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The Impact of Multiple Crises on the Economy. A Comparative Analysis of GFC, COVID-19 and the Ukraine War Period

Giorgiana-Roxana ENE
Bucharest University of Economic Studies, Bucharest, Romania
enegiorgiana10@stud.ase.ro

Abstract. *This paper aims to analyze the correlation between the gross domestic product (GDP) and its components as well as the Harmonized Consumer Price Index (HICP) total, electricity and gas by deploying principal components analysis and factor analysis on wards linkage and compare the results for GFC period, COVID-19 pandemic and the war in Ukraine period for EU27, Romania, Greece, Italy and Hungary. The result obtained show that each crisis has its specificity given their different source, GFC was borne in the financial system the COVID-19 crisis in the medical crisis and the war in Ukraine a military one and that starting with 2020 the economy has faced multiple crisis. Government consumption is found to be one of the significant variables for all crisis as a result of the efforts made by the governments to limit the negative effects of the GFC, pandemic and the war in Ukraine and HICP electricity and HICP gas due to the impact of COVID-19 on the supply chain prior to the war in Ukraine and the shortage of personnel, as well due to the sanctions applied to Russia and the fact that it is the main exporter for the European Union.*

Keywords: economic crisis, GFC, COVID-19, war, principal component analysis.

Introduction

In the last three years the economy has faced several shocks generated by the COVID-19 pandemic and Russia's aggression on Ukraine and economist like Kenneth Rogoff (2022) pointed that "*For the global economy, fuel and food shortages caused by the war are exacerbating post-pandemic inflation that had already reached multi-decade highs in most of the world*" while Martin Wolf (2022) emphasized that "*Disease and war have indeed shaken our world. These huge surprises have also reminded us that it is impossible to forecast the economy*".

Given that GDP represents the country's total economic output for each year and is composed of personal consumption, business investment, government spending, and net exports I thought of looking at its evolution related to HICP total, gas and electricity at the level of the European Union (27 countries) in order to observe the economic health of the EU, as well at the level of Romania, Greece, Italy and Hungary.

Lately the focus of academia has turned to analyzing the effects of the COVID-19 pandemic and war has on the economy from different points of view. The Gross Domestic Product is also considered to be an economic barometer and given its individual components which are in turn affected by the events in the last three years, I think we can talk about contagion and spillover between markets, especially for the countries that were most affected by the pandemic, respectively for those that depended on Russia's gas.

Literature review

Disasters in general lead to a decrease in productivity witch in end affect supply chain, exports and imports which in turn translate to a decrease in GDP. The evolution of GDP (per capita at purchasing power parities) related to natural disasters (earthquakes including tsunamis, floods and windstorms) was analyzed by Cavallo, Galiani et al. (2010) for 196 countries covering the period

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1970-2008 by using a synthetic control methodology. The authors conclude the only very large disasters have displayed an impact on both short and long run-on GDP growth, especially when followed by political revolution, whereas for milder events they don't find present a significant impact on GDP growth.

When it comes to the COVID-19 pandemic, another spillover effect is noticed by researches Chakraborty and Maity (2020) and Ha et al. (2022 a, b) in the energy market and global economy as a whole and high volatility of the energy sector was found present during the pandemic. According to Goodell (2020) and Zhang and Hamori (2021) the extend of the loss brought by the pandemic to the global economy, especially to the stock and energy market was more significant than other crisis such as nuclear wars and natural disasters, while Baker et al. (2020) concluded that the COVID-19 pandemic had a more severe impact on the global stock markets and oil prices compared to any other infectious disease outbreak, findings emphasized by Kumail and Itani (2021) whom noticed during the pandemic a more volatile behavior of oil prices. Other authors (Wang and Yang, 2018; Demirer et al., 2019; Liu et al., 2019) find proof of correlation between oil market volatility and geopolitical uncertainty in the sent that an increase of geopolitical uncertainty will lead to an increase of the oil market volatility.

During the Global Financial Crisis (GFC) a similar effect as the one of contagion and spillover between markets as the one during the COVID-19 pandemic and Russia's aggression on Ukraine, was noticed and several researches explained the volatility spillover in the financial markets by using the term financial contagion (Beraich et al., 2022; Diebold and Yilmaz, 2009). Diebold and Yilmaz (2012) observed, by deploying the VAR model, prior to the GFC a limited market volatility and significant market volatility and volatility spillover during the GFC, while Belcaid and Ghini (2019) observed a significant increase in volatility spillover in the USA and EU markets immediately after the GFC period as a result of the analysis of one index for the stock markets of Morocco, the US, the United Kingdom, France and Germany.

A summary of other relevant articles can be found in **Table 1** below.

Table 1. Brief review of early studies

Author(s)	Period, Variable/s, Geographical Regions and Quantitative Method/s	Outcomes
Hunt et al. (2023)	- 2001 – 2020; - virus detection and inequality; - OECD countries; - SIR-macroeconomic model.	- the authors find a bidirectional relationship between the pandemic recession and inequality; - a negative inequality-growth relationship is found present during the pandemic and inequality affects more the overall GDP growth than the GDP per capita growth; - in countries with a high detection rate of the virus the economy rebounds quickly, whereas the vice-versa is valid as well.
De La Peña and García (2023)	- Q1 2005 - Q2 2022; - domestic economy: output, consumption, inflation, monetary policy rate, corporate financing rate series and foreign economy: output, consumption, monetary policy rate; - Mexic; - Neo-Keynesian small open economy model.	- the level of the financial shocks were approximately 49% and they were the main source of contraction of the GDP in the GFC; - during the COVID-19 the demand shock level recorded was 45,1% and it seriously affected the GDP dynamic, whereas the financial shocks represented 32,2% and the productivity shock 22,3%; - the nature of the GFC and COVID-19 crisis are different, the main driver for GFC were the international financial markets demand and supply shock while for the COVID-19 pandemic

Author(s)	Period, Variable/s, Geographical Regions and Quantitative Method/s	Outcomes
		the main drivers were demand shock, financial shocks and the productivity shock.
Choi (2023)	- the full period (08.2007-07.2022), GFC, COVID-19 pandemic, Russia-Ukraine war period; - sectoral returns in USA for the S&P 500 index; - MST analysis and rolling window analysis.	- the author finds that the GFC affected the industrial sector, while COVID-19 affected the financial, IT, and industrial sectors, whereas the Russia-Ukraine affected the materials sector; - the industrial sector is proved to be highly important for USA based on the static and rolling window analysis; - a sector of very low importance and absence of correlation with other industries is found by the author to be the utilities sector.
Gagnon et al. (2023)	- 2020 – 2021; - COVID-19, GDP; - 90 countries; - panel data regressions.	- the number of deaths caused by the COVID-19 virus had a minor effect in the aggregate sample and a little bit more significant for the advanced economies; - lockdown measures are considered by the authors to be a more important measure than the number of deaths and the authors found that they had an important influence on GDP; - the structural characteristics of the economy had an important influence on the economy as a result of the pandemic and a less significant impact is found for economies more focused on manufacturing and exports and a more significant effect for economies that were more dependent on services and especially tourism.
Garcia et al. (2023)	- Autumn 2019 and the Spring 2020 European Economic Forecasts; - annual growth rate of GDP, private consumption, private investment, GDP deflator; - euro area, USA, rest of the world; - Euro Area and the Global Economy (EAGLE) model.	- from the results obtained the authors concluded that the economic activity of Luxembourg, Netherlands, Ireland and Slovenia (countries noted by the author as small open economies SOEs) declined in 2020, and the factors that had a considerable contribution were the foreign factors resulted from trade and less related to fiscal policies; - a strong international spillovers is found present for each one of the SOEs that were modelled, arising from the rest of the euro area but as well from the USA and the rest of the world.
Cardani et al. (2023)	- 2000 – 2022; - GDP, policy rate, consumption inflation, private consumption, private investment, hours worked, real wages, government primary balance to GDP, trade balance to GDP; - Euro Area, USA, Rest of the World; - estimated multi-region New Keynesian macroeconomic model.	- the impulse response function provide insight of: *(a)* private consumption demand contraction at quarterly frequency in the year 2020 and undeterred savings schocks, *(b)* a decline in hours worked, private consumption and real GDP, *(c)* the constant decrease recorded in hours worked has a negative impact on real wage growth, *(d)* the saving shock was less to non impacted to inflation expectations compared to the demand shock, *(e)* an increase in oil prices leads to higher prices of domestic manufactured products and energy prices which in the end affect the consumer; - the shock decompositions show a lenient recession in USA of approximately 10% yoy contraction in Q1 2021, whereas 15% for Euro Area; - the authors conclude that the drivers for inflation increase were the rising in comodity prices and domestic and foreign demand.
Szczygielski et al. (2022)	- 01.01.2015 – 17.07. 2020; - COVID-19, energy sector; - USA, RU, UK, CN, CA, IN,	- a greater impact of the energy sectors is found for the countries that are located further west from the COVID-19 outbreak in China and the authors find similar results for net

Author(s)	Period, Variable/s, Geographical Regions and Quantitative Method/s	Outcomes
	FR, BR, NO, IT, AU, TH, CO, JP, TW, FI, ES, KR, PL, AT; - ARCH/GARCH.	energy and oil exporters relative to importers; - the magnitude of the impact from the highest to the lowest : high for the American countries, followed by European countries and the the lowest level of impact is found present for Australia and Asian countries; - the heaviest impacted countries by COVID-19 related uncertainty on national energy sectors from each geographical regions are Brazil, Norway and Thailand, while the least impacted countries are Canada, UK and Taiwan; - the heaviest impacted countries by changes in oil prices on the global energy sector and national energy sectors from each geographical regions are Colombia, Norway and Australia, while the least impacted countries are US, Poland and India.
Mirnezami et al. (2021)	- 1990 - 2020; - GDP; - US, MX, DE, IT, ES, FR, IN, JP; - Multilayer Artificial Neural Network (MLANN).	- a decline in GDP is found present for all countries and negative double digits rates for the annualized GDP growth rate are expected to be found; - for the majority of the economies a contraction was found present in Q1 2020 and a decline in GDP growth rate was found present for USA (1,3%), Mexico (1,6%) and Japan (0,5%). A greater decline was experienced by France (5,34%), Spain (5,24%), Italy (5,31%) and Germany (2,2%) due to the strict lockdown measures, while India was the only country analyzed that recorded a 2,38% increase in growth rate; - the forecast results obtained by the authors for Q2 2020 show negative rates for GDP growth for USA (2,74%), Mexico (2,4%) and India (2,78%). The forecasted annualized GDP growth predicted negative rates for USA (10,53%), Mexico (8,3%) and India (10,67%). Also the authors predicted a contraction of the economy for France (1,78%), Spain (2,72%), Italy (2,4%) and Germany (1,04%).
Fezzi and Fanghella (2021)	- 01.01.2015 – 26.08.2020; - electricity load, temperature, residential load, GDP, excess deaths, policies; - AT, BE, DK, FR, DE, GB, IT, NL, NO, ES, SE, CH; - ARMA process and 5000 Monte Carlo simulations.	- the authors estimate the GDP loss caused by the COVID-19 pandemic during the first two quarters of 2020 in 12 countries and the results of the correlation coefficient obtained is 0.98; - in April 2020 is recorded the widest gap for electricity consumption, the estimated reduction in electricity consumption (between -15% and - 10%), after which a decrease in the gap between 2019 and 2020 is noticed as the COVID-19 restrictions ease; - the results obtained for the first two quarters of 2020 for the estimated GDP impacts are very close to the official indicators; - countries that experienced early COVID-19 outbreaks (around March) experienced an initial steep decline on GDP is observed and coincided with the introduction of lockdown measures (eg. BE, FR, IT, ES), after that a return to normalcy is noticed as a result of o reduction in restriction and number of COVID-19 cases, so the authors conclued that the results are consistent with a U-shaped economic shock; - a steeper reduction in GDP is found for GB as a result of implementing lock-down measurea later in the pandemic that resulted in a decrease (20%-30%) during the lockdown weeks and starting with August weak signs of recovery appear;

