characteristics. The plot includes observed values of the dependent series and the predicted values regional turnover for the forecast period, under a confidence interval level = 95% and maximum lags 24.

/SERIESPLOT OBSERVED FORECAST

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The dependent variables of the model are the following:

- NVRT – NV regional turnover (see Figure 12)

- CentruRT – Centru regional turnover

- NERT – NE regional turnover

- SERT - SE regional turnover

- SRT – S regional turnover

- BIFRT – Bucuresti-Ilfov regional turnover

- SVRT – SV regional turnover

- VRT – V regional turnover.

The independent variable (regressors) of the model are presented in Figure 15.

Figure 15. ARIMA model's regressors
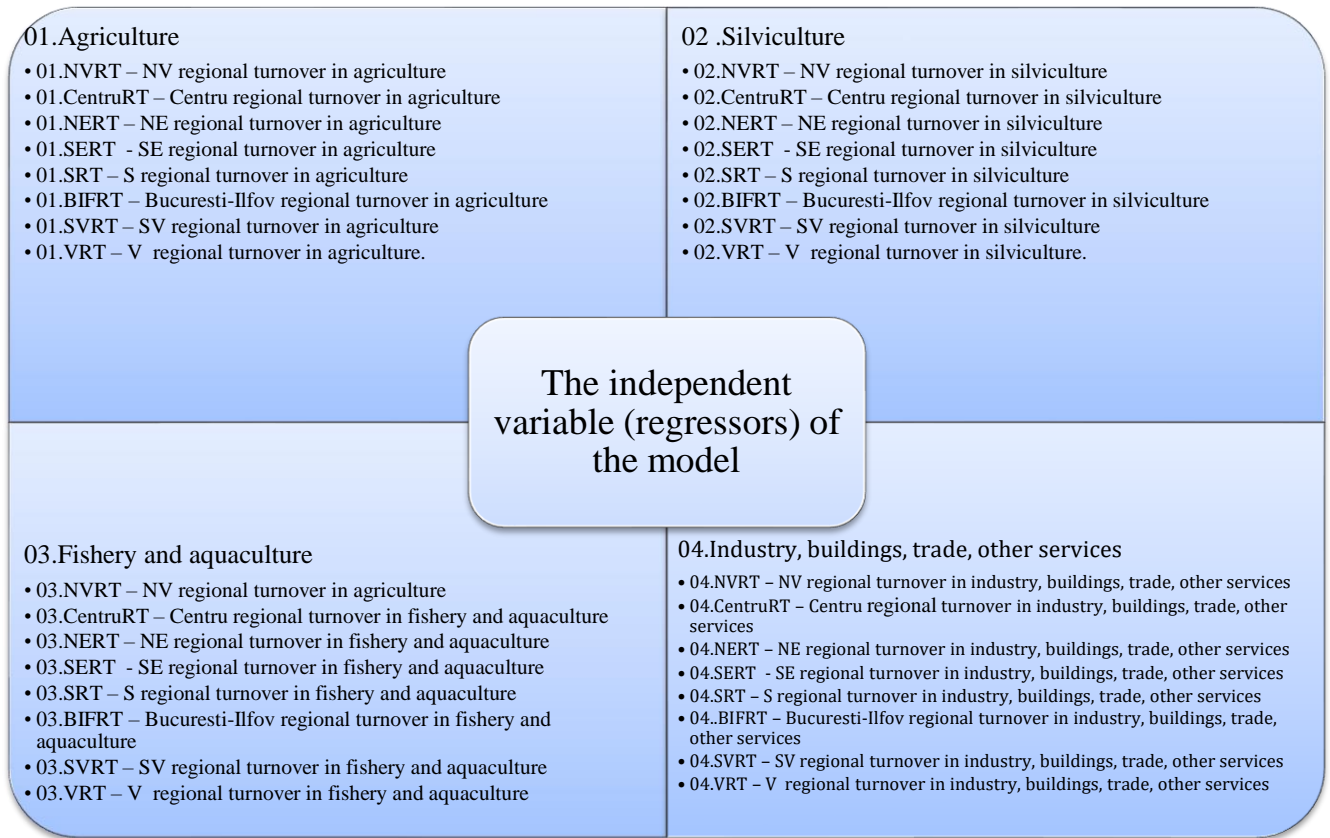
The mathematical expression of the model is:

$$\widehat{NT} = \frac{\sum_{t-k=1}^{12} \left(\alpha_i NTRT_t - \overline{NTRT}\right)\left(\alpha_i NTRT_{t-k} - \overline{NTRT}\right)\big/ 12-k}{\sum_{t-k=1}^{12} \left(\alpha_i NTRT_t - \overline{NTRT}\right)^2 \big/ 12}, \tag{1}$$

where: $\widehat{NT}$- macro-level correlated turnover according to the regional component; α_i- coefficient of regionality, iϵ [1,8]; $NTRT$ - national turnover segmented by sectors $\alpha, \alpha\epsilon$ [1,4], for region i ; t –

forecast horizon; t-k – the period for which the data were collected; $\overline{NTRT}$ – the average modal value for the variation range of the regional turnover segmented by activity sectors.

