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An empirical analysis using panel data gravity models and scenario forecast simulations for the Romanian exports in the context of COVID-19

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ABSTRACT

The paper focuses on the trade performance of Romania, a representative country for the Central and Eastern European region, strongly connected with its European partners in global value chains and thus affected by any change in these countries' relationships with the rest of the world in general and China in particular. Using panel data gravity models for the 2008-2019 period, we find that Romania's exports are significantly influenced by the demand of its major trade partners in the EU, and imports from China and the rest of the world. In addition, exports are vulnerable to the effectiveness of the government in relation to the other countries, corruption control and cultural values such as collectivism. We also assess the capacity of Romanian exports to regain their ascending trend displayed before the COVID-19 pandemic by using simulation forecasting scenarios based on the shape of the economic recovery and the type of shock transmission across economies. We observe a sharp decrease in 2020 followed by an important recovery in 2021 in a V-shape scenario and uniform transmission of the pandemic shock in the internal demand and in the foreign trade, or followed by a very slow recovery in 2021 (in a U-shape scenario and non-uniform transmission type in the two previously mentioned elements), especially when the global relation with rest of the world is included.

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1. Introduction

The crisis induced by the spread of the Coronavirus at global level brought both economists and decision makers in front of a situation almost never imagined. Few

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studies described the consequences of a viral disease, according to Mirza et al. (2020a) or Rizvi et al. (2020) and even fewer were designed for the European Union (EU). Jonung and Roeger (2006) envisaged a potential epidemic in the EU, but encompassing far less than the effects really felt by the countries once the pandemics hit. In fact, EU was one of the most affected regions, experiencing high economic costs (Chen et al., 2020). Staszkiewicz et al. (2020) put forward the idea that the actual crisis has a challenging effect for globalization. Although the impact on industries was asymmetrical, with deep negative consequences for some industries and growth in others, the normal rhythm was reduced by one fifth in both daily activity (Staszkiewicz et al., 2020) and financial markets (Rizvi et al., 2020). Therefore, the literature on Covid-19 impact is growing, encompassing a wide range of studies, from the impact on businesses and corporate solvency (Mirza et al., 2020 b), the equity funds' performance and human capital efficiency (Mirza et al., 2020c; Yarovaya et al., 2021), to the evolution of cryptocurrencies (Corbet et al., 2020; Goodell and Goutte, (2020) and the list goes on.

Our study focuses on the impact Covid-19 induces on the trade performance of EU countries confronted with severe economic difficulties during their history, and which were heavily relying on exports for enhancing their economic growth during and after the previous crisis. The Central and Eastern European (CEE) countries had a turbulent economic past, shaped by the obstacles in the transition to a market economy, the efforts in covering the development gap with the west once with the EU adhesion, the effects of the 2008 financial crisis, and, more recently, in dealing with an industrial reorientation from polluting domestic energy producers to more sustainable ones. Exports had an important role in their recovery and development, especially because CEE countries were targeted by foreign companies in search for low labour costs which subsequently envisaged the larger EU market with products at a good value for money. This is one of the main reasons for which their trade relationships were mostly developed inside the EU borders (Éltető, 2014), being part of the traditional approach in which exports were mostly directed in the more developed neighbouring Western EU countries (Sobański, 2015). They soon became "the manufacturing backbone of the European economy" (Hagemejer & Muck, 2019, p. 1994), with important contribution in the global value chains (GVCs). The development of the 16 + 1 framework of Cooperation initiated by China increased these countries' trade connections with the East Asian country (Éltető & Szunomár, 2016; Pencea, 2017) and further deepened the role of CEE countries as intermediary manufacturers.

As compared to the crisis in 2008, the Covid-19 pandemic caused a shock in both demand and supply. The prevention measures led to a halt of production and made consumers more cautious with their spending, on the demand side. In what the supply is concerned, not only the activity of major manufacturers and international transportation was halted, but the potential risk of not restarting production due to the stop of industries in other countries was also high. In fact, the interdependencies between the countries, integrated in GVCs across the globe, amplified the negative effects of the pandemic. Therefore, bearing all these aspects in mind, the major question is related to the time needed for the exports recovery.

In this study, we relate to Romania because together with Poland, this country is one of the latest eastern members of the EU with the largest economic potential. However, exactly opposite from Poland, it presents steep economic evolutions (overheating in positive cycles and deep dives during crisis period). On the same time, the Romanian economy is well connected with its European partners as part of longer GVCs (such as in the automotive industry). Therefore, it is heavily affected by any change in these countries' relationships with the rest of the world in general and China in particular. Most of the times, in the literature, Romania is only part of a more extended panel of countries (namely the CEE countries) within most empirical studies, analysing the particularities of such a former socialist country. We consider that analysing Romania's exports and taking into account its economic ties with China we could provide a valuable input for other similar countries (Bulgaria, Poland, Czech Republic, Hungary, Greece, etc.) that pursue to monitor their commercial relationships and develop their trade capacity.

Our study contributes to the existing literature in several ways. Firstly, we establish the dependence of Romania's trade on the forces of demand and supply by using panel data gravity models for the 2008-2019-time period. Secondly, we use a more nuanced gravitational model focused on the components of the demand and supply. We thus build on the studies of Esteves and Rua (2013), Bobeica et al. (2016), Esteves and Prades (2016) and consider the influence of domestic demand on the export dynamics for increasing the accuracy of our conclusions in the actual context. In addition, we include aspects related to Romania's position in the GVCS, given the increased role of CEE countries in manufacturing at international level. Thirdly, we include cultural and institutional factors which could affect the trade relationship. Finally, we assess the impact of Coronavirus on the Romanian exports with the EU partners using simulation forecasting scenarios and depending on the shape of the recovery and of the transmission of the shocks (uniform or not in both the internal demand and the international trade).

The paper is organised as follows. The second section takes a look on the factors enhancing exports in CEE region in general and Romania in particular and highlights these countries' role in GVCs, including the potential consequences of the actual crisis. Section 3 is dedicated to the presentation of the data and research methodology and sheds light on the main group of products traded between Romania, its most important 12 European partners and China. Section 4 presents the main empirical results incorporating the impact of Coronavirus on the Romanian exports with EU partners using simulation forecasting scenarios. The paper ends with the most relevant conclusions and recommendations of further research.

2. Literature review

The usual paradigm for assessing the development of exports is that of a classical gravitational model, which relies on both the economic and geographic distance for explaining the trade bonds between countries. In terms of an empirical relationship, the export performance equation is described based on the demand in the destination

country and the supply capacity of the origin one, adjusted by the distance between them.

There are several studies using gravity models for explaining international trade pattern of the CEE countries during 1990s (as mentioned in Paas, 2000 or Pravorne et al., 2003). During 2000s, a new range of studies is developed under the new prospects of EU adhesion (see, for example, Bussière et al., 2005; Dragutinović-Mitrović & Bjelić, 2015; Stojčić et al., 2018; Maciejewski & Wach, 2019). Our study focuses on Romania's trade relations under the expansion of GVCs and in this context, it checks for potential negative effects of the COVID crisis. There are not too many gravity models for explaining the performance of Romania' exports, as the country is usually included in the larger panel of CEE countries. Among the few attempts, Goschin (2016) finds that exports are directed to countries with rather similar economic dimensions, given that her findings indicate that the higher the GDP difference between the partners, the lower the exports. Still, there is a direct and positive relationship between exports and GDP per capita levels. The study is limited to 10 CEE countries covering the period 1999 to 2013. Viorică (2012) indicates a positive and direct impact between exports and the GDP of the 74 partners included in the sample, with a high influence of FDI. Rault et al. (2007) establish that the dimensions of the trade partner and the economic size positively affects the exports of Romania and Bulgaria in OECD countries. A recent study of Miron et al. (2019) focused on Romania's exports during 2001-2015 period suggests that Romania's trade relationships are concentrated on the neighbouring countries, sharing a common border, with similar GDP per capita and population levels.

Over time, the traditional gravity model was nuanced in order to better assess how both demand and supply factors are influencing exports' performance. While the factors taken into account for the demand side are usually related to foreign demand (such as the imports of the trade partners and the real exchange rate expressing the competitiveness of export products of a country as compared to its major competitors – price competitiveness), Esteves and Rua (2013) signal that the supply side is not developed enough. As a consequence, they add the domestic demand and obtain significant impact for explaining export dynamics, which is further confirmed by Bobeica et al. (2016). Usually, studies identify a significant negative effect of domestic demand on exports, suggesting that firms tend to firstly supply the domestic market, while resources are allocated to exports once the domestic demand declines or enters recession (Esteves & Prades, 2016). We are not aware of similar studies integrating the example of Romania so far.

In addition, both factors influencing exports should be considered in the actual context shaped by the global value chains (GVCs). GVCs, whose emergence is strongly connected to globalization, means that production of goods is rather fragmented (Hagemejer & Muck, 2019; Di & Forster, 2008). On the background of the coronavirus crisis, exports were affected by a shock on both sides, demand and supply, in most sectors, as compared to the crisis of 2008 when exports were only hit by decreasing demand.

On the demand side, following the crisis of 2008, Baldwin and Tomiura (2020) have identified three major sources for the collapse: a generalised decrease for all

goods, difficult access to financing and increased trade barriers. The decrease of demand was enhanced not only by a delay in consumption manifested by the customers or a postponement of the investments, but also by a "bullwhip" effect affecting upstream producers on the supply chains due to inventory adjustments (Zavacka, 2012). Given the integration of EU countries into the global value chains, it is highly possible that a shock affecting major trade hubs to be felt throughout all the countries participating in that supply chain (Huidrom et al., 2019).