Author(s)	Period, Variable/s, Geographical Regions and Quantitative Method/s	Outcomes
		- DK implemented timely restrictions and during the lockdown period the country experienced a limited reduction in economic activity (5%-10%), while SE didn't implement strict restrictions and as a result they delayed the economic impact of the pandemic however they failed to recover together with the other countries that had imposed restrictions.
Gunay (2021)	- GFC and COVID-19 period; - exchange rates: USD/EUR, USD/GBP, USD/JPY, USD/CNY, USD/BRL, USD/TRY; - Kapetanios m-break unit root test, investigations of standalone risk measures—downside variance, upside risk, volatility skewness, Gaussian Value at Risk (VaR), historical VaR, modified VaR—and Diebold–Yilmaz volatility spillover analysis.	- by employing the Jarque–Bera test statistic indicates the author find that for the GFC the average growth in standard deviations is 2,88 while for the COVID-19 pandemic is 2,01; - the results of the Gaussian VaR model show that during the GFC an increase in market risk of 2,04 on average is found pressent during the pre-crisis and crisis periods as a result of the default of the Lehman Brothers, compared to 0,8 for the COVID-19 pandemic. The shockwave recorded for the covid-19 pandemic was only 47% of the GFC in terms of exchange rates for standalone risk measurement; - the market risk growth resulted from the historical VaR analysis is found to be just 50 % during the COVID-19 pandemic compared to GFC, while the volatility spilover is 8 times greater during the COVID-19 pandemic than the GFC; - the exchange rates USD/EUR, USD/GBP, and USD/BRL record the highest average returns in the GFC pre-crisis, while the Turkish lira and Brazilian real recorded the greatest increase in volatility received furing both crisis.
Batten et al. (2023)	- 2007 – 2022; - Chicago Board Options Exchange Volatility Index (VIX) and global banking sector; - US, CN, UK, JP, IN, FR, SW, SP, NL, DE; - DCC model with GARCH volatility.	- the authors find proof from Granger causality of: *(a)* symmetric causality during the GFC between changes in volatility and negative bank returns, *(b)* asymmetric causality during the COVID-19 pandemic between the increase in volatility and lower quartile of bank returns, *(c)* highest value-at-risk (VaR) levels are recorded during the GFC, while the lowest VaR during the Russia – Ukraine war period. - a more considerable resiliance to volatility impact is found present Asian banks compared to European banks that where the ones most affected during the COVID-19 pandemic and Russia – Ukraine war; - during the Russia – Ukraine war the volatility has a more insignificant impact on the global banking sector the compared to the other two crisis which as authors noted provide proof of a lower downside risk compared to a financial crisis.
Hosoe (2023)	- static world trade CGE model based on GTAP database version 11 for 2017; - 14 sectors and goods, consisting of agri-food products (wheat, other agriculture, and food) and energy goods (coal, oil, natural gas, electricity, and town gas); - JP, North America (incl. MX), EU, UK, EFTA, Oceania, RU, BY, UA, CN (incl. HK), IN,	- the economic sanctions applied to Russia (import tariffs and export taxes) reduced the GDP by 3% - 7 %, while for GDP senders the losses accounted for at most 0,2% in Europe and 0,05 % or even less in Japan and other Western countries; - the results of the simulation provide proof that the sanctions imposed had an impact on trade in general rather than exclusively on trade of natural gas; - price hikes were noticed in the sector of primary energies, especially in gas; - food security is found to not be a significant issue for any country, including developing ones; - the study limitations stated by the authors are the lack of

Author(s)	Period, Variable/s, Geographical Regions and Quantitative Method/s	Outcomes
	Other Asia, Middle East and North Africa, Sub-Saharan Africa, South America, Rest of the world.	considerations of other variables such as asset freezing, the blocking of Russian banks, travel bans and trade restrictions as sanction devices.
Ferriani and Gazzani (2023)	- 23.02.2022 - 31.07.2022 - major European firms listed in the Eurostoxx 600 index; - AT, ES, IT, PR, BE, FI, LU, SW, CH, FR, NL, DE, GB, NO, DN, IR, POL; - VAR model	- the results provide proof of statistically significant negative correlation between the financial performance of firms' starting with the beginning of Russia's aggression on Ukraine and their emissions and energy intensity; - the estimated coefficient on energy intensity is found to have be statistically significant meaning that a 1 p.p. increase in energy intensity results in a decrease of the company' s equity return post-war by 0,11p.p. to 0,15p.p., depending of the fixed effects (FE) specifications, while between CDS spread variations and the energy cost share on total revenues a positive relationship is found meaning that a 1 p.p. increase in energy intensity contributes to an increase of CDS spreads by 0,11p.p. to 0,31p.p. depending on the FE specification.
Chen et al. (2023)	- 01.06.2011 - 31.12.2022; - daily return data of the S&P GSCI natural gas index; - OECD countries; - new volatility ratio analysis.	- the authors categorize Russia's aggression on Ukraine and the COVID-19 pandemic as being Black Swan events; - fluctuation and high volatility of S&P GSCI variable is found present, while volatility-of-volatility began to decline rapidly in intensity before the war in Ukraine, then lasting longer to decrease in intensity in the case of the S&P GSCI natural gas index; - the results provide evidence of the persistence of energy volatility that does not decrease even following the period of the war crisis.

Source: (Authors' own work based on the literature review).

Methodology

The data analyzed consists of quarterly observations rounded up to two decimals for data series GDP, government consumption, investments, household consumption, exports, imports, and monthly observations converted to quarterly observations and rounded up to two decimals for data series Harmonized Consumer Price Index total (HICP), Harmonized Consumer Price Index for electricity and Harmonized Consumer Price Index for gas for which the data source is Eurostat website. Some values of the 2023 data series are provisional and there were no available data for variable HICP gas for Finland.

The PAC will provide further insight on how the variables are correlated throughout the following time frames: *(a)* Q1 2007 - Q42009 period representing the GFC, *(b)* Q1 2020 - Q42022 period representing the COVID-19 pandemic, the selected period is based on the fact that the first cases of COVID-19 in European countries were reported in January 2020 according to Our World in Data published statistics and in May 2023 the head of the UN World Health Organization declared an end to the COVID-19 as a public health emergency WHO (2023) and *(c)* Q1 2022 – Q32023 period representing the war in Ukraine, the selected period is based on the fact that Russia's aggression on Ukraine started on 24th February 2022.

The selected regions for which I will deploy the principal component analysis are: Greece as to it was one of the countries that was most affected during the GFC (Bank of Finland, 2018;

The New York Times, 2016), Italy due to the fact that it was one of the countries that was most affected during the COVID-19 pandemic (Sapir, 2018), Hungary given that it was one of the countries that was most affected by the war in Ukraine (European Investment Bank, 2022) as well its proximity, Romania and European Union (27 countries).

I applied the logarithmical transformation in order to normalize the data based on the skewness results which were for the majority of the variables outside the -0,5 and 0,5 interval and I have applied the second difference to log transformed data based on ADF results obtained for t-statistic, based on the skewness and ADF, for the EU27 data series, tests deployed in Eviews10. Further I deployed principal components analysis (PAC) in order to determine the correlations between the data points selected in Stata MP.

Results and discussions

From the raw data graphic representation of the GDP, HICP for electricity and HICP for gas we can notice a similar behavior of the evolution of these variables during the GFC and the COVID-19 pandemic, the GDP has a constant however small growth and the HICP indicators register a decrease at the beginning of the two moments in time, of these the HICP for gas records a greater fluctuation.

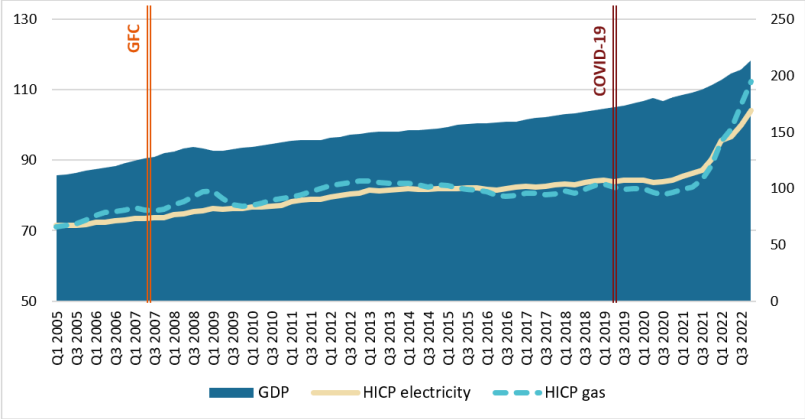


Figure 1. Graphical representation of GDP and HICP for electricity and gas

Source: (Authors' own work).

In order to determine the amount of the variation of the data that the principal components explain, I looked at the *proportion* and *cumulative proportion* results from the principal component analysis, specifically for the eigen vector value greater than one in order to retain only the fitting proportion of the variance explained and significant components. The tabular results can be found in the Appendix at **Table 6**: Principal component (eigenvalue>1), result that are also supported by the graphical representation that can be found in the Appendix at **Figure 3**: Screen Plot (eigenvalue) representation, while the summarized results can be found in the table below.

Table 2. Summarized results for the principal component analysis

	EU27 GFC	EU27 COVID-19	EU27 WAR	RO GFC	RO COVID-19	RO WAR
No. of components	2	3	4	2	4	3
Cumulative proportion	81,42%	84,95%	97,52%	68,5%	83,68%	88,35%

	EU27 GFC	EU27 COVID-19	EU27 WAR	RO GFC	RO COVID-19	RO WAR
	GR GFC	**GR COVID-19**	**GR WAR**	**IT GFC**	**IT COVID-19**	**IT WAR**
No. of components	4	4	3	3	3	3
Cumulative proportion	88,68%	82,46%	83,37%	83,45%	90,76%	93,48%
	HU GFC	HU COVID-19	HU WAR			
No. of components	3	3	3			
Cumulative proportion	85,43%	76,01%	89,82%			

Source: (Authors' own work).

Given that the results provided by the PCA show a different number of components with eigenvalue greater than one and as well as the fact that the variables have a more significant loading on the first principal component (PC) I decided to further analyze the first principal component for all geographical regions and all periods. The percentage explained by each variable in the principal can be found at **Table 6** from the Appendix and the summarized results for the first component for the values that have positive value, the results of the *Orthonormal Loadings representation* (**Figure 4** from the Appendix) which emphasize the kinship to the first component and excluded the variables that have a greater loading on the second component, are summarized in the table below.