For the model with the above parameters, the frequency series becomes the following:

$$NT_t = a_0 + a_1 NT_{t-1} + a_2 NT_{t-2} + \cdots + \varepsilon_t, \tag{2}$$

where: a_i – regression coefficients for the analysed plus the predicted time horizon; ε - residual value.

The collected data regarding the regional dynamics of the financial performance of the Romanian economic entities during 2008-2020 (INS Tempo On-line, 2020) were transposed into an econometric model using the ARIMA method (TSMODEL), a model whose statistical representativeness is over 90%. The model revealed, for the regressive variables, the regional performance of the economic entities in relation to the national performance, in the form of valid statistical tests whose correlation values are representative for the analysed sample, segmented on the 3 sectors of activity in Romania. These data are presented in Table 2.

Table 2. ARIMA Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum
Stationary R-squared	.015	.073	-.018	.196
R-squared	.906	.064	.761	.963
RMSE	10808.539	8358.245	5778.714	30803.186
MAPE	5.125	1.092	3.856	6.629
MaxAPE	17.737	3.735	10.337	23.683
MAE	7849.501	6514.516	4053.615	23295.211
MaxAE	21594.439	13455.524	12652.993	53244.551
Normalized BIC	18.441	1.110	17.521	20.868

**Source:** Own representation using SPSS 25 software

The complexity of the model is average. The model is reasonably accurate on the SE data series with a statistical significance determined by the R^2 coefficient of 90% up to a maximum of 96%, and the RMSE and MAPE error measurement coefficients have reached higher values. The Bayesian information criterion similar to the Schwarz criterion based on the likelihood predictive function is minimized on the SE standardized series and demonstrates the reasonable accuracy of the model.

The graphically transposed results of the ARIMA model on regional trend curves for the dependent variable reflect the syncope that will affect the economic sector in Romania, the syncope that is assimilated to the current conditions (economic crisis and pandemic) (see Figure 16).

Under the crisis' conditions, the proposed model reveals that regional economies react differently depending on the winding on the trend curve of point values in dynamics. The lower the dispersion result, the faster stabilization is possible after the cessation of the effects of disruptive factors such as the Covid-19 pandemic.

Figure 16. Predictive analysis of the trend curves for the dependent variable of the model on its regional components (Regional turnover, mill. Lei).
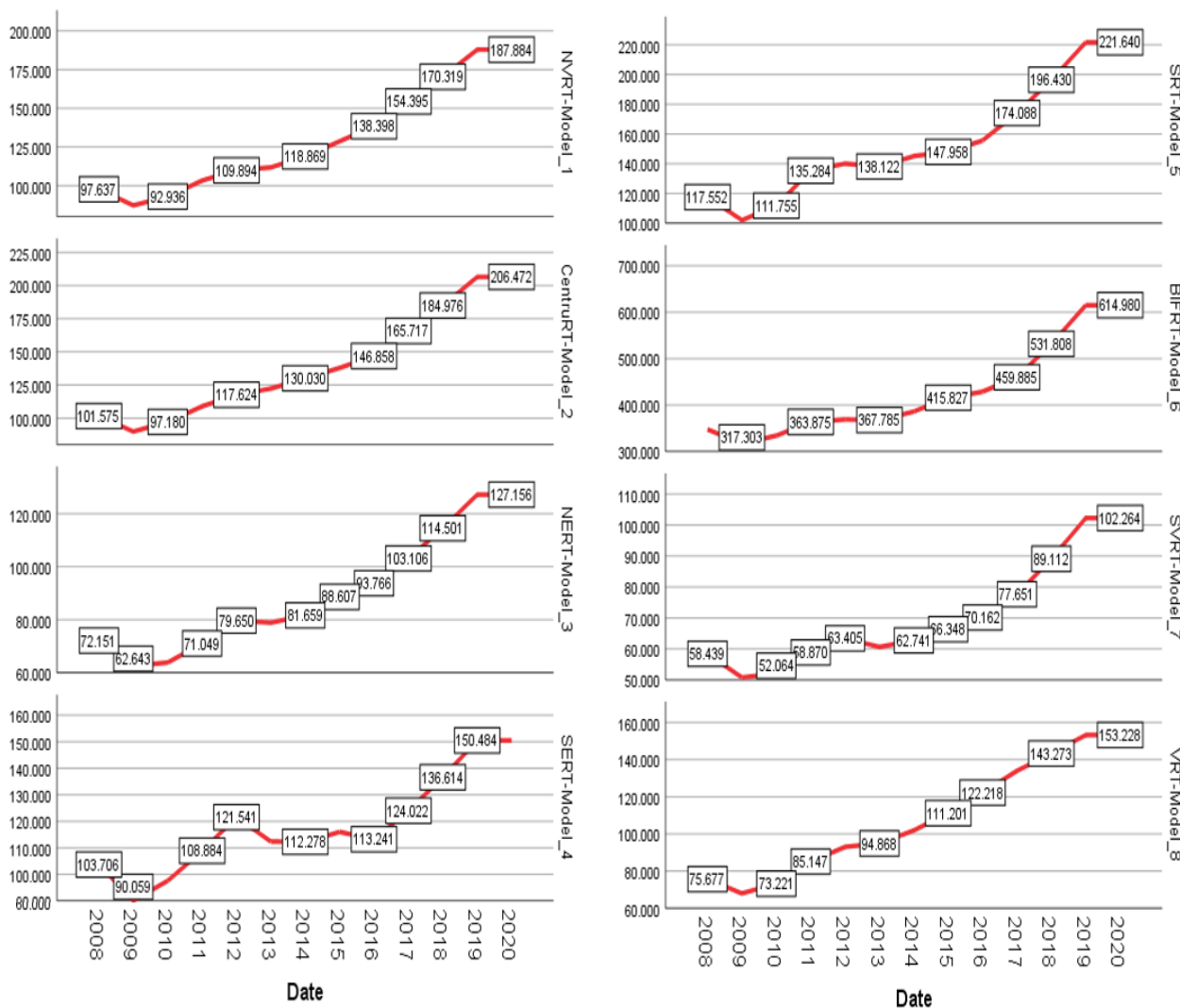
Source: Own research