As compared to the previous crisis, where no impact of trade barriers was found (Crowley & Luo, 2011), now it is more possible that such effects to be experienced. The last period saw a surge in protectionist measures, best mirrored by the trade war between the US and China, which affected all countries on the global value chain (Huidrom et al., 2019). In the recent context of the pandemics, US, Japan, and France expressed their intentions of relocating activities closer to home, especially those from China, in a "push to repatriate supply chains", according to Baldwin and Tomiura (2020, p. 68). Although such a situation is less feasible given the advantages China provides for these companies, a change in investors' behaviour, making them more prudent in choosing the location of their investment, could be expected in the future. However, the negative impact on the demand side from this source is more feasible than a decade ago, in the context of the economic crisis.

On the supply side, GVCs entail a growth in trade for ensuring the supply of the needed goods in each stage of production. As regards countries similar to Romania, Hagemejer and Muck (2019) consider that CEE countries became "the manufacturing backbone of the European economy" (p. 1994). In this context, a significant role is attributed to China, whose importance as both a supplier and a destination for the goods manufactured in CEE countries increased in the last years. On one hand, CEE countries took a diversification path of the exports market following the financial crisis in 2008 and became more oriented towards China (Oehler-Şincai, 2016). On the other hand, China seized the opportunity to increase its market share in this region after the World Trade Organization accession (Stanojevic et al., 2020) and pursued its aim by developing the 16 + 1 framework of Cooperation in the global approach of China's Belt and Road Initiative. As a consequence, the trade increases between CEE countries and East Asia were more dynamic than with the rest of the EU countries in the last period, especially on the import component from China (Éltető & Szunomár, 2016). There are a lot of studies suggesting a direct and positive impact of economic development and trade between countries along the Belt and Road and China, among which Romania is included, as suggested by Chen et al. (2020). In addition, Pencea (2017) finds a growth of 10 percentage points of Romania's exports to China in just 5 years (during 2010-2015).

Ambroziak (2016) points that the intra-industry trade of six new EU member states, among which Romania, was enhanced by the foreign direct investments directed in the automotive sector. Focusing on the Machinery and transport equipment, Gheorghe and Simion (2018) find that a high percent of the exports in this area (85%) are influenced by the imports of the same goods and the FDI directed here. Jacimovic et al. (2018) is more specific and finds that an increase in bilateral exports of the new EU and Western Balkans countries is enhanced by larger flows of

foreign direct investments from China. However, Chinese exports could have a double effect. Bin and Jian (2020) prove, on one hand, that there is a crowding out effect of Chinese exports on the exports of 15 West European countries in the CEE region in the sectors of textile and furniture. On the other hand, the authors state that Chinese exports in CEE countries also enhance other EU countries' exports in the region, especially in the sectors of machinery and electronics, but also on total trade. The same authors suggest that there is an increased cooperation between CEE countries imports of parts and components from China, which lead to further developing a complementary trade approach with other countries in the EU. In addition, Chinese companies have opened assembly lines in these countries, which could be the reason of increased imports.

A strong integration on the GVC could sometimes hide a high dependence on the supplying countries, which could be harmful in the case of a crisis situation such as the COVID-19 pandemics, which lead to the disruption of the GVCs and affected both factors enhancing exports, demand and supply. The export activity risks not to be connected to the comparative advantages of the country, but to volatile advantages such as low labour costs or low trade barriers, which could vanish when being challenged by other countries, by "commercial wars", revival of protectionism or other types of conflict that could emerge in relation with the supplying country. The challenge is not only to be present in international GVCs and bilateral trade, but also to "keep producing new, more diversified and higher value-added products" (Di & Forster, 2008, p. 11) for strengthening the competitive position at international level.

In this context, our approach assesses Romania's export dependence on the foreign and domestic demand. In addition, we complement the supply side variables by adding the imports from China, given the last years' developments. This will also allow us to evaluate the importance of Chinese imports for the trading activity of Romania in the EU.

3. Research design

3.1. Romania's exports and imports with the most important 12 European partners and China

Romania's exports are mostly focused on European partners. Between 63% and 70% of the total volume of exports during 2008-2019 targeted 12 countries in Europe: Austria, Belgium, Bulgaria, the Czech Republic, Spain, France, Germany, Hungary, Italy, the Netherlands, Poland and the United Kingdom during the last ten years (Figure 1), being therefore Romania's most important export partners. Romania's exports saw a major increase after 2008, being considered the engine of growth after the economic crisis. Exports to China are low, covering only 1.1% of total Romanian exports in 2019, but are on an ascending trend rising from 0.48% in 2008.

The value of the first five main groups of exported products, according to HS4 (Harmonized Commodity Description and Coding Systems) classification, increased from 49.6% (in 2008) to 58.9% (in 2019) of the total value of Romanian exports to its main 12 European partners. Starting with 2009, the structure of the main exported products stabilized, and is composed by exports in the group 85 (Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television etc.),

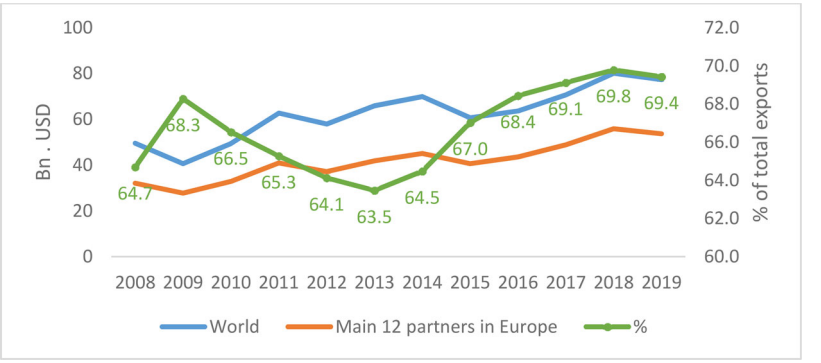

Figure 1. Romania exports to the world and 12 main European partners, bn. USD and % of total.
Source: UN Comtrade data

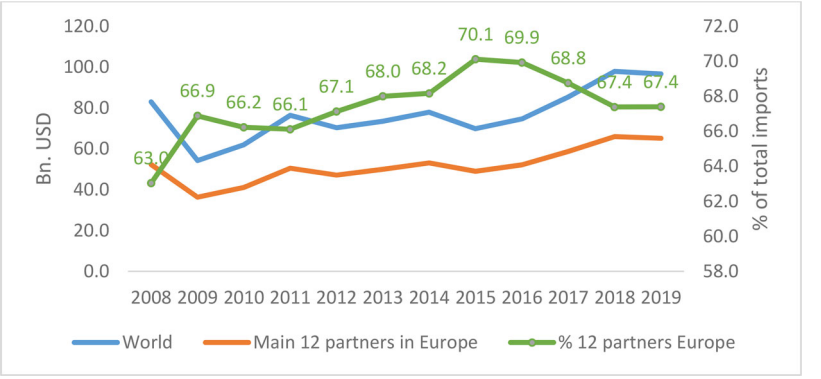

Figure 2. Romania imports from the world and 12 main European partners, bn. USD and % of total.
Source: UN Comtrade data

followed by group 87 (Vehicles other than railway or tramway rolling stock, and parts and accessories thereof) and group 84 (Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof).

The situation regarding the sources of imports is slightly different. The 12 European countries continue to remain important partners for imports, supplying around 67% of total imports in the last two years, in a slight decrease from the maximum of 70.1% in 2015 (Figure 2). However, China is also an important partner, given that 5.3% of total imports are originating here. China's share increased constantly from 4.2% in 2008 and from only 1.6% in 2001.

The structure of imports from the European countries is more stable, as the most important five groups of imported products remained unchanged during 2008-2019. Half of the value of imported goods comes from five major groups. Group 85 contains the products with the highest imported value, representing almost 15% of total imports from the European countries in the last years. Group 84 ranks second the structure of total imports, being usually around 13%, while group 87 had a steady increase in the last years, peaking 11.3% of the total, in 2019.

As regards imports from China, two thirds of the imported value come from five major groups. The most important one is group 85, where the imports hit 29.8% of the total value of imported goods from China in 2019, followed by group 84 (22.75%). However, the value of products in group 85 was decreasing in the last ten years, as the share of group 85 in total imports was almost 49% in 2009. A slight decrease was also registered for group 84 starting with 2016. The remaining places of the hierarchy are occupied by products in group 90 (representing 5.4% of total imports from China), followed by group 87 (4.1%) and group 94 (3.5%).

3.2. Data and methodology

We use gravity models in order to identify the determinants of Romanian trade flows and to quantify the dependence on imports from China mainly in this particular situation of pandemics. The gravity model assumes that the bilateral economic activities between two countries depend on the dimensions of both economies and the physical distance between them, using theoretical aspects widely used in physics and involving the following specification (Tinbergen, 1962):

$$\log X_{ij} = \beta_0 + \beta_1 \log Y_i + \beta_2 \log Y_j + \beta_3 \log D_{ij} \quad (1)$$

The main advantage of using panel data within the gravity models resides in the additional information provided by the cross-sectional data observed on several periods of time as compared to the classical cross-sectional data, capturing the relationships between variables over the time. Gravity models have undergone a series of developments in recent years, proving their applicability in analysing also other themes such as migration (Davidescu et al., 2017).