Table 3. Summarized results for the first principal component

Variables Time frame	1st PC EU27			1st PC RO		
	Variable	**Percentage**	**Variance explained**	**Variable**	**Percentage**	**Variance explained**
Q1 2007 Q4 2009	Household consumption GDP Imports Investments Exports	41,29% 39,82% 38,41% 37,29% 37,05%	59,57%	Exports GDP Household consumption Imports Government consumption	47,48% 46,89% 43,12% 36,97% 25,11%	43%
Q1 2020 Q4 2022	Imports Investments Exports Household consumption HICP electricity HICP gas	51,06% 44,79% 38,56% 25,23% 17,90% 13,90%	37,92%	HICP electricity HICP HICP gas Household consumption Imports Government consumption	50,60% 48,29% 41,43% 27,83% 22,95% 15,14%	29,03%
Q1 2022 Q3 2023	Government consumption Household consumption HICP gas HICP electricity GDP HICP	47,74% 46,37% 43,22% 37,86% 26,85% 25,31%	34,56%	Exports Investments GDP Household consumption Government consumption	47,22% 46,25% 39,82% 21,80% 8,45%	44,34%

	1st PC GR			1st PC IT		
	Variable	**Percentage**	**Variance explained**	**Variable**	**Percentage**	**Variance explained**
Q1 2007 Q4 2009	Exports Imports HICP gas Investments HICP electricity Household consumption	51,62% 47,70% 46,25% 41,67% 26,79% 13,13%	36,87%	Household consumption Imports Exports HICP electricity Investments	47,92% 47,53% 43,61% 37,18% 32,68%	44,12%
Q1 2020 Q4 2022	Household consumption Exports Imports GDP Government consumption HICP electricity HICP gas	56,21% 44,42% 36,01% 31,41% 29,89% 28,47% 9,58%	28,48%	GDP Government consumption HICP Household consumption HICP electricity HICP gas	44,76% 38,46% 36,10% 35,81% 25,22% 22,84%	50,12%
Q1 2022 Q3 2023	GDP HICP electricity Exports Government consumption	54,99% 40,34% 38,68% 30,06%	34,94%	Household consumption HICP gas HICP electricity Government consumption HICP GDP Investments	42,64% 41,17% 39,76% 39,10% 38,23% 37,23% 10,62%	56,80%
	1stPC HU					
	Variable	**Percentage**	**Variance explained**			
Q1 2007 Q4 2009	Investments GDP Household consumption Imports Government consumption	45,08% 43,72% 43,60% 42,45% 40,38%	55,19%			
Q1 2020 Q4 2022	Government consumption Imports Household consumption GDP Exports Investments	41,43% 38,93% 36,02% 34,54% 32,61% 31,83%	40,41%			
Q1 2022 Q3 2023	Investments Household consumption GDP Exports Government consumption	47,18% 45,95% 43,36% 42,81% 32,94%	46,37%			

Source: (Authors' own work).

Further I deployed wards linkage and analyzed the dendrogram cluster graphic and based on the number of groups that show similarity (excluding the variables that don't show any similarity with other variables, if the case), tabulated the groups, generated the statistics table and then applied factor analysis on the new clusters. The detailed results can be found in the Appendix as follows: dendrogram at **Figure 5** and the factor analysis at **Table 7**.

Table 4. Summarized results for the dendrogram

	EU27 GFC	EU27 COVID-19	EU27 WAR	RO GFC	RO COVID-19	RO WAR
No. groups	4	4	2	4	5	3
Similarity	~10%	~10%	~15%	~15%	~50%	~25%
	GR GFC	GR COVID-19	GR WAR	IT GFC	IT COVID-19	IT WAR
No. groups	4	4	2	3	3	2
Similarity	~15%	~40%	~90%	~20%	~40%	~50%
	HU GFC	HU COVID-19	HU WAR			
No. groups	4	4	2			
Similarity	~20%	~55%	~40%			

Source: (Authors' own work).

The percentage explained by each variable based on the factor analysis can be found at **Table 7** from the Appendix and the summarized results for the first factor for the values that have positive value, the results of the *Orthonormal Loadings representation* (**Figure 6** from the Appendix) which emphasize the kinship to the first component and excluded the variables that have a greater loading on the second component, are summarized in the table below. For the majority of geographical regions for the Q1 2022 - Q3 2023 period the was only one factor retained.

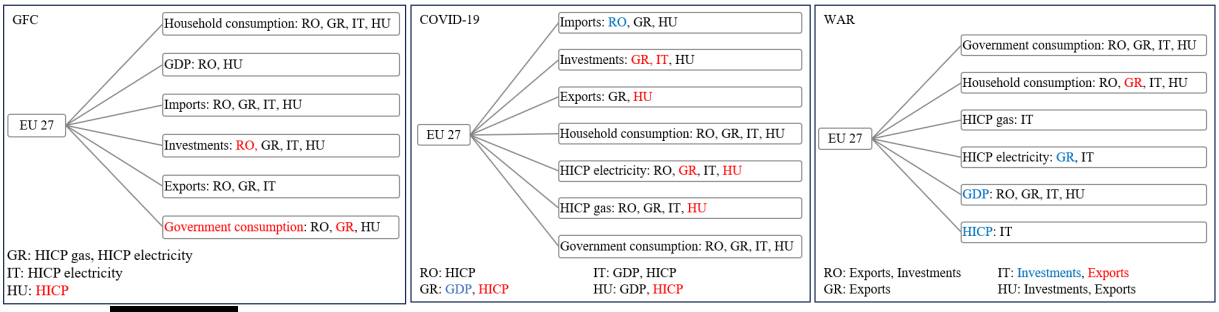
Table 5. Summarized results for the factor analysis

Variables Time frame	1st PC EU27			1st PC RO		
	Variable	Percentage	Variance explained	Variable	Percentage	Variance explained
Q1 2007 Q4 2009	Government consumption Household consumption GDP Exports Imports Investments	97,84% 97,75% 97,57% 96,03% 95,27% 94,14%	81,12%	Exports Imports GDP Household consumption Government consumption Investments	98,92% 98,89% 98,30% 90,76% 60,34% 51,89%	60,27%
Q1 2020 Q4 2022	Investments Imports Household consumption Exports HICP electricity HICP gas	97,90% 97,08% 75,17% 62,86% 62,57% 51,64%	66,03%	HICP gas HICP HICP electricity Household consumption Government consumption	99,72% 95,36% 94,46% 92,61% 90,56%	84,79%
Q1 2022 Q3 2023	Government consumption Household consumption Imports HICP electricity HICP gas	Only one factor retained	100%	GDP Exports Investments Household consumption Government consumption	98,74% 98,26% 97,99% 88,57 1,07%	67,66%

Variables Time frame	1stPC EU27			1st PC RO		
	Variable	Percentage	Variance explained	Variable	Percentage	Variance explained
Q1 2007 Q4 2009	Imports HICP electricity Exports Government consumption HICP gas Investments Household consumption	95,25% 92,20% 90,89% 81,69% 81,25% 79,76% 76,72%	62,35%	Household consumption Exports Imports HICP electricity Investments	99,98% 99,72% 99,10% 98,75% 96,28	61,50%
Q1 2020 Q4 2022	HICP gas Household consumption Investments HICP Government consumption Exports Imports	99,73% 88,36% 70,68% 54,62% 53,32% 43,35% 17,92%	43,68%	GDP HICP Government consumption Household consumption HICP electricity HICP gas Investments	99,99% 99,11% 95,61% 94,73% 89,00% 86,43% 12,58%	76,91%
Q1 2022 Q3 2023	GDP Government consumption Household consumption Imports Exports	Only one factor retained	100%	GDP Government consumption Household consumption Exports HICP HICP electricity HICP gas	Only one factor retained	100%
	1stPC HU					
	Variable	Percentage	Variance explained			
Q1 2007 Q4 2009	Investments Government consumption Household consumption GDP Imports HICP	99,72% 99,59% 97,05% 95,66% 94,72% 87,16%	66,81%			
Q1 2020 Q4 2022	Household consumption Government consumption GDP HICP gas Imports Investments HICP HICP electricity	99,99% 99,97% 99,96% 95,96% 95,91% 89,08% 85,46% 78,79%	81,68%			
Q1 2022 Q3 2023	GDP Government consumption	Only one factor retained	100%			

Variables Time frame	1stPC EU27			1st PC RO		
	Variable	Percentage	Variance explained	Variable	Percentage	Variance explained
	Household consumption Investments Exports					

Source: (Authors' own work).



Legend: common PCA and FA
PCA
FA

Figure 2. Summarized results for PCA and FA

Source: (Authors' own work).

I aggregated the results obtained in the PCA and FA (factor analysis) in order to observe the commonality between countries depending on the time frames analyzed related to EU27 and as well the values that weren't common, results that can be found in the figure above.

Based on these results we can see the difference between the three crisis and given that the source of each crisis is different, the GFC was borne in the financial system the COVID-19 crisis in the medical crisis and the war in Ukraine a military one, each of them with different effects on the economy. The findings are as follows:

(a) the countries with the most similar results are Romania and Hungary no matter the time frame,
(b) during the GFC:
   i. the variables identified for all the countries as significant are Household consumption, Imports and Investments, result that is expected given the fact that during the GFC period the purchasing power of the population decreased, which spilled over to imports and separately investor uncertainty had an impact on investments,
   ii. GDP in one of the variables for RO and HU that are significant meaning that is one of the variables that was affected during the GFC,
   iii. Exports for RO, GR, IT which is related to the facts stated at pt. i.
(c) during the COVID-19 pandemic:
   i. the variables identified for all the countries are Household consumption, HICP electricity, HICP gas and Government consumption,
   ii. Imports for RO, GR and HU and Export for GR and HU as a result of the restrictions imposed by the pandemic which affected the work force and the supply chain; Romania is not found for Exports given that it is a predominantly an importing country,

iii. HICP electricity and HICP gas are significant given that during the pandemic the prices began to increase as a result of supply chain deficiencies caused by the restrictions imposed as well as tensions between Russia and Ukraine,
iv. given that HICP is found significant for all countries because the purchasing power of the population decreased during the pandemic, however it is not found to be significant at EU27 level which could be explained by the fact that the government of other countries instated stricter rules regarding price regulation throughout the pandemic,
v. more variables are found significant compared to GFC and the war in Ukraine which could reflect the novelty character of a worldwide pandemic and the capacity of governments to react fast in order to contain the pandemic and mitigate its risks, although there were several other pandemics recorded throughout the history.

(d) during the war:
i. the variables identified for all the countries are Government consumption, GDP and Household consumption,
ii. HICP electricity for IT and HICP gas for GR and IT and given that compared to the pandemic period the number of countries decreased it could be given that the government of those countries managed to take faster measures and made provisions in order to mitigate the effects of the war,
iii. Household consumption is found to be relevant due to two factors, first of all due to the fact that an increase in energy prices lead to an increase of prices in general and second Ukraine is one of the biggest exporters of grains which as well put pressure on prices.

(e) Government consumption in one of the variables found present as significant for every crisis which could be explained by the government efforts to mitigate the effects of the crisis,
(f) no matter the source of the crisis GDP is one of the variables that will be significant given its componence.

Conclusions

The novelty of the article is being the first to analyze the dynamic of these variables by using the PAC, however further analysis is needed to better determine the extent of the dependency between these variables. Also, it is important to mention that given that the variables government consumption, investments, household consumption, exports and imports are components of GDP it can be said that the GDP was affected on every occasion GFC, COVID-19 pandemic as well during Russia's aggression on Ukraine but at a different level and the PCA and FA analysis provide insight on the level of significance of it, respectively of each component of GDP.