4. Results and Discussion

The proposed model in this paper allowed the confirmation of the economic forecasts evaluated in relation to the effects of the Covid-19 pandemic in Romania and, subsequently of the economic recession, proving that this model is homogeneous, well determined and statistically significant for

the studied phenomenon. The performed statistical tests allowed the demonstration of working hypotheses, as follows:

H1: The distance between the slope of the linear trend curve related to the economic recovery and the slope of the economic restart after the state of emergency due to Covid-19 pandemic is minimal if the period of the state of emergency is minimal. If the state of emergency period is prolonged, this aspect would imply the prolongation of the economic blockade for the secondary and tertiary sectors, which would have as a direct consequence the flattening of the economic restart curve. For the current situation, the dynamics of the economic restart curve was presented in Figure 16.

H2: The territorial distribution of the pandemic influences the economic regression of the agents in the territory and it is even greater as the structure of the regional economy is more oriented towards the secondary sector of the economy. It is found that, for the Romanian NUTS2 regions oriented mainly towards the secondary and tertiary sector (NE- North-East, Center, V- West), the disease rate is maximized. Primary sector oriented NUTS2 regions, such as SE (South-East), S (South) and SV (South-West), had the lowest disease rates. The parallel can be extrapolated to the European level, where it is found that developed countries such as France, Germany, Italy and Sweden have faced a much larger crisis related to the pandemic than countries whose economies have a higher share of the primary sector (developing economies).

H3: The deeper the economic crisis, the greater the pressure on the regional budget by activating social measures related to the social protection of people aged 40-60 years and not only. As we have demonstrated in terms of methodology, the population at higher risk due to the onset of the pandemic corresponds to the 40-60 year old segment, a segment that involves the congruence of several risk components (maximum illness rate, maximum unemployment rate, vulnerabilities for insertion on the labour market).

The study aimed to identify the economic relationships between the regional historical course of the economic performance and the Covid-19 pandemic, including the economic regression induced by it. These objectives were pursued during the research and demonstrated, as follows:

O1: There is a direct proportional relationship between the economic recovery curve from 2009-2012 and that of the economic restart started in 2020 (after Q1). The pre-pandemic regional development has allowed some regional economies to attenuate the economic regression and a certain lightness in adopting the restart measures. Conversely, less developed regions have experienced a deepening of the regression curve and face more difficulties in the process of economic recovery (see Figure 16).

O2: The regional segmentation of the economic recovery is in direct dependence with the territorial distribution of the Covid-19 pandemic, but also with the structure of the regional economy. This objective was demonstrated by the proposed econometric model, whose validity and homogeneity were statistically tested. The tests indicated the validity of the objective by highly statistically significant values of regression coefficients, dispersion and p-value values for the analysed data series.

O3: The economic restart trend is directly influenced by the socio-economic evolution of the disadvantaged population segment, respectively people aged 40-60 years. This objective was assessed by applying a segmented risk grid according to the age segments of the young, adult and elderly population, a risk that was assessed at health, social and economic levels. It was found that the 40-60 age segment is highly vulnerable to the current situation in Romania and subsequently we appreciate that it is necessary to pay more attention to economic and social protection measures addressed to this age group.

5. Conclusion

The study presents an element of novelty through the analysis on the regional component of the effects of the Covid-19 pandemic in Romania, the analysis that allowed the identification of general risk factors and the evaluation of the context in which the economic recovery measures must be applied. The study is current, based on real data statistically tested, econometrically modelled and is addressed to the decision-making specialists in the public administrative apparatus in order to identify the viable solutions for economic restart.

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