Linneman (1966) has added the population size in the model, analysing the correlation between the quantity of products exported by a country i and the GDP, the size of the population in destination country j, together with the effect that the distance between the two countries has on the trade volume (Kristjánsdóttir, 2005). The population expresses the size of each economy, considering that a large country generally has an economy characterized by a high degree of self-sufficiency, compared to an economy of small proportions (Zaman, 1999). Tinbergen (1962) suggested that a country's export flow depends on its economic size and on the size of the importing country. Distances are used to specify transportation costs.

In the generalised form of the gravity model, the trade/exports/imports volume between the two countries depend on their own revenues, populations, distance and a set of dummy variables that either facilitate or restrict trade between these countries such as belonging to a trade agreement, common land border, cultural similarities (the same language or religion). Therefore, a positive sign for the GDP of the exporting and importing country and a negative sign for the distance, because an increase of the distance also increases the transport cost, is often obtained.

The present study is focused on analysing Romania's export flows with the main trade partners in the EU (Germany, Italy, France, Hungary, the United Kingdom, Poland, Bulgaria, the Czech Republic, the Netherlands, Spain, Austria and Belgium), taking into account the interdependencies with the Chinese economy. The empirical

model is build based on annual data for the period 2008-2019, once with the restoration of the situation after the global financial crisis. The scenario forecast simulations were envisaged for the out of the sample period 2020-2021.

The general specification of the gravity model for Romanian exports to EU partners including the interdependencies of China's economy is the following:

$$\begin{aligned}\log(\exp_{ijt}) = {} & \beta_0 + \beta_1 \log(dom_{dem}it) + \beta_2 \log(dom_{dem}jt) + \beta_3 \log(imp_{ichinat}) \\ & + \beta_4 \log(\exp_{jchinat}) + \beta_5 \log\left(distance_{ijt}\right) \\ & + \beta_6 Perception_{ind}it + \beta_7 Perception_{ind}jt \; + \sum_h \delta_h P_{ijht} + \varepsilon_{ijt}\end{aligned} \tag{2}$$

The variables' definitions and abbreviations are presented in Table 1 in the Appendix, while data sources are Eurostat, UN Comtrade and World Bank.

Alternatively, we also test a gravity model of Romania's exports to EU partners, which includes the volumes of imports of both Romania and the partner countries from the rest of the world. In this way, we are integrating the conditions generated by the pandemic shock on the supply. The general specification of this model is:

$$\begin{aligned}\log(\exp_{ijt}) = {} & \beta_0 + \beta_1 \log(dom_{dem}it) + \beta_2 \log(dom_{dem}jt) + \beta_3 \log(imp_{iwt}) + \beta_4 \log(\exp_{jwt}) \\ & + \beta_5 \log\left(distance_{ijt}\right) \\ & + \beta_6 Perception_{ind}it + \beta_7 Perception_{ind}jt \; + \sum_h \delta_h P_{ijht} + \varepsilon_{ijt}\end{aligned} \tag{3}$$

In order to increase the suitability of the data set and to reduce variability in some variables, logarithms were used.

Taking into consideration the proposed specifications, we expect a positive sign for the domestic demand in the partner countries, partner total population, similarity degree between the countries, Romanian imports of goods worldwide, Romanian imports from China, partner exports to world, partner exports to China, concentration of all supplying partner countries, RO industry, value added (% of GDP), partner industry, a set of perception variables (economic freedom index, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule of law, control of corruption, ease of doing business) and language. On the other hand, in accordance with the literature, we expect a negative sign for domestic demand of Romania, real effective exchange rate in the partner country and distance between countries. The five cultural dimensions (power distance, individualism, masculinity, uncertainty avoidance, long-term orientation, as described by Hofstede) could have either negative or positive impacts depending on the countries cultural behaviour. For these variables, we have used the data provided by the Hofstede Insights. Also, starting from the paper of Benzarti and Tazhitdinova (2019) as well as Kristjánsdóttir (2020), we have introduced in the model also the potential impact of VAT[1] change in the origin country for exports, within the specification of the gravity model. We

Table 1. Empirical results of the gravitational models for Romania's exports taking into account the relations with China.

Variables	MI	MII	MIII	MIV	MV	MVI	MVII	MVIII	MIX	MX	MXI
Log(domestic demand_i)	**-0.247***	−0.275*	−0.261*	−0.037	−0.031	−0.038	−0.0018	−0.310**	−0.361**	−0.302	−0.402***
Log(domestic demand_j)	**0.872*****	0.994***	0.808***	0.572***	0.782***	0.552***	0.928***	0.833***	1.068***	1.376***	0.614***
Log(Impichina)	**0.354*****	0.340***	0.185**	0.247***	0.213**	0.05	0.153*	0.135*	0.0055	0.145*	0.083
Log(Expjchina)	**0.349*****	0.350***	0.433***	0.440***	0.459***	0.369***	0.388***	0.386***	0.365***	0.465***	0.365***
Log(distanceij)	**-2.20****	−2.32**	−2.18**	−1.76***	−2.95***	−3.04***	−3.12***	−1.624*	−1.498	−1.78	−1.817*
Individualism_j	**-0.02*****	−0.025*	−0.02***	−0.003					−0.022*	−0.033***	
Long term orientation_j						0.00043					
Masculinity_j					−0.0054						
Power distance_j							0.02*		0.015		
Uncertainty avoidance_j								0.026**			
Easy of doing business_j						0.025***		0.028***			
Corruption Control_i			0.497***			0.154*					
Reg.Quality_i				0.094	0.103					0.240	
Reg.Quality_j				0.271***							
Gov_effect_i	**0.530*****	0.527***									
Rule of law_i									0.676***		
Political stability_j							0.119*				
Borderij	**1.795*****	1.99**	1.81***	1.109***		1.227*	1.142*	1.888***	2.477***	2.73***	1.597**
Languageij		−0.299		−0.237			−0.583	−0.65			
Cij									13.395		
Simij										3.82**	
OECD		0.279									
OCEMN				0.715*	0.727	0.768	0.654				
REER_j							−0.127***				
Log(Population_j)						0.413					
VAT change in country i(RO)											−0.0023
Constant	**13.92***	14.00	16.08***	10.319*	17.738	21.56	18.90**	7.98	10.06	5.268	8.93
No of obs.	**144**	144	144	144	144	144	144	144	144	144	144
No of groups	**12**	12	12	12	12	12	12	12	12	12	12
R^2*-within*	**0.7899**	0.7926	0.7707	0.7535	0.7559	0.8036	0.7845	0.7994	0.7897	0.7666	0.7313
R^2*-between*	**0.7686**	0.7717	0.7696	0.7903	0.7245	0.7608	0.7901	0.7157	0.7223	0.7281	0.7237
R^2*-overall*	**0.7648**	0.7659	0.7626	0.7839	0.7181	0.7546	0.7835	0.7162	0.7240	0.7223	0.7209
Sigma_u[3]	**.4699**	.56777	.46989	.2752	0.5399	0.423	0.4788	0.4652	.5459	.51359	.47774
Sigma_e[4]	**.1203**	.1203	.12525	.1263	0.1294	0.1060	0.1229	0.1174	.12169	.1272	12217
rho[5]	**.9384**	.9569	.93365	.82589	0.9456	0.941	0.938	0.9400	.9526	.942	.93861
Wald test	**492.78*****	493.57***	439.89***	405.93***	397.05***	506.64	469.68***	503.75***	484.71***	422.04***	330.93***
Hausman test	**7.94**	6.31	8.47	8.52	8.17	8.34	6.24	8.89	8.45	10.16	8.87
BG test	**610.41*****	606.1***	590.34***	114.20***	585.76***	355.67***	450.91***	392.49***	582.26***	575.21***	526.27***

Note: ***, **, * mean statistically significant at 1%, 5% and 10%.

empirically assessed the impact of VAT changes that occurred in Romania, and estimated their effect on export flows.

In the first stage, we used ordinary least squares method both cross-section and period fixed effects models for our estimations. In relation to time, there are invariant factors that characterize Romania's trade with partner countries. If these are ignored, the empirical results can lead to inconsistent and biased coefficients (which are included in another basic hypothesis of the validity of the model through its coefficients), which would affect the validity of the model. In this regard, unobservable individual effects will be controlled using fixed effect models (FEM) or random effect models (REM). In order to select the appropriate model, the Redundant Fixed Effects test was used accompanied by the Hausman test. In order to overcome the impossibility of using independent variables which remain constant over time for each statistical unit in the case of FEM models, we have decided to estimate a regression model in which the dependent variable is represented by the individual fixed effects (IE_{ij}) obtained from the panel estimation and the independent variables are represented by the dummy variables Pij (distance, language or border). The general structure of this model is:

$$IE_{ij} = \beta_0 + \beta_1 \ln(distance_{ij}) + \beta_2 language_{ij} + \epsilon_{ij}$$

$$IE_{ij} = \beta_0 + \beta_1 \log(distance) + \sum_h \delta_h P_{ijht} + u_{ijt} \quad (4)$$

where IE_{ij} is the fixed individual effect.

As already mentioned, the type of model depends on the potential correlation of the explanatory variables with the unobservable effects (if the unobservable effects are uncorrelated with all the explanatory variables it is better to opt for the use of models with REM effects). The empirical results of the Hausman test showed that the random effects estimator is consistent, with a probability very close to 1 (the results could be provided by request). Therefore, different specifications of the gravity model were estimated using the least squares method for panel data.