GDP is found to be a significant variable during all time frames, similar to the findings of De La Peña and García (2023) which identified a contraction of GDP both during the GFC and COVID-19, Gagnon et al. (2023) and Fezzi and Fanghella (2021) found that the lockdown measures during the COVID-19 pandemic had an important influence on GDP, Cardani et al. (2023) found proof of a decline in real GDP and similar Mirnezami et al. (2021) found a decrease in GDP in Q1 2020 for France, Spain and Italy, while Hosoe (2023) found during Russia's aggression on Ukraine a decrease in GDP as a result of the sanctions applied to Russia which impacted general trade.

Investments represent one of the economic variables that show the stability, health and prospects of growth of the economy and is one of the variables that is found significant for all geographical regions (EU27, RO, GR, IT, HU) during the GFC, and for the majority of the regions

(EU27, GR, HU, IT) during the COVID pandemic which is expected given the increase in uncertainty, volatility of exchange rates, increase in unemployment and decrease of wages and similar results were found by Gunay (2021) who concluded that market risk growth is found to be just 50 % during the COVID-19 pandemic compared to GFC and that the shockwave recorded for the covid-19 pandemic was only 47% of the GFC in terms of exchange rates for standalone risk measurement.

When it comes to energy HICP electricity and HICP gas are found relevant for all regions during the pandemic given that the prices began to increase as a result of supply chain deficiencies caused by the restrictions imposed as well as tensions between Russia and Ukraine, while the significance reduced at region level during the war in Ukraine given that the government of those countries managed to take faster measures and made provisions in order to mitigate the effects of the war, and countries such as Romania managed to make sufficient supplies in order to cover the national consumption. Similar result related to energy were identified by Cardani et al. (2023) which found an increase in energy prices, Hosoe (2023) found price hikes in the sector of primary energies, especially in gas as a result of the war in Ukraine, authors Chakraborty and Maity (2020) and Ha et al. (2022 a, b) noticed a spillover effect in the energy market and global economy as a whole and as well high volatility of the energy sector, while Ferriani and Gazzani (2023) found that the estimated coefficient on energy intensity is found to have be statistically significant meaning starting with the beginning of Russia's aggression on Ukraine.

Thus, we can conclude that the results show the specificity of each crisis and in what concerns the economic situation starting with 2020 it is noticed that the significant variables are investments as a result of the fact that the population is uncertain with on the future due to the pandemic and the war, the household consumption as a result of the restrictions imposed during the pandemic and the situation between Russia and Ukraine (both in terms of electricity and food prices; Ukraine being a major exporter of grain), exports and imports were affected due to the limitation measures and subsequently the sanctions applied to Russia and the reluctance of countries to import and export from and to Russia, and the price of energy (electricity and gas) increased as a result of the impact of COVID-19 on the supply chain prior to the war in Ukraine and the shortage of personnel, as well due to the sanctions applied to Russia and the fact that it is the main exporter for the European Union, government consumption as a result of the efforts made by the governments to limit the negative effects of the GFC, pandemic and the war in Ukraine and, in the end GDP given that all changes in the economy reflect in the GDP.

The current study has limitations as to it provides insight only on the significant variables for the three crises, however the results can be further used for a more thorough analysis targeted on the specific of each one of the crises.

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Appendix

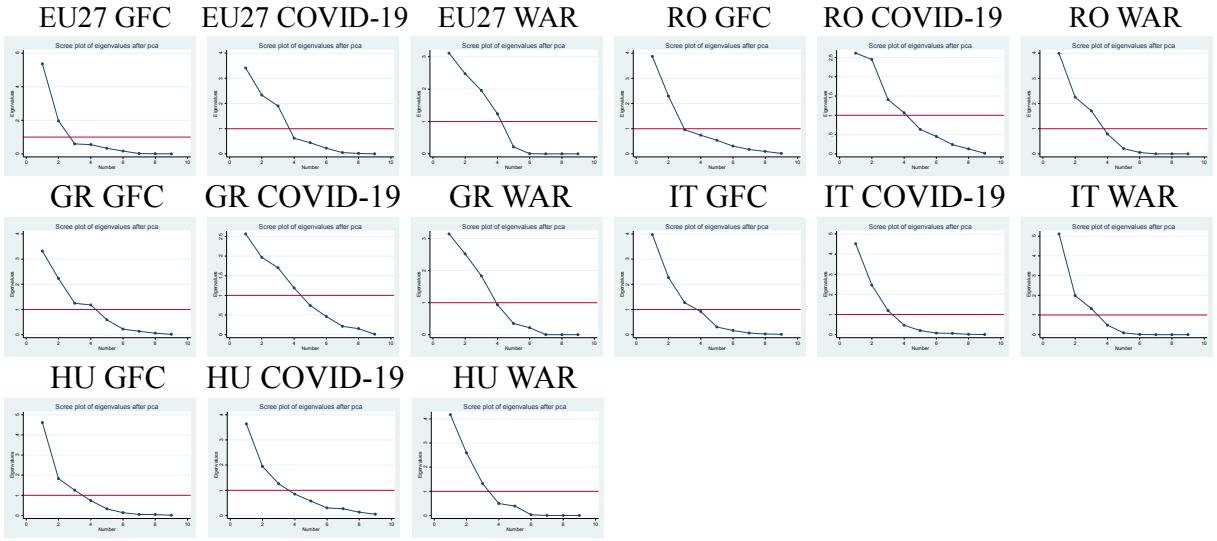


Figure 3. Screen Plot (eigenvalue) representation

Source: (Authors' own work).

EU27 GFC

Principal components/correlation — Number of obs = 12; Number of comp. = 2; Trace = 9; Rotation: (unrotated = principal); Rho = 0.8142

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	5.36161	3.39565	0.5957	0.5957
Comp2	1.96596	1.36979	0.2184	0.8142
Comp3	.596165	.0473413	0.0662	0.8804
Comp4	.548824	.217774	0.0610	0.9414
Comp5	.33105	.164615	0.0368	0.9782
Comp6	.166435	.143161	0.0185	0.9967
Comp7	.0232739	.0185443	0.0026	0.9993
Comp8	.00472959	.00277474	0.0005	0.9998
Comp9	.00195486	.	0.0002	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
d2GDPEU27	0.3982	0.1000	.13
d2Governm~27	0.3244	-0.3231	.2307
d2Househo~27	0.4129	0.1459	.04408
d2Investm~27	0.3729	0.2394	.1417
d2Exports~27	0.3705	0.2579	.1333
d2Imports~27	0.3841	0.2721	.06324
d2HICPEU27	0.2545	-0.3683	.3861
d2HICPele~27	-0.1621	0.5966	.1595
d2HICPgas~27	-0.2254	0.4181	.3839

EU27 COVID-19

Principal components/correlation — Number of obs = 12; Number of comp. = 3; Trace = 9; Rotation: (unrotated = principal); Rho = 0.8495

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.41273	1.08085	0.3792	0.3792
Comp2	2.33188	.430576	0.2591	0.6383
Comp3	1.9013	1.27966	0.2113	0.8495
Comp4	.621646	.180655	0.0691	0.9186
Comp5	.440991	.217543	0.0490	0.9676
Comp6	.223448	.17337	0.0248	0.9924
Comp7	.0500781	.0328021	0.0056	0.9980
Comp8	.017276	.0166233	0.0019	0.9999
Comp9	.00065265	.	0.0001	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Unexplained
d2GDPEU27	-0.3235	-0.0461	0.5283	.1072
d2Governm~27	-0.4073	-0.0083	0.4183	.101
d2Househo~27	0.2523	0.0289	0.5030	.2996
d2Investm~27	0.4479	-0.1019	0.2277	.1927
d2Exports~27	0.3856	-0.3793	0.1155	.1318
d2Imports~27	0.5106	-0.0805	0.0416	.09179
d2HICPEU27	-0.0665	-0.4735	0.3485	.2312
d2HICPele~27	0.1790	0.5534	0.1831	.1127
d2HICPgas~27	0.1390	0.5530	0.2665	.0861

EU27 WAR

Principal components/correlation — Number of obs = 7; Number of comp. = 4; Trace = 9; Rotation: (unrotated = principal); Rho = 0.9752

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.11008	.638158	0.3456	0.3456
Comp2	2.47192	.512537	0.2747	0.6202
Comp3	1.95939	.723843	0.2177	0.8379
Comp4	1.23554	1.02101	0.1373	0.9752
Comp5	.214538	.206014	0.0238	0.9991
Comp6	.0085234	.0085234	0.0009	1.0000
Comp7	0	0	0.0000	1.0000
Comp8	0	0	0.0000	1.0000
Comp9	0	.	0.0000	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Unexplained
d2GDPEU27	0.2685	0.3134	-0.5120	0.1032	.00622
d2Governm~27	0.4774	-0.0090	0.1185	-0.3687	.09557
d2Househo~27	0.4637	0.3259	-0.0640	0.1567	.03037
d2Investm~27	-0.0391	0.5059	-0.1301	0.4609	.06684
d2Exports~27	-0.2494	0.4799	0.3350	-0.0829	.00889
d2Imports~27	-0.1645	0.2337	0.6052	0.2207	.002886
d2HICPEU27	0.2531	0.4210	0.1540	-0.5019	.00508
d2HICPele~27	0.3786	-0.1957	0.2046	0.5523	.0006337
d2HICPgas~27	0.4322	-0.1978	0.3983	0.0629	.006578

RO GFC

Principal components/correlation — Number of obs = 12; Number of comp. = 2; Trace = 9; Rotation: (unrotated = principal); Rho = 0.6850

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.87015	1.57546	0.4300	0.4300
Comp2	2.29469	1.337	0.2550	0.6850
Comp3	.95769	.216516	0.1064	0.7914
Comp4	.741174	.204203	0.0824	0.8737
Comp5	.536971	.228979	0.0597	0.9334
Comp6	.307993	.132734	0.0342	0.9676
Comp7	.175259	.0771693	0.0195	0.9871
Comp8	.0980893	.0801011	0.0109	0.9980
Comp9	.0179882	.	0.0020	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
d2GDPRO	0.4689	0.0211	.1481
d2Governme~O	0.2511	-0.4539	.2833
d2Househol~O	0.4312	0.2531	.1333
d2Investme~O	0.0611	-0.4056	.6081
d2ExportsRO	0.4748	-0.1431	.08054
d2ImportsRO	0.3697	0.0463	.4662
d2HICPRO	-0.3645	0.0939	.4657
d2HICPelec~O	0.1787	0.5174	.2622
d2HICPgasRO	0.0239	0.5156	.3878

RO COVID-19

Principal components/correlation — Number of obs = 12; Number of comp. = 4; Trace = 9; Rho = 0.8368
Rotation: (unrotated = principal)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.61239	.163648	0.2903	0.2903
Comp2	2.44874	1.04137	0.2721	0.5623
Comp3	1.40736	.344449	0.1564	0.7187
Comp4	1.06291	.429799	0.1181	0.8368
Comp5	.633114	.181264	0.0703	0.9072
Comp6	.45185	.212345	0.0502	0.9574
Comp7	.239504	.110308	0.0266	0.9840
Comp8	.129197	.114259	0.0144	0.9983
Comp9	.0149377	.	0.0017	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Unexplained
d2GDPRO	-0.0349	0.5594	0.1701	0.1001	.1792
d2Governme~O	0.1514	0.1617	-0.6222	0.4969	.06873
d2Househol~O	0.2783	0.1857	0.6846	0.1684	.02349
d2Investme~O	-0.1183	0.4673	-0.0164	-0.3196	.3197
d2ExportsRO	-0.4134	-0.2410	0.1300	0.2550	.3183
d2ImportsRO	0.2295	0.5152	-0.1089	0.1165	.1812
d2HICPRO	0.4829	-0.0747	-0.2280	-0.2786	.2216
d2HICPelec~O	0.5060	-0.2042	0.0434	-0.3571	.0908
d2HICPgasRO	0.4143	-0.1928	0.1799	0.5733	.06562