The random effects model is:

We have also tested the existence of random effects applying the Breusch-Pagan Lagrange multiplier (LM) which helps us to decide between a random effects regression and a simple OLS regression. The null hypothesis in the LM test is that variances across entities is zero, meaning no significant difference across units (i.e. no panel effect).

4. Results and discussion

4.1. Determinants of Romania bilateral trade using panel data analysis

The empirical results of the Hausman test showed that the random effects estimator is consistent, with a probability very close to 1. Therefore, different specifications of the gravity model were estimated using the least squares method for panel data (Panel Least Squares). Also, the use of random effects has been confirmed by the

empirical results of LM test, which has been highly statistically significant for a significance level of 1%, addressing significant differences across countries, supporting the use of random effects.

Different specifications of the model were analysed, testing the statistical impact of different variables, different perception indices and dummy variables, and eliminating variables without statistically significant impact and re-estimating those models. The table of empirical results (Table 1) presents the most relevant specifications for both specifications the relations with China as well as with the rest of the world, exhibiting the most important results from the study. Table 2 in Appendix displays the univariate statistics for the entire dataset.

The empirical results of the panel analysis indicate that Romania's exports are significantly influenced by the domestic demand of Romania's main trade partners, the variable preserving its statistical significance in all specifications. In this respect, the higher the demand on the foreign market, the higher the volume of Romania's exports. The result is valid for all model specifications (Table 1). In line with our findings, Viorică (2012), Rault et al. (2007) or Sova et al. (2009) also indicate towards a positive relationship between exports and GDP in the case of Romania. This means that, in the event of a demand shock on the markets of the EU countries (the main 12 economies which represent Romania's largest export partners), Romania's exports will be affected to a considerable extent (the coefficients obtained for the domestic demand of the partner countries are among the largest) through this channel.

In contrast, domestic demand in Romania negatively affects exports. Such a result indicates that when domestic demand is high, domestic production will primarily tend to cover domestic consumption, which results in a decrease in the size of exports. Bobeica et al. (2016) also point towards a similar substitution effect between the domestic demand and foreign sales but for the euro area countries, further confirmed by Esteves and Prades (2016). To our knowledge, this is the first study to reach a similar conclusion for a CEE country. Regardless of the specifications of the model, the distance between Romania and the exporting country has a negative impact on Romania's exports, as expected. Moreover, exports to neighbouring countries are preferred, as the coefficient for the dummy variable indicating the presence of a common border is positive and significant.

Most of the studies reach a similar conclusion (see, for example, Maciejewski & Wach, 2019 or Miron et al., 2019 for Romania). Therefore, exports will be higher if the distance between partners is shorter, with neighbouring countries being preferred as export destinations.

We were further interested, in a first phase, on the extent to which the trade relations with China of both Romania and its main trade partners could affect and reverberate on the evolution of Romanian exports. In a second phase, we translated this investigation to the trade relationship with the rest of the world, in order to check for a similar impact. Such an approach allows us to establish the pressure carried by Romania's exports following the evolution of world economies and, especially, the degree of integration in the global flows, in order to determine to what extent it may be affected by a shock such as the Covid-19 pandemic.

Table 2. Empirical results of the gravitational models for Romania's exports taking into account the relations with the rest of the world.

Variables	MI	MII	MIII	MIV	MV	MVI	MVII	MVIII	MIX	MX	MXI
Log(domestic demand_i)	**-1.70*****	−1.719***	−1.854***	−1.867***	−1.761***	−1.781***	−1.882***	−1.782**	−1.857**	−1.973***	−1.185***
Log(domestic demand_j)	**0.839*****	.9137***	0.759***	0.820***	.71126***	0.470**	0.949***	0.908***	0.799***	1.050***	0.559***
Log(impiw)	**1.043*****	1.040***	1.112***	1.033***	.98663***	1.126***	0.147***	1.126***	1.029**	1.015****	0.849***
Log(expjw)	**0.404*****	.3929***	0.477***	0.341**	.4786***	0.466***	0.408***	0.339**	0.358**	0.559***	0.491***
Log(distanceij)	**-2.05****	−2.172**	−1.97**	−1.970**	−2.10***	−2.743***	−2.92**	−1.646	−1.917**	−1.708*	−1.674*
Individualism_j	**-0.017****	-.0174	−0.018***	−0.0167*					−0.0158	−0.025**	
Long term orientation_j						.00831					
Masculinity_j					.0015						
Power distance_j							0.0156				
Uncertainty avoidance_j								0.015			
Easy of doing business_i						-.00016					
Easy of doing business_j				0.018***					0.017***		
Corruption Control_i			−0.012								
Gov_effect_i	**0.244*****										
Political stability_j							0.119*	0.124**			
Borderij	**1.81*****		1.80***	1.777***	1.30**	1.086*	1.243*	1.917***	1.71***	2.35***	1.666***
Languageij		-.2336				-.1805	−0.462	−0.502	−0.0888		
Simij										2.182	
OECD		-.1866									
OCEMN					1.0801	.86351	0.818		0.087		
REER_j								−0.0036			
Log(Population_j)						.4967					
VAT Rate_j											-.0007
Constant	**24.53*****	25.096	24.81***	25.48*	25.637***	26.788	29.02***	19.27**	25.07***	20.36***	18.91***
No of obs.	**144**	144	144	144	144	144	144	144	144	144	144
No of groups	**12**	12	12	12	12	12	12	12	12	12	12
R^2-within	**0.8125**	0.8135	0.8033	0.8211	0.8045	0.8052	0.8094	0.8103	0.8208	0.8077	0.7806
R^2-between	**0.7982**	0.8050	0.8087	0.7650	0.7917	0.8692	0.8106	0.7589	0.7710	0.7804	0.7386
R^2-overall	**0.7983**	0.8039	0.8073	0.7700	0.7916	0.8588	0.8085	0.7616	0.7756	0.7817	0.7417
Sigma_u	**.4142**	.4912	.4141	.43796	.4478	.38825	.5845	0.7616	.37987	.4263	.467366
Sigma_e	**.1150**	.1150	.11813	.11272	.1175	.1067	.1166	0.7616	.1127	.1164	.11213
rho	**.9284**	.9480	.92474	.9378	.9355	.9296	.9617	0.7616	.9190	.93057	.9455
Wald test	**579.23*****	575.44***	550.61***	607.29***	546.62***	548.36***	562.53 ***	559.10 ***	595.61 ***	558.85***	434.83***
Hausman test	**3.57**	2.75	2.14	4.23	3.47	7.65	1.24	1.83	2.38	5.15	3.47
BG test	**588.44*****	576.84***	584.04***	546.87***	573.31***	403.28***	588.59 ***	559.10 ***	289.38 ***	547.93 ***	549.42***

Note: ***, **, * mean statistically significant at 1%, 5% and 10%.

In the first case, in which we analyse Romania's exports taking into account the relations with China (Table 1), we conclude that Romania's imports from China have a positive and significant impact on subsequent exports to EU countries, which means that Chinese imports are most likely used in the production process for goods that are subsequently exported to the EU. The exports of Romania's main EU partners in China have a positive and significant impact on Romanian exports, which suggests that goods exported by Romania are integrated into the production process of goods from EU countries which are then exported to China. Romania's main exports to EU countries are car components and parts, which are then used in the production of cars in the EU. Subsequently, part of this production is exported to the Chinese market.

In the second case (Table 2) we have checked whether Romania's exports are dependent on the relationship with the rest of the world. The conclusions suggest that Romania's imports from the rest of the world have a positive and significant impact on exports. This means, again, that the imported goods are later used in the production process. In addition, the exports of the main EU trading partners to the rest of the world influence Romanian exports. Therefore, as long as there is global demand for goods produced in the EU, Romania's exports will increase. These results, added to the aspects extracted from Ambroziak (2016), Gheorghe and Simion (2018) and Jacimovic et al. (2018) and to the conclusion of the statistical description in Romania's foreign trade with China and major EU partners, point to the fact that Romania acts as an intermediary, by importing products or parts and components from countries such as China, and then exporting them in other EU countries.

We were also interested whether other factors, such as cultural or institutional ones, could hamper or enhance Romania's exports, as they shape the environment for doing business. Levchenko (2007) shows that, without assessing for the quality of institutions, conclusions on trade outcomes could be incomplete; therefore, we consider that such an approach would improve the results of our study. We have tested several variables which include perception indicators on different aspects in Romania or in the destination country, to determine whether they are relevant for stimulating exports. The results in Table 1 indicate that only two of the perception indicators are positive and significant to explain exports: government effectiveness and control of corruption. The higher the level of these indicators, the more exports will be encouraged. The two indicators were added sequentially in the analysed model to avoid multicollinearity problems:

- The effectiveness of the government in Romania, namely the provision of high quality public services and public policy measures, independent of political pressure, for which a high commitment from the government is perceived to be achieved, are able to stimulate Romania's exports if, in the model, we take into account both relations with China and with the rest of the world.
- High corruption control has a positive and significant impact on exports only in the case in which the model takes into account the variables regarding the relationship with China; the indicator is insignificant in the model specifications that include the rest of the world.

Significant impact of institutional quality on the export performance of companies in emerging economies is also indicated by LiPuma et al. (2013), while Bierut and Kuziemska-Pawlak (2016) reach a similar conclusion for the CEE countries.