RO WAR

Principal components/correlation — Number of obs = 7; Number of comp. = 3; Trace = 9; Rho = 0.8835
Rotation: (unrotated = principal)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.99032	1.7383	0.4434	0.4434
Comp2	2.25201	.542401	0.2502	0.6936
Comp3	1.70961	.924429	0.1900	0.8835
Comp4	.785184	.575723	0.0872	0.9708
Comp5	.209461	.156047	0.0233	0.9941
Comp6	.053414	.053414	0.0059	1.0000
Comp7	0	0	0.0000	1.0000
Comp8	0	0	0.0000	1.0000
Comp9	0	.	0.0000	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Unexplained
d2GDPRO	0.3982	0.2280	0.2177	.1693
d2Governme~O	0.0845	0.5008	-0.3748	.1665
d2Househol~O	0.2180	0.5109	0.2366	.1269
d2Investme~O	0.4625	0.0289	0.2679	.02168
d2ExportsRO	0.4722	0.0672	-0.0107	.09981
d2ImportsRO	-0.1589	-0.0369	0.7067	.04249
d2HICPRO	-0.2946	0.3903	0.3262	.1286
d2HICPelec~O	-0.4492	0.1950	0.1405	.0754
d2HICPgasRO	-0.1898	0.4890	-0.2424	.2174

GR GFC

Principal components/correlation — Number of obs = 12; Number of comp. = 4; Trace = 9; Rho = 0.8868
Rotation: (unrotated = principal)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.3186	1.08432	0.3687	0.3687
Comp2	2.23428	.984848	0.2483	0.6170
Comp3	1.24943	.0705896	0.1388	0.7558
Comp4	1.17884	.590941	0.1310	0.8868
Comp5	.587901	.36502	0.0653	0.9521
Comp6	.222881	.0884375	0.0248	0.9769
Comp7	.134443	.0753778	0.0149	0.9918
Comp8	.0590654	.0445088	0.0066	0.9984
Comp9	.0145566	.	0.0016	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Unexplained
d2GDPGR	-0.1710	0.5767	-0.1211	0.1029	.129
d2Governme~R	0.0070	0.4886	-0.3761	0.3472	.1476
d2Househol~R	0.1313	0.3486	0.5837	0.3916	.06483
d2Investme~R	0.4167	-0.0757	-0.5316	-0.1181	.04135
d2ExportsGR	0.5162	-0.0298	0.1981	-0.0877	.05577
d2ImportsGR	0.4770	0.2095	-0.2262	0.1626	.05189
d2HICPGR	0.0159	-0.3892	0.0556	0.6746	.1204
d2HICPelec~R	0.2679	0.2832	0.3464	-0.4239	.2209
d2HICPgasGR	0.4625	-0.1583	0.0839	0.1806	.187

GR COVID-19

Principal components/correlation — Number of obs = 12; Number of comp. = 4; Trace = 9; Rho = 0.8246
Rotation: (unrotated = principal)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.56339	.596293	0.2848	0.2848
Comp2	1.96709	.263533	0.2186	0.5034
Comp3	1.70356	.515774	0.1893	0.6927
Comp4	1.18779	.448808	0.1320	0.8246
Comp5	.738979	.277126	0.0821	0.9068
Comp6	.461853	.250893	0.0513	0.9581
Comp7	.210961	.0566809	0.0234	0.9815
Comp8	.15428	.14218	0.0171	0.9987
Comp9	.0121001	.	0.0013	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Comp4	Unexplained
d2GDPGR	0.3141	0.3101	-0.2091	0.0160	.4832
d2Governme~R	0.2989	0.2357	0.1904	-0.6640	.07628
d2Househol~R	0.5621	-0.1162	0.1198	-0.0237	.1383
d2Investme~R	-0.2754	0.3455	0.3904	0.4081	.1133
d2ExportsGR	0.4442	0.0526	0.2536	0.2656	.2955
d2ImportsGR	0.3601	-0.4298	-0.0335	0.4848	.02316
d2HICPGR	0.0549	0.6095	0.2178	0.2437	.1102
d2HICPelec~R	0.2847	0.3674	-0.4468	0.0919	.1766
d2HICPgasGR	0.0958	-0.1466	0.6639	-0.1352	.1616

GR WAR

Principal components/correlation — Number of obs = 7; Number of comp. = 3; Trace = 9; Rho = 0.8337
Rotation: (unrotated = principal)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.14456	.621503	0.3494	0.3494
Comp2	2.52306	.6871	0.2803	0.6297
Comp3	1.83596	.902907	0.2040	0.8337
Comp4	.933049	.587001	0.1037	0.9374
Comp5	.346048	.128718	0.0384	0.9759
Comp6	.217331	.217331	0.0241	1.0000
Comp7	0	0	0.0000	1.0000
Comp8	0	0	0.0000	1.0000
Comp9	0	.	0.0000	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Unexplained
d2GDPGR	0.5499	-0.0150	0.0195	.0477
d2Governme~R	0.3006	0.4803	0.2354	.03218
d2Househol~R	-0.0663	0.5539	-0.0016	.212
d2Investme~R	-0.4211	0.1882	0.3108	.1758
d2ExportsGR	0.3868	0.2490	-0.3501	.148
d2ImportsGR	-0.3113	-0.0946	-0.2781	.5308
d2HICPGR	-0.0794	0.1867	0.6709	.0658
d2HICPelec~R	0.4034	-0.1932	0.2927	.2367
d2HICPgasGR	-0.0997	0.5326	-0.3345	.04747

IT GFC

Principal components/correlation — Number of obs = 12; Number of comp. = 3; Trace = 9; Rho = 0.8345
Rotation: (unrotated = principal)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.97049	1.7024	0.4412	0.4412
Comp2	2.2681	.996454	0.2520	0.6932
Comp3	1.27164	.355814	0.1413	0.8345
Comp4	.915828	.614311	0.1018	0.9362
Comp5	.301516	.135145	0.0335	0.9697
Comp6	.166372	.101831	0.0185	0.9882
Comp7	.0645408	.0369749	0.0072	0.9954
Comp8	.027566	.0136204	0.0031	0.9985
Comp9	.0139455	.	0.0015	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Unexplained
d2GDPIT	-0.1239	0.5983	0.2826	.02579
d2Governme~T	-0.0587	0.6074	0.2667	.0591
d2Househol~T	0.4792	0.0388	-0.0949	.07326
d2Investme~T	0.3268	0.0089	0.5755	.1548
d2ExportsIT	0.4361	0.1818	-0.0200	.1696
d2ImportsIT	0.4753	-0.1053	0.0524	.07453
d2HICPIT	0.2053	0.3589	-0.3954	.3417
d2HICPelec~T	0.3718	-0.1881	0.2455	.2942
d2HICPgasIT	-0.2199	-0.2515	0.5377	.2969

IT COVID-19

Principal components/correlation — Number of obs = 12; Number of comp. = 3; Trace = 9; Rho = 0.9076
Rotation: (unrotated = principal)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	4.51044	2.05094	0.5012	0.5012
Comp2	2.45951	1.26143	0.2733	0.7744
Comp3	1.19807	.733886	0.1331	0.9076
Comp4	.464186	.264103	0.0516	0.9591
Comp5	.200082	.121423	0.0222	0.9814
Comp6	.0786596	.0150154	0.0087	0.9901
Comp7	.0636442	.0463626	0.0071	0.9972
Comp8	.0172816	.00915642	0.0019	0.9991
Comp9	.00812517	.	0.0009	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Unexplained
d2GDPIT	0.4476	-0.1055	0.2221	.009839
d2Governme~T	0.3846	-0.2993	0.1619	.08105
d2Househol~T	0.3581	0.3931	0.0522	.03807
d2Investme~T	-0.0096	-0.2218	0.8481	.01683
d2ExportsIT	-0.3478	0.3431	0.3138	.04679
d2ImportsIT	-0.3953	0.0815	0.2255	.2178
d2HICPIT	0.3610	-0.2096	-0.0520	.3007
d2HICPelec~T	0.2522	0.5117	-0.0244	.06846
d2HICPgasIT	0.2284	0.5152	0.2232	.05238

IT WAR

Principal components/correlation — Number of obs = 7; Number of comp. = 3; Trace = 9; Rotation: (unrotated = principal); Rho = 0.9348

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	5.11158	3.13149	0.5680	0.5680
Comp2	1.9801	.658691	0.2200	0.7880
Comp3	1.3214	.839936	0.1468	0.9348
Comp4	.481469	.387377	0.0535	0.9883
Comp5	.0940918	.0827354	0.0105	0.9987
Comp6	.0113564	.0113564	0.0013	1.0000
Comp7	0	0	0.0000	1.0000
Comp8	0	0	0.0000	1.0000
Comp9	0	.	0.0000	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Unexplained
d2GDPIT	0.3723	-0.2959	0.2943	.003803
d2Governme~T	0.3910	0.2368	0.2056	.05172
d2Househol~T	0.4264	0.0179	-0.1416	.04364
d2Investme~T	0.1062	0.0460	0.8371	.01211
d2ExportsIT	0.0584	0.6914	-0.1182	.01766
d2ImportsIT	-0.1958	0.5955	0.1947	.05179
d2HICPIT	0.3823	0.0882	-0.0001	.2374
d2HICPelec~T	0.3976	-0.0010	-0.1522	.1613
d2HICPgasIT	0.4117	0.1164	-0.2743	.007583

HU GFC

Principal components/correlation — Number of obs = 12; Number of comp. = 3; Trace = 9; Rotation: (unrotated = principal); Rho = 0.8543

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	4.60713	2.77808	0.5119	0.5119
Comp2	1.82905	.576817	0.2032	0.7151
Comp3	1.25224	.515973	0.1391	0.8543
Comp4	.736262	.407269	0.0818	0.9361
Comp5	.328993	.189954	0.0366	0.9726
Comp6	.139039	.0883835	0.0154	0.9881
Comp7	.0506558	.00402886	0.0056	0.9937
Comp8	.046627	.0366268	0.0052	0.9989
Comp9	.0100001	.	0.0011	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Unexplained
d2GDPHU	0.4372	0.1965	0.0167	.04849
d2Governme~U	0.4038	-0.2788	0.0312	.1054
d2Househol~U	0.4360	-0.0860	0.2261	.04684
d2Investme~U	0.4508	-0.1223	0.0900	.02602
d2ExportsHU	0.1803	0.3655	-0.5457	.2331
d2ImportsHU	0.4245	-0.0067	-0.2565	.08742
d2HICPHU	0.1689	0.2595	0.5763	.3294
d2HICPelec~U	-0.0749	0.4878	0.4483	.2873
d2HICPgasHU	0.0754	0.6499	-0.2072	.1476

HU COVID-19

Principal components/correlation — Number of obs = 12; Number of comp. = 3; Trace = 9; Rotation: (unrotated = principal); Rho = 0.7601

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	3.63721	1.68969	0.4041	0.4041
Comp2	1.94751	.691502	0.2164	0.6205
Comp3	1.25601	.407852	0.1396	0.7601
Comp4	.84816	.278399	0.0942	0.8543
Comp5	.569761	.272406	0.0633	0.9176
Comp6	.297354	.0324293	0.0330	0.9507
Comp7	.264925	.13549	0.0294	0.9801
Comp8	.129435	.0798039	0.0144	0.9945
Comp9	.049631	.	0.0055	1.0000

Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Unexplained
d2GDPHU	0.3454	-0.1232	-0.1610	.5039
d2Governme~U	0.4134	-0.1134	-0.4171	.1349
d2Househol~U	0.3602	-0.3109	-0.0470	.337
d2Investme~U	0.3183	-0.3760	-0.1796	.3157
d2ExportsHU	0.3261	-0.2627	0.5082	.1543
d2ImportsHU	0.3893	0.0753	0.4388	.1959
d2HICPHU	0.2653	0.4148	0.3480	.2568
d2HICPelec~U	0.2710	0.4035	-0.4393	.1733
d2HICPgasHU	0.2775	0.5695	-0.0278	.08734

HU WAR

Principal components/correlation — Number of obs = 7; Number of comp. = 3; Trace = 9; Rotation: (unrotated = principal); Rho = 0.8982

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	4.17295	1.57869	0.4637	0.4637
Comp2	2.59426	1.27791	0.2883	0.7519
Comp3	1.31635	.820408	0.1463	0.8982
Comp4	.495939	.106297	0.0551	0.9533
Comp5	.389642	.358773	0.0433	0.9966
Comp6	.0308692	.0308692	0.0034	1.0000
Comp7	0	0	0.0000	1.0000
Comp8	0	0	0.0000	1.0000
Comp9	0	.	0.0000	1.0000

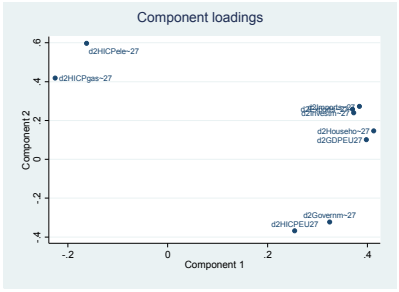
Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Unexplained
d2GDPHU	0.4336	0.1456	-0.2922	.04805
d2Governme~U	0.3294	0.3190	-0.1413	.2571
d2Househol~U	0.4595	0.0061	0.2738	.02024
d2Investme~U	0.4718	0.0203	-0.0105	.07
d2ExportsHU	0.4281	-0.1152	0.3391	.04942
d2ImportsHU	0.1295	0.4661	-0.4421	.1092
d2HICPHU	-0.0038	0.3503	0.7004	.03584
d2HICPelec~U	-0.1895	0.4701	0.1283	.2552
d2HICPgasHU	-0.1840	0.5499	0.0466	.0714

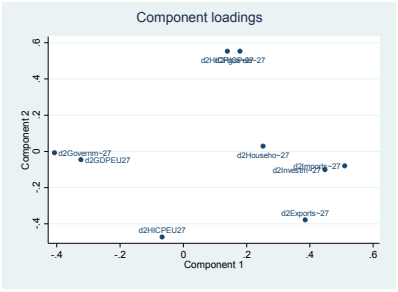
Table 6. Principal component (eigenvalue>1)

Source: (Authors' own work).

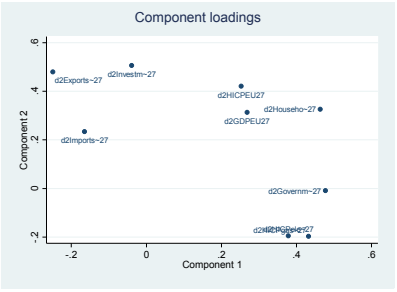
EU27 GFC



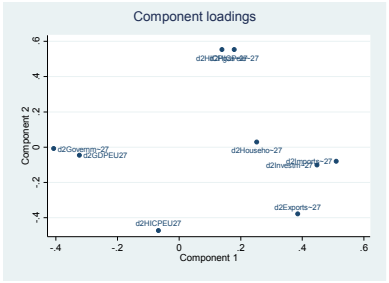
EU27 COVID-19



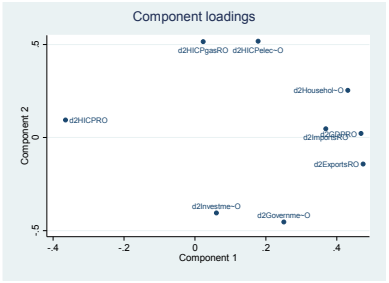
EU27 WAR



RO GFC



RO COVID-19



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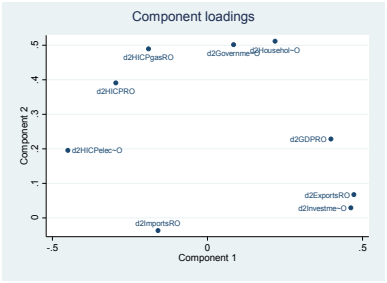


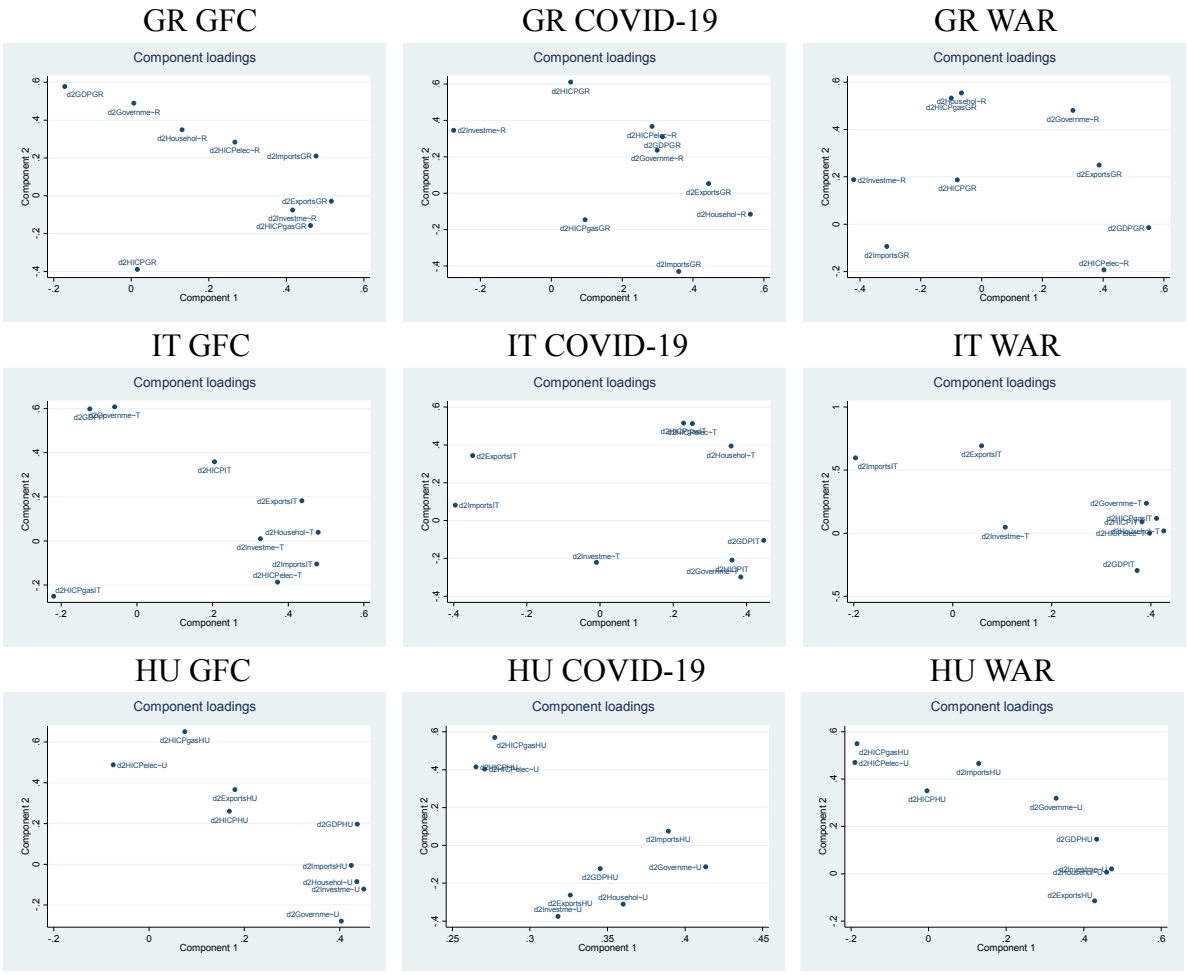
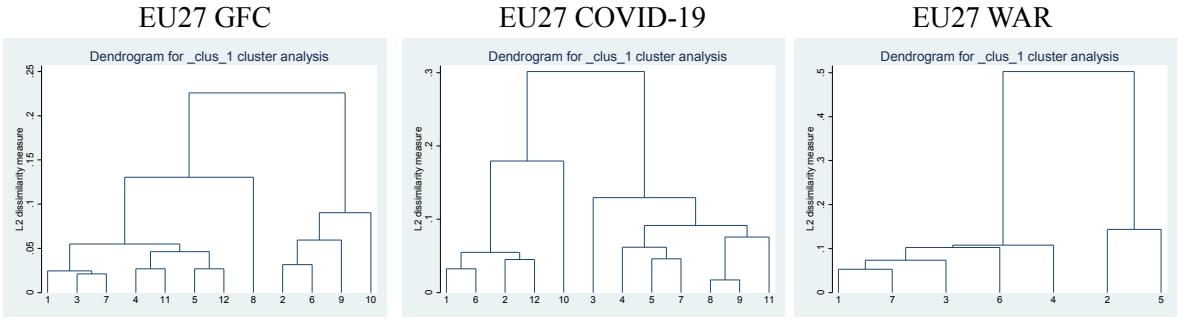


Figure 4. Orthonormal Loadings representation

Source: (Authors' own work).