Regarding the variables that describe the culture of a country, the only one that was significant among the model specifications was the degree of individualism in the destination countries. The variable is significant but with a negative impact on Romanian exports and maintains its robustness regardless the specifications of the model. A high degree of individualism, as defined by Hofstede in his studies describing the cultural dimensions of countries, indicates a high level of attention paid to the individual, his performance and merit, to the detriment of the group. At the opposite end are countries with a collectivist culture, where the emphasis is on the group and the effects of various measures on it. As Romania is rather a collectivist country, according to Hofstede, the result obtained in our models indicates that the size of exports is negatively affected if their destination country is culturally different. Mornah and MacDermott (2016) test a similar assumption between the impact of cultural variables on exports and discover that, among others, institutional collectivism improves bilateral trade. The study is carried out on 59 countries. The results of other studies on the same topic usually indicate that cultural affinities increase trade performance (Linders et al., 2005; Söderström, 2008).

The empirical results support the idea that the exports' flows were not affected by changes in VAT rate in the origin country, as the VAT coefficient does not exhibit a statistically significant impact on exports' flows. The results are in line with the findings of Benzarti and Tazhitdinova (2019), who pointed out the lack of trade response as an "evidence of relative trade neutrality", stipulating that a change in VAT rate for a certain good "i" most likely will not create any distortion in the amount of exports of good "j" relative to good "i". A potential explanation for the inverse relationship of VAT change and exports could be in the reduction of individuals' consumption for all goods in response to a VAT increase, or vice versa for a VAT decrease.

Other dummy variables, such as the common language or OECD membership, are not significant for Romania's exports.

Concluding, there are several important aspects that could affect Romania's exports in case of crises such as the one generated by the pandemic:

- The decrease of the demand on the markets of Romania's main EU trade partners;
- The increase of the domestic demand, which reconfigures the distribution of the products that would have otherwise been exported;
- The decrease of Romania's imports from China, either because China partially closes its production, or due to import restrictions, reductions in the transport activity etc.;
- The decrease of the EU member states' exports to China, due to import restrictions, reductions in the transport activity, etc.;
- The decrease of Romania's imports from the rest of the world, as a result of restrictions (isolation, reduction of transport activity, decrease of orders, etc.).
- The decrease of the EU member states' exports to the rest of the world, due to the same causes mentioned above.

4.2. Modelling the impact of coronavirus on the Romanian exports with EU partners using simulation forecasting scenarios

Similar to 2008-09, during the actual crisis governments have again intervened with monetary and fiscal policy measures to counter the downturn and provide temporary income support to both the businesses sector and to the population. A novelty is the high impact of the distancing and lockdown measures on the labour supply, or on the transport and the manufacturing sector. The effect on most economic sectors is direct and immediate. Under these circumstances, forecasting requires strong assumptions about the progress of the disease and a greater reliance on estimated rather than reported data.

According to the WTO, the world merchandise trade is set to plummet by between 13 and 32% in 2020 due to the COVID-19 pandemic. The wide range of possibilities for the predicted decline is explained by the unprecedented nature of this health crisis and the uncertainty around its precise economic impact, while the decline will likely exceed the trade slump brought on by the global financial crisis of 2008-09. The recovery in 2021 is uncertain, being crucially influenced to the duration of outbreak as well as by the effectiveness of the policy responses.

In order to test for the shocks resulted from the pandemic, we have designed four scenarios by crossing the V-Shape recovery and the U-Shape recovery with a uniform effect on both internal demand and international trade and with a non-uniform effect on internal demand and international trade (see table 3 in the Appendix).

The recovery scenarios could be explained as follows:

- (1): a relatively optimistic scenario, with a sharp drop in trade followed by a recovery starting in the second half of 2020, with measures that will stay in place for three months and after that there will be a V-shaped recovery.
- (2) a less optimistic scenario, where measures stay in place for six months, leading to a U-shaped recovery.

Therefore, two scenarios include a V-Shape recovery of the economies, while two scenarios include a U-Shape recovery of the world economies. The GDP change of the analysed economies was built as an average of World Trade Organization (WTO) and McKinsey forecasts.

For each recovery scenario, we have considered that the average GDP change for each country is transmitted uniformly in both its internal demand (in the case of Romania) and in the size of the international trade (for Romania's partners), for both 2020 and 2021. In addition, we also took into account the situation in which the average GDP change is not transmitted uniformly in Romania's internal demand and on the international trade for the two periods, 2020 and 2021. Thus, Romania's internal demand only records 80% of the GDP decrease for 2020 and during 2021 the internal demand increases with 110% of the increase of GDP. During the same time periods, the international trade decreases with 130% of the decrease recorded by the GDP, for 2020 and in 2021 the international trade increases only by 80% of the increase recorded by the GDP increase.

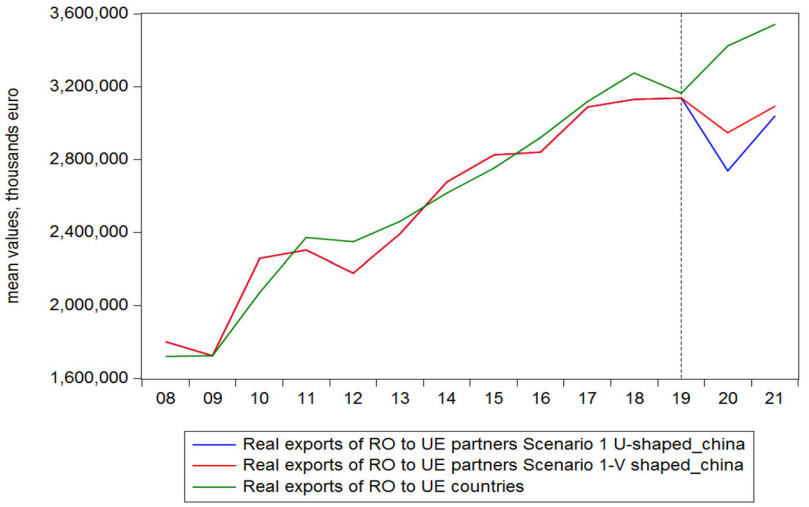

Figure 3. Forecasting the Romanian exports to EU partners-A Projection-China.

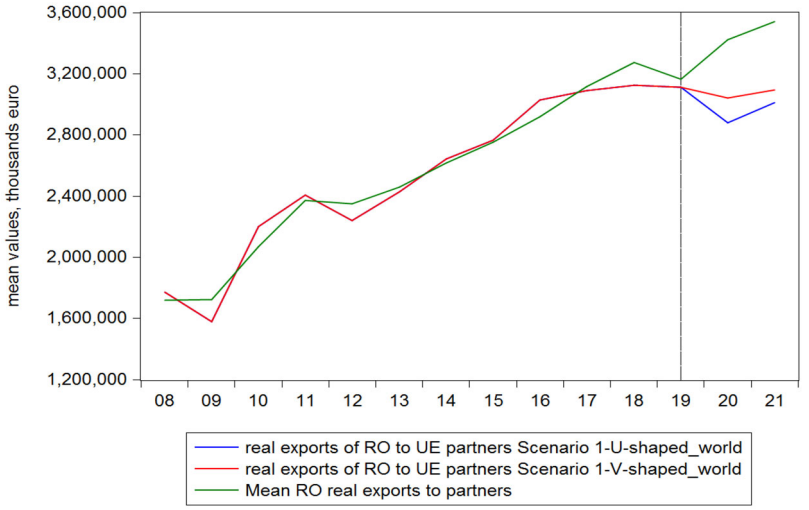

Figure 4. Forecasting the Romanian exports to EU partners-A Projection-World.

By mixing the shape of the recovery and the transmission of shocks (uniform or not) we test the stability of the estimates and also propose some potential scenarios that might be used by decision makers when designing contingency or development policies.

Therefore, under the A projection of a uniform effect on both internal demand and international trade for both years and taking into account firstly the trade relationship with China and latter with the rest of the world, the empirical results presented in the Figures 3 and 4 below reveal a decrease in the volumes of Romania's average exports under both scenarios, with a higher decrease in the case of U-shape scenario and relatively quick recovery starting with the year 2020. In the absence of the pandemic shock, Romania's average exports to EU partners were expected to follow an upward trend.

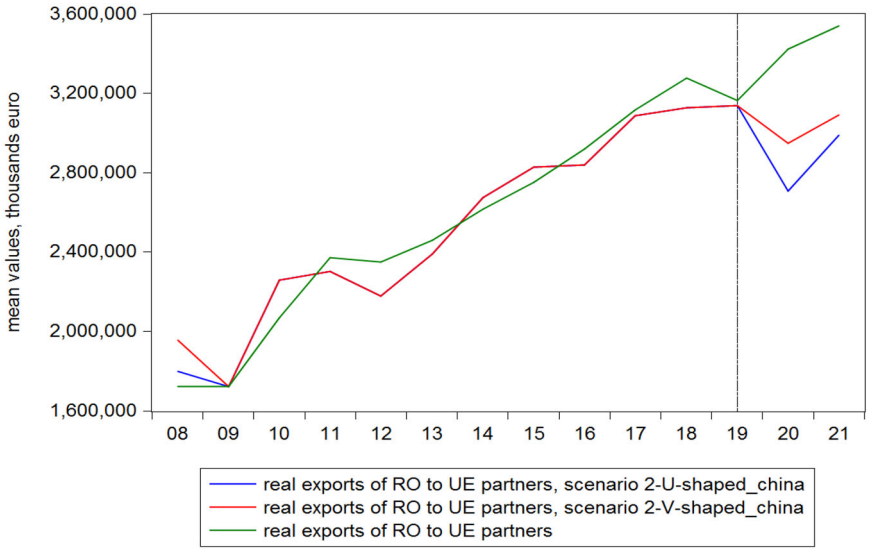

Figure 5. Forecasting the Romanian exports to EU Partners-B Projection-China.

From the point of view of Romania's relations with each of the twelve EU partners (see appendix for Figures 1 and 2), Germany was the top partner of Romanian exports, with growth projections in the absence of pandemics, but with the biggest decline caused by the pandemic shock. Taking into account both types of scenarios, Germany remains one of the main partners of Romania, exhibiting the highest decline under both scenarios, followed by Italy and France with the U-shape scenario marking the largest declines for all EU partners.

Analysing comparatively the impact of the pandemic shock on the Romania's exports to EU partners in relation to China and also to the rest of the world under A projection (Figures 3 and 4), it is worth to mention that the highest declines were registered under the U-shape scenario and most likely in the context of trade relations with China.

In the case of B projection, assuming an uneven internal and external transmission in the internal demand and international trade and taking into account firstly the trade relationship with China and later the rest of the world, the empirical results evidenced by Figures 5 and 6 reveal a decrease in the volumes of Romania's average exports, with a higher decrease in the case of U-shape scenario and relatively quick recovery starting with the year 2020 under the assumption of China relations. It is important to mention that under the assumption of this uneven transmission, and taking into account the relations with the rest of the world, the pandemic shock marks a decline in 2020, but with a fairly slow potential for recovery in 2021.

Analysing the projections of Romania's exports with each of the twelve EU partners under both U-shape and V-shape scenarios assuming firstly the trade relations with China and secondly with the rest of the world (see Appendix 2, figures 4 and 5), Germany remains the top partner of Romania, exhibiting a higher decline in the case of U shape scenario compared with the V shape scenario.

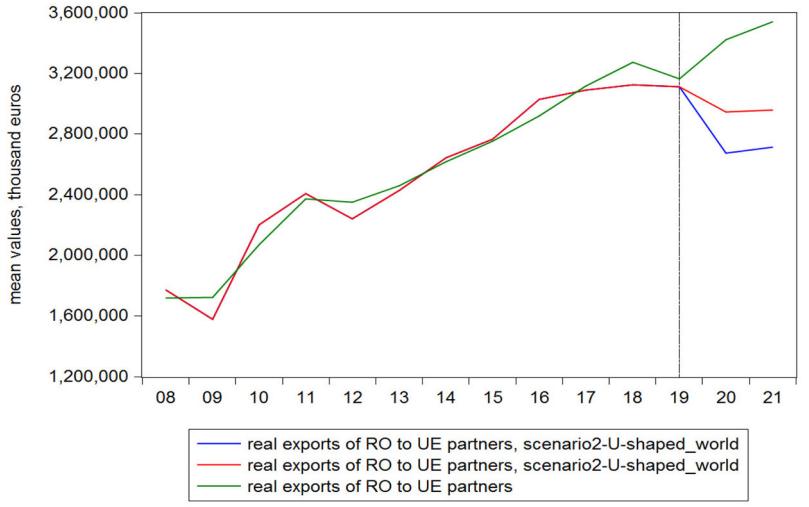

Figure 6. Forecasting the Romanian exports to EU Partners-B Projection-World.

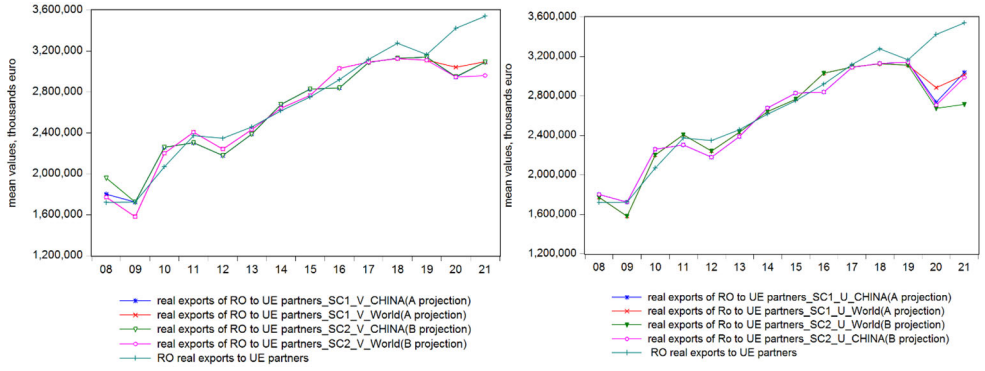

Figure 7. Comparative analysis of the main scenarios of Romania's exports to EU partners.

The impact of the pandemic shock on the Romania's exports to EU partners in relation to China and also to the rest of the world under B projection has been felt in the highest decline registered under the U shape scenario in the context of trade relations with China.

Analysing comparatively both types of scenarios – the optimistic one (the V-shape recovery) and the less optimistic (U-shape recovery) under the assumption of A projection (meaning an uniform effect on both internal demand and international trade) and B projection (uneven internal and external transmission) presented in Figure 7, we conclude that the smallest impact of the pandemic shock was felt in the case of A projection in relation to the rest of the world, but with a lower effect in the case of the optimistic scenario (V-shape) compared with the U shape scenario. Under the assumption of the uneven transmission (B projection) and taking into account the relations with the rest of the world, the pandemic shock marks a similar pattern in both scenarios, signalling declines in 2020 with a low potential for recovery in 2021 and with a greater negative impact in the case of the U shape scenario. In the case of

trade relations with China, considering both transmission effects, the forecasts of U-shape and V-shape scenarios revealed a relatively quick recovery after the shock, although with different magnitudes, highlighting upward trends in 2021 after the decline from 2020.

5. Conclusions and future research

The aim of our paper is to assess the dependence of Romania's exports on the foreign and domestic demand, as well as on the supply factors, such as imports from other countries, especially China. Using panel data gravity models with annual data during 2008 to 2019, our results reveal that Romania's export flows are vulnerable to the decrease of demand on the markets of its twelve main EU trade partners. All our model specifications confirm that, for the case of Romania, the distance has a negative impact on exports. At the same time, as already stated in the literature, our results support that the increase of the domestic demand is also negatively impacting the Romanian exports. Moreover, a drop in imports from China or the rest of the world contributes to the reduction of the export flows. Taking into account the statistics of exported and imported goods between Romania, China and major EU partners, we discover that Romania acts as an intermediary, by importing products or parts and components from countries such as China, and then exporting them in other EU countries, where a similar process is followed. Therefore, Romania's exports are not only sensitive to the demand of its main trade partners, but also to these countries' exports to both China and the rest of the world due to the high integration of the production processes supported by globalisation. Such a situation contributes to increased vulnerability of the foreign trade in Romania.

In addition, exports from Romania are vulnerable to the effectiveness of the government in relation to the other countries and corruption control when the relation with China is included. Therefore, better perceptions related to corruption control and the effectiveness of government are also fuelling exports since Romania might be perceived as more macro-stable and desirable as trade partner. Moreover, the relationships with countries having a high degree of collectivism, similar to Romania, seems to favour bilateral trade flows. Therefore, this cultural feature tends to behave like a catalyst in the international trade flows and to discriminate between trade partners. In the case of Romania, it clusters the countries with similar collectivist cultures.

Based on the four scenarios that were constructed (combinations of V-shape and U-shape recovery with uniform and variable impact), we have estimated the impact of the pandemic in relations with all trade partners. The scenarios represent a solid starting point for the policymakers for analysing and pre-testing both internal policy and measures and also external trade relations. However, our scenarios should only act as starting point for more complex and in-depth analysis since governments behave differently as a result of the evolution of the pandemics. Another important limitation of the study is represented by the fact that it does not include in a straightforward manner a second shock generated by the pandemic during the fall-winter season. Thus, further research should focus on two directions as follows: 1) creating

more detailed scenarios for each trade partner since their behaviour depends dramatically on the sanitary and economic measures taken by their governments and 2) including the impact of a second and third pandemic shock, since the evolution might actually be a "W", a combination of "W's" or a "K".

Notes

1. VATs are a form of indirect taxation that applies to the value-added of goods and services sold. During the studied period, VAT rate changes vary between 0 and 4 percentage points.
2. United States federal antitrust authorities such as the Department of Justice and the Federal Trade Commission use the Herfindahl index as a screening tool to determine whether a proposed merger is likely to raise antitrust concerns. They consider Herfindahl indices between 0.1000 and 0.1800 to be moderately concentrated and indices above 0.1800 to be concentrated.
3. sd of residuals within groups ui
4. sd of residuals (overall error term) ei
5. Percentage of the variance is due to differences across panels. 'rho' is known as the intraclass correlation.

Disclosure statement

No potential conflict of interest was reported by the authors

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Appendices

Table 1. Variables and data sources.