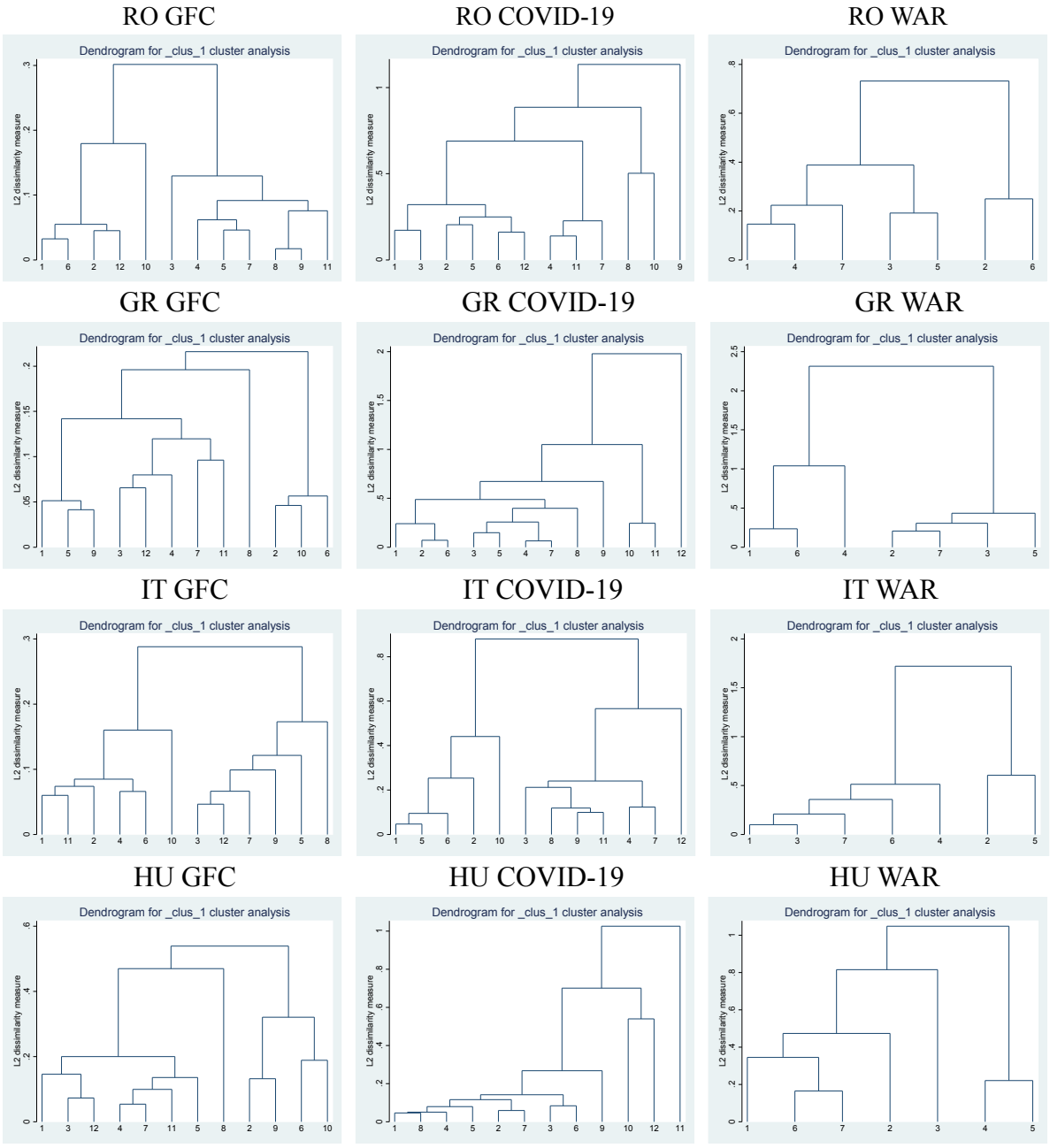


Figure 5. Dendrogram representation

Source: (Authors' own work).

EU27 GFC

Factor analysis/correlation — Number of obs = 4; Method: principal factors — Retained factors = 3; Rotation: (unrotated) — Number of params = 24

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	7.30042	5.65659	0.8112	0.8112
Factor2	1.64384	1.58810	0.1826	0.9938
Factor3	0.05574	0.05574	0.0062	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	0.00000	0.00000	0.0000	1.0000
Factor7	0.00000	0.00000	0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) = . Prob>chi2 = .

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Uniqueness
d2GDPEU27	0.9757	0.2064	0.0740	0.0000
d2Governm-27	0.9784	-0.2056	0.0220	0.0000
d2Househo-27	0.9775	0.1928	0.0658	0.0000
d2Investm-27	0.9414	0.3285	-0.0764	0.0000
d2Exports-27	0.9603	0.2716	0.0629	0.0000
d2Imports-27	0.9527	0.3036	-0.0154	0.0000
d2HICPEU27	0.9476	-0.2950	-0.1229	0.0000
d2HICPele-27	-0.3405	0.9347	-0.1020	0.0000
d2HICPgas-27	-0.8402	0.5359	0.0829	0.0000

EU27 COVID-19

Factor analysis/correlation — Number of obs = 4; Method: principal factors — Retained factors = 3; Rotation: (unrotated) — Number of params = 24

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	5.94292	3.50400	0.6603	0.6603
Factor2	2.43892	1.82077	0.2710	0.9313
Factor3	0.61815	0.61815	0.0687	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	0.00000	0.00000	0.0000	1.0000
Factor7	0.00000	0.00000	0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) = . Prob>chi2 = .

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Uniqueness
d2GDPEU27	-0.9014	0.3506	0.2542	0.0000
d2Governm-27	-0.8991	0.3625	0.2454	-0.0000
d2Househo-27	0.7517	0.3483	0.5601	-0.0000
d2Investm-27	0.9790	-0.1908	0.0712	-0.0000
d2Exports-27	0.6286	-0.7378	0.2462	0.0000
d2Imports-27	0.9708	-0.2164	0.1038	-0.0000
d2HICPEU27	-0.8960	-0.3627	0.2561	-0.0000
d2HICPele-27	0.6257	0.7601	-0.1753	-0.0000
d2HICPgas-27	0.5164	0.8523	0.0829	-0.0000

EU27 WAR

Factor analysis/correlation — Number of obs = 2; Method: principal factors — Retained factors = 1; Rotation: (unrotated) — Number of params = 9

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	9.00000	9.00000	1.0000	1.0000
Factor2	0.00000	0.00000	0.0000	1.0000
Factor3	0.00000	0.00000	0.0000	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	-0.00000	0.00000	-0.0000	1.0000
Factor6	-0.00000	0.00000	-0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) = . Prob>chi2 = .

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Uniqueness
d2GDPEU27	-1.0000	-0.0000
d2Governm-27	1.0000	0.0000
d2Househo-27	1.0000	0.0000
d2Investm-27	-1.0000	0.0000
d2Exports-27	-1.0000	0.0000
d2Imports-27	1.0000	-0.0000
d2HICPEU27	-1.0000	-0.0000
d2HICPele-27	1.0000	-0.0000
d2HICPgas-27	1.0000	0.0000

RO GFC

Factor analysis/correlation — Number of obs = 4; Method: principal factors — Retained factors = 3; Rotation: (unrotated) — Number of params = 24

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	5.94292	3.50400	0.6603	0.6603
Factor2	2.43892	1.82077	0.2710	0.9313
Factor3	0.61815	0.61815	0.0687	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	0.00000	0.00000	0.0000	1.0000
Factor7	0.00000	0.00000	0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) = . Prob>chi2 = .

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Uniqueness
d2GDPEU27	-0.9014	0.3506	0.2542	0.0000
d2Governm-27	-0.8991	0.3625	0.2454	-0.0000
d2Househo-27	0.7517	0.3483	0.5601	-0.0000
d2Investm-27	0.9790	-0.1908	0.0712	-0.0000
d2Exports-27	0.6286	-0.7378	0.2462	0.0000
d2Imports-27	0.9708	-0.2164	0.1038	-0.0000
d2HICPEU27	-0.8960	-0.3627	0.2561	-0.0000
d2HICPele-27	0.6257	0.7601	-0.1753	-0.0000
d2HICPgas-27	0.5164	0.8523	0.0829	-0.0000

RO COVID-19

Factor analysis/correlation — Number of obs = 5; Method: principal factors — Retained factors = 4; Rotation: (unrotated) — Number of params = 30

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	5.42435	2.45533	0.6027	0.6027
Factor2	2.96902	2.50475	0.3299	0.9326
Factor3	0.46427	0.32191	0.0516	0.9842
Factor4	0.14236	0.14236	0.0158	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	0.00000	0.00000	0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) = 210.64 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Factor4	Uniqueness
d2GDPRO	0.9830	0.0806	-0.1647	0.0107	0.0000
d2Governme-O	0.6034	-0.7482	0.1012	0.2567	-0.0000
d2Househol-O	0.9076	0.4178	-0.0054	-0.0405	0.0000
d2Investme-O	0.5189	-0.6594	0.5302	-0.1218	0.0000
d2ExportsRO	0.9892	-0.0519	-0.1252	0.0564	0.0000
d2ImportsRO	0.9889	0.1010	-0.1091	0.0010	0.0000
d2HICPRO	-0.9928	-0.0298	-0.0102	0.1155	0.0000
d2HICPelec-O	0.2411	0.9519	0.1807	-0.0560	-0.0000
d2HICPgasRO	0.0293	0.9346	0.2922	0.2005	0.0000

RO WAR

Factor analysis/correlation — Number of obs = 3; Method: principal factors — Retained factors = 2; Rotation: (unrotated) — Number of params = 17

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	6.08925	3.17851	0.6766	0.6766
Factor2	2.91075	2.91075	0.3234	1.0000
Factor3	0.00000	0.00000	0.0000	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	0.00000	0.00000	0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) = . Prob>chi2 = .

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Uniqueness
d2GDPRO	0.9874	0.1585	-0.0000
d2Governme-O	0.0107	-0.9999	-0.0000
d2Househol-O	0.8857	0.4643	-0.0000
d2Investme-O	0.9799	0.1995	-0.0000
d2ExportsRO	0.9826	-0.1856	-0.0000
d2ImportsRO	-0.1507	0.9886	-0.0000
d2HICPRO	-0.7994	0.6008	-0.0000
d2HICPelec-O	-0.9474	0.3199	-0.0000
d2HICPgasRO	-0.9190	-0.3942	-0.0000

GR GFC

Factor analysis/correlation — Number of obs = 4; Method: principal factors — Retained factors = 3; Rotation: (unrotated) — Number of params = 24

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	5.61109	2.91453	0.6235	0.6235
Factor2	2.69656	2.00421	0.2996	0.9231
Factor3	0.69235	0.69235	0.0769	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	0.00000	0.00000	0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) = 35.89 Prob>chi2 = 0.4740

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Uniqueness
d2GDPGR	0.3887	-0.9191	-0.0649	0.0000
d2Governme-R	0.8169	-0.4771	-0.3242	0.0000
d2Househol-R	0.7672	-0.4166	0.4877	0.0000
d2Investme-R	0.7976	0.4741	-0.3729	0.0000
d2ExportsGR	0.9089	0.4118	0.0661	0.0000
d2ImportsGR	0.9525	0.2377	-0.1904	0.0000
d2HICPGR	-0.5696	0.8113	0.1319	0.0000
d2HICPelec-R	0.9220	0.0869	0.3773	-0.0000
d2HICPgasGR	0.8125	0.5780	0.0760	0.0000

GR COVID-19

Factor analysis/correlation — Number of obs = 4; Methods principal factors — Retained factors = 3; Rotation: (unrotated) — Number of params = 24

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	3.93105	0.55939	0.4368	0.4368
Factor2	3.37165	1.67436	0.3746	0.8114
Factor3	1.69730	1.69730	0.1886	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	0.00000	0.00000	0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) = 36.06 Prob>chi2 = 0.4659

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Uniqueness
d2GDPGR	-0.4504	0.6591	0.6023	-0.0000
d2Governme-R	0.5332	0.7772	0.3341	-0.0000
d2Househol-R	0.8836	-0.3379	0.3242	-0.0000
d2Investme-R	0.7068	0.6217	-0.3375	0.0000
d2ExportsGR	0.4335	-0.7340	0.5228	-0.0000
d2ImportsGR	0.1792	-0.8736	0.4524	-0.0000
d2HICPGR	0.5462	0.6962	0.4658	-0.0000
d2HICPelec-R	-0.8065	0.2142	0.5510	-0.0000
d2HICPgasGR	0.9973	0.0088	-0.0727	0.0000

GR WAR

Factor analysis/correlation — Number of obs = 2; Method: principal factors — Retained factors = 1; Rotation: (unrotated) — Number of params = 9

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	9.00000	9.00000	1.0000	1.0000
Factor2	0.00000	0.00000	0.0000	1.0000
Factor3	0.00000	0.00000	0.0000	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	-0.00000	0.00000	-0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) =-5.2e+02 Prob>chi2 = 1.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Uniqueness
d2GDPGR	1.0000	0.0000
d2Governme-R	1.0000	0.0000
d2Househol-R	1.0000	0.0000
d2Investme-R	1.0000	0.0000
d2ExportsGR	1.0000	0.0000
d2ImportsGR	-1.0000	0.0000
d2HICPGR	-1.0000	0.0000
d2HICPelec-R	-1.0000	0.0000
d2HICPgasGR	1.0000	-0.0000

IT GFC

Factor analysis/correlation — Number of obs = 3; Method: principal factors — Retained factors = 2; Rotation: (unrotated) — Number of params = 17

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	5.53542	2.07085	0.6150	0.6150
Factor2	3.46458	3.46458	0.3850	1.0000
Factor3	0.00000	0.00000	0.0000	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	-0.00000	0.00000	-0.0000	1.0000
Factor6	-0.00000	0.00000	-0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) =-2.1e+02 Prob>chi2 = 1.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Uniqueness
d2GDPIT	-0.1014	0.9948	0.0000
d2Governme-T	-0.0137	0.9999	0.0000
d2Househol-T	0.9998	-0.0198	0.0000
d2Investme-T	0.9628	-0.2701	0.0000
d2ExportsIT	0.9972	0.0745	0.0000
d2ImportsIT	0.9910	-0.1339	0.0000
d2HICPIT	0.1265	0.9920	0.0000
d2HICPelec-T	0.9875	-0.1574	0.0000
d2HICPgasIT	-0.7940	-0.6079	0.0000

IT COVID-19

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	6.92165	4.84330	0.7691	0.7691
Factor2	2.07835	2.07835	0.2309	1.0000
Factor3	0.00000	0.00000	0.0000	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	-0.00000	0.00000	-0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) =-2.1e+02 Prob>chi2 = 1.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Uniqueness
d2GDPIT	0.9999	-0.0112	-0.0000
d2Governme-T	0.9561	-0.2931	-0.0000
d2Househol-T	0.9473	0.3204	-0.0000
d2Investme-T	0.1258	-0.9921	-0.0000
d2ExportsIT	-0.7640	0.6452	-0.0000
d2ImportsIT	-0.9946	0.1039	0.0000
d2HICPIT	0.9911	-0.1328	0.0000
d2HICPelec-T	0.8900	0.4559	-0.0000
d2HICPgasIT	0.8643	0.5030	-0.0000

IT WAR

Factor analysis/correlation — Number of obs = 2; Method: principal factors — Retained factors = 1; Rotation: (unrotated) — Number of params = 9

Beware: solution is a Heywood case (i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	9.00000	9.00000	1.0000	1.0000
Factor2	0.00000	0.00000	0.0000	1.0000
Factor3	0.00000	0.00000	0.0000	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	-0.00000	0.00000	-0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) =-5.3e+02 Prob>chi2 = 1.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Uniqueness
d2GDPIT	1.0000	-0.0000
d2Governme-T	1.0000	-0.0000
d2Househol-T	1.0000	-0.0000
d2Investme-T	-1.0000	-0.0000
d2ExportsIT	1.0000	-0.0000
d2ImportsIT	-1.0000	-0.0000
d2HICPIT	1.0000	-0.0000
d2HICPelec-T	1.0000	-0.0000
d2HICPgasIT	1.0000	0.0000

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HU GFC

Factor analysis/correlation — Number of obs = 4
Method: principal factors — Retained factors = 3
Rotation: (unrotated) — Number of params = 24

Beware: solution is a Heywood case
(i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	6.01312	3.78661	0.6681	0.6681
Factor2	2.22651	1.46614	0.2474	0.9155
Factor3	0.76037	0.76037	0.0845	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	-0.00000	0.00000	-0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) = . Prob>chi2 = .

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Uniqueness
d2GDPHU	0.9566	0.2662	0.1190	0.0000
d2Governme~U	0.9959	-0.0849	0.0319	0.0000
d2Househol~U	0.9705	-0.1192	0.2095	0.0000
d2Investme~U	0.9972	-0.0056	0.0741	0.0000
d2ExportsHU	0.0791	0.9645	-0.2520	0.0000
d2ImportsHU	0.9472	0.1630	0.2762	0.0000
d2HICPHU	0.8716	-0.4463	-0.2029	0.0000
d2HICPelec~U	-0.7109	-0.2094	0.6714	0.0000
d2HICPgasHU	-0.0406	0.9666	0.2530	0.0000

HU COVID-19

Factor analysis/correlation — Number of obs = 3
Method: principal factors — Retained factors = 2
Rotation: (unrotated) — Number of params = 17

Beware: solution is a Heywood case
(i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	7.35151	5.70302	0.8168	0.8168
Factor2	1.64849	1.64849	0.1832	1.0000
Factor3	0.00000	0.00000	0.0000	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	-0.00000	0.00000	-0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) = -2.1e+02 Prob>chi2 = 1.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Uniqueness
d2GDPHU	0.9996	0.0271	0.0000
d2Governme~U	0.9997	0.0246	0.0000
d2Househol~U	0.9999	-0.0112	0.0000
d2Investme~U	0.8908	0.4544	0.0000
d2ExportsHU	0.6063	0.7952	0.0000
d2ImportsHU	0.9591	0.2830	0.0000
d2HICPHU	0.8546	-0.5194	0.0000
d2HICPelec~U	0.7879	-0.6157	0.0000
d2HICPgasHU	0.9596	-0.2813	-0.0000

HU WAR

Factor analysis/correlation — Number of obs = 2
Method: principal factors — Retained factors = 1
Rotation: (unrotated) — Number of params = 9

Beware: solution is a Heywood case
(i.e., invalid or boundary values of uniqueness)

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	9.00000	9.00000	1.0000	1.0000
Factor2	0.00000	0.00000	0.0000	1.0000
Factor3	0.00000	0.00000	0.0000	1.0000
Factor4	0.00000	0.00000	0.0000	1.0000
Factor5	0.00000	0.00000	0.0000	1.0000
Factor6	-0.00000	0.00000	-0.0000	1.0000
Factor7	-0.00000	0.00000	-0.0000	1.0000
Factor8	-0.00000	0.00000	-0.0000	1.0000
Factor9	-0.00000	.	-0.0000	1.0000

LR test: independent vs. saturated: chi2(36) = . Prob>chi2 = .

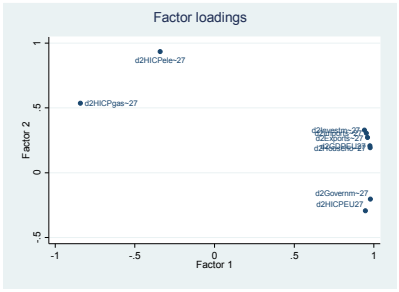
Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Uniqueness
d2GDPHU	1.0000	-0.0000
d2Governme~U	1.0000	0.0000
d2Househol~U	1.0000	-0.0000
d2Investme~U	1.0000	0.0000
d2ExportsHU	1.0000	-0.0000
d2ImportsHU	-1.0000	-0.0000
d2HICPHU	-1.0000	0.0000
d2HICPelec~U	-1.0000	0.0000
d2HICPgasHU	-1.0000	-0.0000

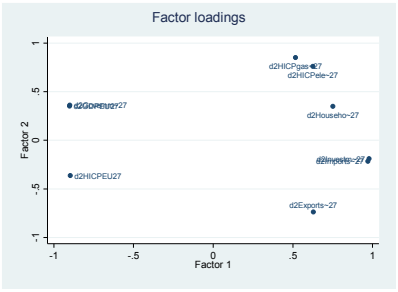
Table 7. Factor analysis on Wards linkage cluster

Source: (Authors' own work).

EU27 GFC



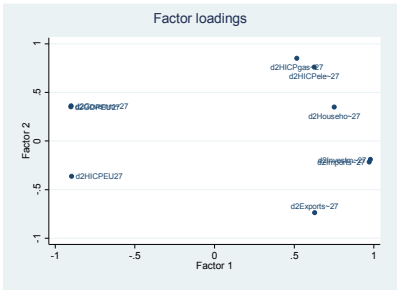
EU27 COVID-19



EU27 WAR

Only one factor retained

RO GFC



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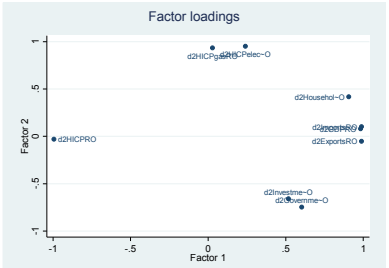

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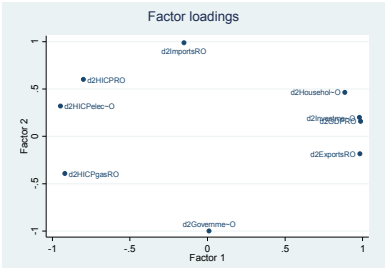
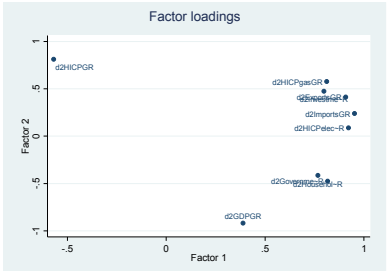
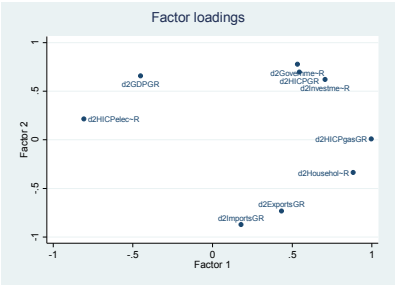


GR GFC



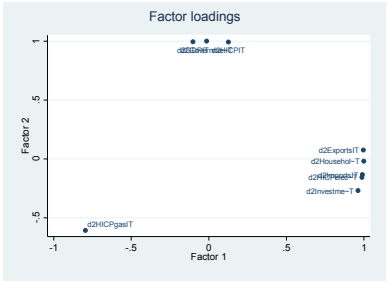
GR COVID-19



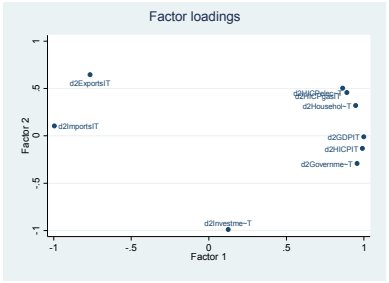
GR WAR

Only one factor retained

IT GFC



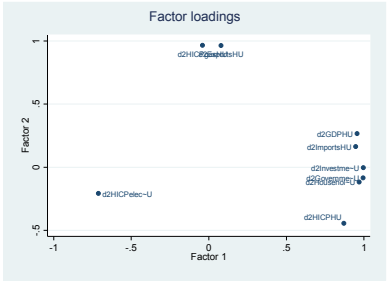
IT COVID-19



IT WAR

Only one factor retained

HU GFC



HU COVID-19

HU WAR

Only one factor retained

Figure 6. Orthonormal Loadings representation

Source: (Authors' own work).