Indicators	Source	Variable
Romanian exports of goods to partners	Chain linked volumes (2010), thousand euro, Seasonally and calendar adjusted data was provided by the Trade Map Database. The series has been deflated using GDP deflator (2010 = 100), euro, seasonally adjusted was provided by Quarterly National Accounts Database, Eurostat.	Xij
Romanian Domestic Demand	Chain linked volumes (2010), million euro, Seasonally and calendar adjusted data. Quarterly National Accounts Database, Eurostat	Dom_dem_i
Partner Domestic Demand	Chain linked volumes (2010), million euro, Seasonally and calendar adjusted data. Quarterly National Accounts Database, Eurostat	Dom_dem_j
The degree of similarity (between the economic size of two states)	The coefficient varies between 0 and 0.5. The value 0.5 denotes equal GDPs of both countries, and a value that tends to zero shows the low degree of similarity between the countries. The general presumption is that more developed countries have more intense trade with countries with a high degree of similarity. The greater degree of divergence between states tends to reduce exports and increase imports in the given country. $SIM_{ijt} = \left[1 - \left(\frac{GDP_{it}}{GDP_{it}+GDP_{jt}}\right)^2 - \left(\frac{GDP_{jt}}{GDP_{it}+GDP_{jt}}\right)^2\right]$	SIMij
Partner REER, Consumer Price Index	The real effective exchange rate is based on CPI index (2010 = 100), %. The source of the data is International Financial Statistics IMF database, Seasonally and calendar adjusted data. The real effective exchange rate (REER) is the weighted average of a country's currency in relation to an index or basket of other major currencies. The weights are determined by comparing the relative trade balance of a country's currency against each country within the index. This exchange rate is used to determine an individual country's currency value relative to the other major currencies in the index. Countries with the largest trading relationships would typically have the largest weightings in this comparative index, while countries with small trading relationships would have smaller weightings in the basket of currencies.	REERj
Partner Total population	Thousand persons, Seasonally and calendar adjusted data. Quarterly National Accounts Database, Eurostat	POPj
Romanian imports of goods from the rest of the world	Chain linked volumes (2010), thousand euro, Seasonally and calendar adjusted data was provided by the Trade Map Database. The series has been deflated using GDP deflator (2010 = 100), euro, seasonally adjusted was provided by Quarterly National Accounts Database, Eurostat.	imp_{iw}
Romanian imports from China	Chain linked volumes (2010), thousand euro, Seasonally and calendar adjusted data was provided by the Trade Map Database.	$imp_{ichinat}$

(*continued*)

Table 1. Continued.

Indicators	Source	Variable
	The series has been deflated using GDP deflator (2010 = 100), euro, seasonally adjusted was provided by Quarterly National Accounts Database, Eurostat.	
Partner exports to world	Chain linked volumes (2010), thousand euro, Seasonally and calendar adjusted data was provided by the Trade Map Database. The series has been deflated using GDP deflator (2010 = 100), euro, seasonally adjusted was provided by Quarterly National Accounts Database, Eurostat.	exp_{jw}
Partner exports to China	Chain linked volumes (2010), thousand euro, Seasonally and calendar adjusted data was provided by the Trade Map Database. The series has been deflated using GDP deflator (2010 = 100), euro, seasonally adjusted was provided by Quarterly National Accounts Database, Eurostat.	$exp_{jchinat}$
Average distance between RO and their partner countries (km)	Trade Map Database.	Dij
Concentration of all supplying partner countries	The concentration is based on the Herfindahl index. It is calculated by squaring the share of each country in the selected market and by summing the resulting numbers $H = \sum_{i=1}^{N} s_i^2$ where s_i is the share of the country i in the market, and N is the number of countries. The Herfindahl Index[2] (H) ranges from 1 / N to one.	Cij
Ease of doing business index	The ease of doing business score helps assess the absolute level of regulatory performance over time. An economy's ease of doing business score is reflected on a scale from 0 to 100, where 0 represents the lowest and 100 represents the best performance.	EDBi/j
Political Stability and Absence of Violence/Terrorism	Worldwide Governance Indicators (WGI), World Bank. measures perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism. Ranges from approximately −2.5 (weak) to 2.5 (strong) governance performance	Pol_stab_i/j
Regulatory Quality	Worldwide Governance Indicators (WGI), World Bank. Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. −2.5 weak; 2.5 strong	Reg_Qual_i/j
Rule of Law	Worldwide Governance Indicators (WGI), World Bank. Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. −2.5 weak; 2.5 strong	Rule_law_i/j
Government Effectiveness	Worldwide Governance Indicators (WGI), World Bank. Reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. −2.5 weak; 2.5 strong	Gov_effect_i/j
Control of Corruption	Worldwide Governance Indicators (WGI), World Bank. Reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. −2.5 weak; 2.5 strong	Corr_i/j
Economic freedom(0-100)	Heritage Foundation – The index measure the degree of economic freedom in the countries of the world.	Ec_freed_i/j

(*continued*)

Table 1. Continued.

Indicators	Source	Variable
Power distance	Hofstede Culture Compass - The extent to which the less powerful members of institutions and organisations within a country expect and accept that power is distributed unequally.	Power_dist_i/j
Individualism	Hofstede Culture Compass - The preference for a social framework in which individuals are expected to take care of only themselves and their immediate families.	Ind_i/j
Masculinity	Hofstede Culture Compass – The preference in society for achievement, heroism, assertiveness, and material rewards for success.	Masc_i/j
Uncertainty avoidance	Hofstede Culture Compass - the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity.	Uncert_i/j
Long term orientation	Hofstede Culture Compass - The general overview on dealing with the challenges of the present and the future.	Lt_orient_i/j
Border	Dummy variable, 1 for sharing a common border with Romania, 0 otherwise	border
EU	Dummy variable, 1 for EU membership, 0 otherwise	EU
OCEMN	Dummy variable, 1 for OCMEN membership, 0 otherwise	OCEMN
OECD	Dummy variable, 1 for OECD membership, 0 otherwise	OECD
Global financial crisis	Dummy variable, 1 for years of financial crisis, 0 otherwise	G_fin_cr_i/j
Language	Dummy variable, 1 for linguistic interconnected economies, 0 otherwise	Language

Table 2. Descriptive statistics for the variables used in the analysis.

	Mean	*Median*	*Maximum*	*Minimum*	*Std. Dev.*	*Skewness*	*Kurtosis*	*Jarque-Bera*	*Probability*	*Observations*
XIJ_EXP	2544555	1584099	12973616	499892.4	2522550.000	2.258	8.019	273.480	0.000	144
REAL_DOM_D_I	145376.1	141870.4	176349.8	124830.6	16700.930	0.464	1.898	12.454	0.002	144
REAL_DOM_D_J	944872.8	507548.4	2827631	39133.5	867631.800	0.668	1.934	17.535	0.000	144
SIMIJ	0.294556	0.324078	0.499077	0.087167	0.144	−0.047	1.483	13.869	0.001	144
REER_J	98.59918	99.18211	113.745	88.3415	4.485	0.239	3.974	7.063	0.029	144
POP_J	140426.3	110925.5	332422	27970.38	105924.700	0.365	1.544	15.929	0.000	144
IMP_I_W	56917.41	50941.55	83581.9	35813.8	15084.880	0.510	1.902	13.478	0.001	144
IMP_CHINA_I	2626481	2495525	3658507	1848852	604547.100	0.495	1.862	13.641	0.001	144
EXP_CHINA_J	10643186	4739009	83535400	96687.95	17492304.000	2.853	10.454	528.676	0.000	144
EXP_J_W	293358.3	219464.7	1233288	11543.6	269397.900	1.915	6.591	165.380	0.000	144
DISTANCEIJ	2853.083	2828	3828	1936	599.341	−0.150	1.947	7.194	0.027	144
CIJ	0.0725	0.065	0.14	0.04	0.026	1.259	4.103	45.345	0.000	144
EDBI	68.43333	66.5	73	65	3.216	0.499	1.437	20.642	0.000	144
EDBJ	73.42917	73	83.7	65.1	5.005	0.314	2.237	5.849	0.054	144
POLITICAL_STABIL_I	0.162647	0.179547	0.360215	0.049136	0.100	0.446	2.069	9.972	0.007	144
POLITICAL_STABIL_J	0.627643	0.613069	1.364101	−0.47378	0.369	−0.353	2.780	3.283	0.194	144
REGULATORY_QUALI_I	0.566302	0.58441	0.658256	0.445399	0.068	−0.698	2.291	14.709	0.001	144
REGULATORY_QUALI_J	1.210914	1.173062	2.047448	0.538901	0.394	0.181	2.032	6.409	0.041	144
RULE_OF_LAW_I	0.168873	0.14128	0.387541	−0.01361	0.138	0.383	1.582	15.584	0.000	144
RULE_OF_LAW_J	1.134352	1.27074	1.980403	−0.11174	0.613	−0.496	2.069	11.101	0.004	144
GOV_EFFECT_I	−0.21625	−0.25344	−0.02599	−0.35975	0.110	0.455	1.813	13.429	0.001	144
GOV_EFFECT_J	1.104549	1.171748	1.851793	−0.04731	0.528	−0.345	1.820	11.223	0.004	144
CORR_I	−0.14336	−0.13224	−0.01765	−0.2634	0.086	0.125	1.752	9.727	0.008	144
CORR_J	1.007853	1.224854	2.143759	−0.26729	0.741	−0.177	1.581	12.838	0.002	144
EC_FREED_I	65.725	65.3	69.7	61.7	2.362	0.309	2.208	6.052	0.049	144
EC_FREEDOMJ	68.96389	69	79.4	58.8	4.749	0.044	2.197	3.916	0.141	144
POWER_DISTANCE_J	50	53.5	70	11	17.143	−0.738	2.799	13.304	0.001	144
INDIVIDUALISM_J	66	69	89	30	15.519	−0.734	3.095	12.985	0.002	144
LONG_TERM_ORIENT_J	62.5	62	83	38	12.597	−0.108	2.514	1.701	0.427	144
MASCULINITY_J	56.91667	60.5	88	14	19.200	−0.536	2.971	6.894	0.032	144
UNCERTAINTY_AVOI_J	74.83333	78.5	94	35	16.605	−1.056	3.383	27.662	0.000	144

Table 3. Main assumption for the V and U simulation scenarios.

		V-shaped		U-shaped	
	EUROZONE	2020 Real GDP growth % change	2021 Real GDP growth % change	2020 Real GDP growth % change	2021 Real GDP growth % change
GERMANY	1	−4.4	3.5	−9.7	8.1
ITALY	1	−4.4	3.5	−9.7	8.1
FRANCE	1	−4.4	3.5	−9.7	8.1
HUNGARY	0	−5.2	4.1	−10.1	8.4
UK	0	−5.2	4.1	−10.1	8.4
POLAND	0	−5.2	4.1	−10.1	8.4
BULGARIA	0	−5.2	4.1	−10.1	8.4
CZECH REPUBLIC	0	−5.2	4.1	−10.1	8.4
NETHERLANDS	1	−4.4	3.5	−9.7	8.1
SPAIN	1	−4.4	3.5	−9.7	8.1
AUSTRIA	1	−4.4	3.5	−9.7	8.1
BELGIUM	1	−4.4	3.5	−9.7	8.1
ROMANIA	0	−5.2	4.1	−10.1	8.4

Source: Authors' work based on McKinsey and Oxford Economics forecasts.

Version A: Uniform transmission

The change in GDP reflects uniformly in the change of internal demand (for Romania) and also in the international trade for its partners for both years.

Version B: Uneven internal and external transmission

Romania's internal demand only records 80% of the GDP decrease for 2020.

Romania's internal demand increases with 110% of the increase of GDP, for 2021.

The international trade decreases with 130% of the decrease recorded by the GDP, for 2020.

The international trade increases only by 80% of the increase recorded by the GDP, for 2021.

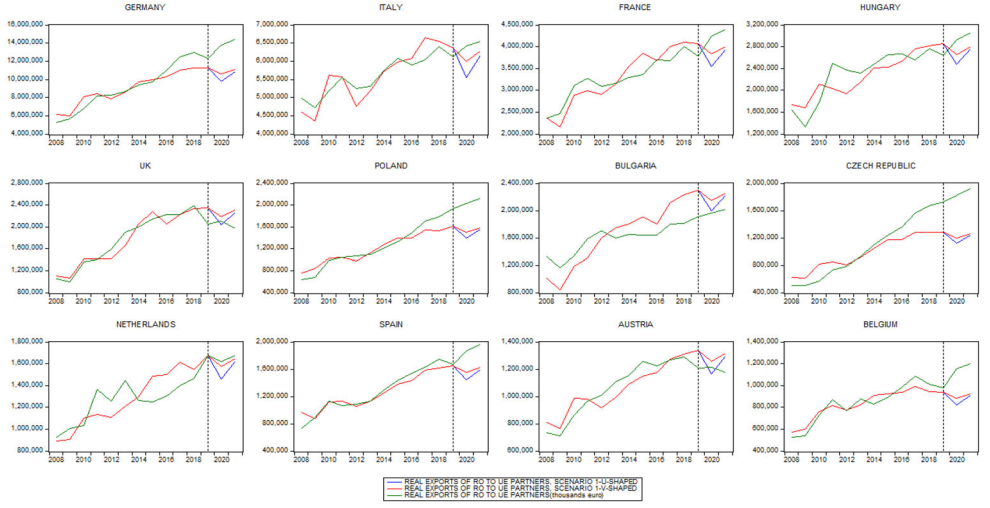

Figure 1. Forecasting the Romanian exports to EU partners-A Projection-China.

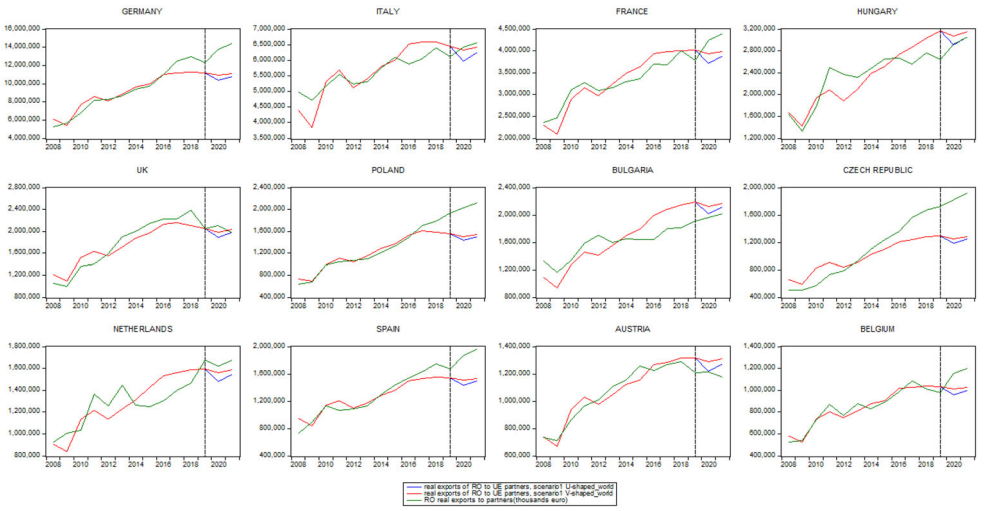

Figure 2. Forecasting the Romanian exports to EU partners-A Projection-World.

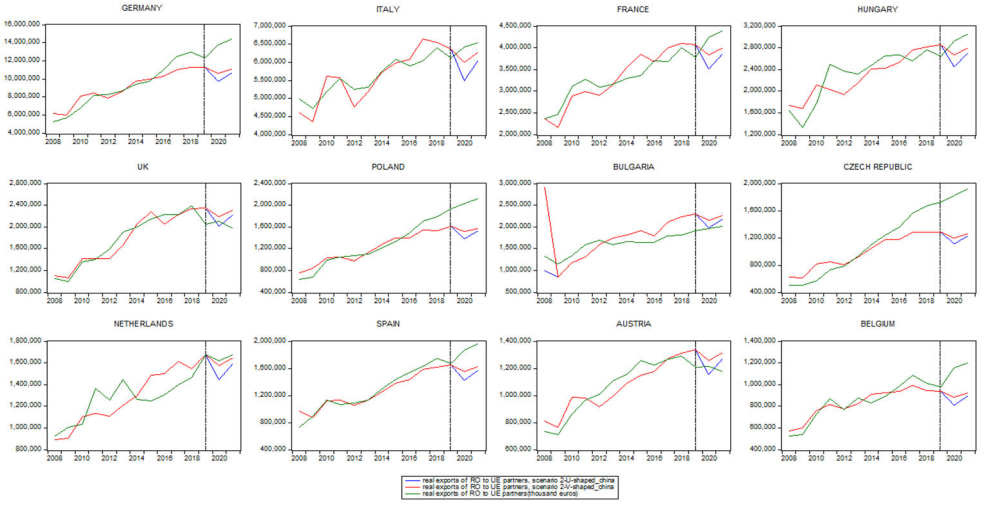

Figure 3. Forecasting the Romanian exports to EU Partners-B Projection-China.

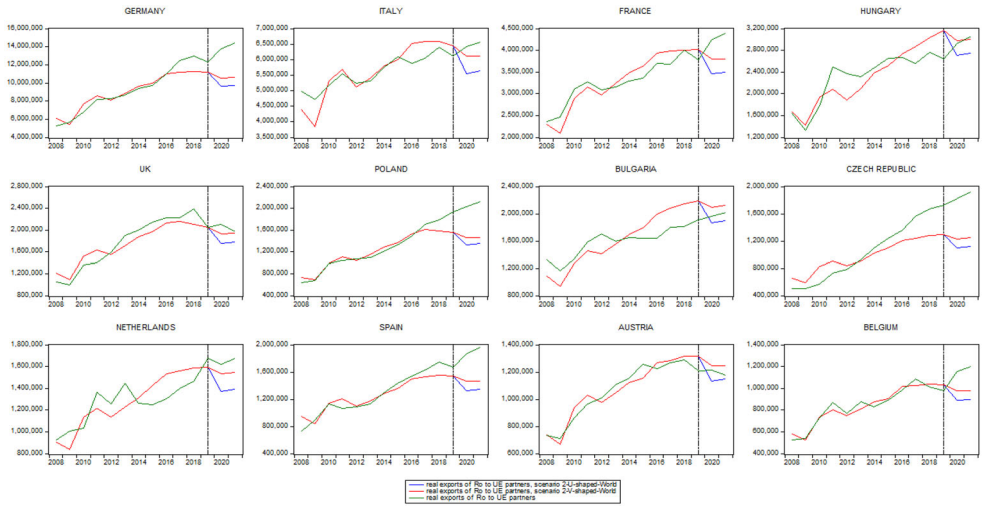

Figure 4. Forecasting the Romanian exports to EU Partners-B Projection-World.