

## The relationship between external factors and economic growth: Differences between the global financial crisis and the COVID-19 pandemic from a Granger causality perspective

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**Abstract.** *The paper investigates the causal relationship between external factors and economic growth in three countries from Central and Eastern Europe and contains a series of complex analyses on the study of typologies of economic crises. The study includes Markov-Switching Autoregressive (MS-AR) models for characterizing business cycles, and the Granger causality technique is used to analyze the relationship between external shocks and economic growth, separately during financial and pandemic crises. The results indicated that, in the case of Romania, the global financial crisis has a longer period of negative growth rates, but a faster recovery from health crisis. It is also noted that the Czech Republic and Hungary have a more stable economic evolution over time. In addition, the causality test indicates unidirectional causality between external factors and the GDP growth rate during financial and pandemic crises.*

**Keywords:** external shocks, economic growth, COVID-19 pandemic, financial crisis, Granger causality.

**JEL Classification:** E17, E32, E37, E58.

## 1. Introduction

The sustainability of economic growth is one of the most discussed topics in the period of economic decline and is also of great importance in the process of managing economic crises. The economic crises have had various causes, a recent example being the economic decline caused by the spread of the SARS-COV2 virus worldwide, which has affected economic activity in an unprecedented way. Thus, the mobility restrictions adopted to combat the spread of the virus have led to the interruption of economic activities in certain sectors of the economy, but also to the slowdown of production processes in all sectors of activity.

One of the most well-known extreme economic events of the last two decades has been the global financial crisis, which has materialized mainly through a decline in the financial sector and its subsequent spread throughout the economy. Therefore, history shows countless causes that can lead to economic recessions, and some of them are very difficult to predict. However, the main challenge is how to manage them, to ensure rapid but sustainable economic growth. However, depending on the type of economic crisis, many factors hinder the recovery process, which do not depend directly on the affected national economy, but on the evolution of the international economy.

The empirical studies of economic cycles and their characteristics are the most common in the literature, but recent literature is not very developed in terms of comparisons between different types of economic crises, nor comparative analyzes of their evolution in terms of external factors and vulnerabilities. Therefore, the recent health crisis favors the comparative study to provide a better understanding of the vulnerabilities in the management process of economic crises, depending on their typology.

It is well known that the great financial crisis has had a major impact on the economic policies and laws related to the bank's lending activities. During the financial crisis, the world economy experienced the most severe economic recession in decades, with hyperinflation and high unemployment rates, balance of payments disequilibrium and a severe external debt burden with long-lasting effects. Furthermore, there was a significant relationship between the external factors and economic growth as there are two possible effects of external debt burden on economic growth. The negative effect that led to the crowding out of private investments and the crowding-in Keynesian effect, which causes a positive multiplier effect on national output. Also, the disruption in the market's supply and demand equilibrium have led to increases in producer and final consumer prices, generating hyperinflation and balance of payments disequilibrium.

Based on this, the paper proposes a series of analyzes to identify the effects of external factors on economic growth rates in several Central and Eastern European countries, depending on the typologies of economic crises identified over the last two decades. The results of the study provide important information about the current economic context regarding the economy's sensitivity to external factors and make a comparison between three strongly correlated economies to identify possible weaknesses that could lead to severe systemic effects.

## 2. Literature review

There is a vast body of literature that studies the business cycles and their characteristics, but only part of it has dealt over time with the analysis of the impact of external factors on economic growth. Ndubuisi (2017) analyzed the impact of external debt on economic growth through several indicators such as external debt, external debt service, external reserves, and exchange rate and found that there is a unidirectional causality between external debt and GDP. It is also mentioned that the relationship between external debt and GDP could be bidirectional, since debt capital adds to capital formation and has a positive impact on economic growth, but also reduces real GDP through capital outflows.

Gómez-Puig and Sosvilla-Rivero (2015) also studied the existence of bidirectional causality between public debt and economic growth and show that the level of debt has a negative effect on economic growth in several European countries. However, they conclude that further research is needed to better understand and quantify the different effects of public debt on short-term and long-term growth, given the importance of policy implications. Feldstein (2014) argues that a low growth rate means lower government revenues, and in times of economic stress, governments may be forced to increase their debt levels to maintain their wealth, to stimulate short-term demand, and to ensure a high long-term growth rate. Wang et al. (2021) studied the relationship between external debt and economic growth and found that an increase in external debt may predict a slowdown in economic growth in the short and medium term. Similarly, Sosa (2008) points out that the external shocks of economic growth are the main factors that can predict the economic fluctuations in Mexico. Therefore, in addition to the study of the determinants of economic crises, in the literature, the analysis of the impact of external factors provides important information on the current economic context and the main weaknesses of the economy, thus helping to manage them more efficiently. The literature confirms the theoretical expectations that external factors can predict the economic fluctuations but does not provide a clear picture of these relationships depending on the type of economic recession, this being particularly important given the specific effects on certain sectors of activity.

The paper proposes a series of analyzes to identify the effects of external factors on economic growth rates, in three Central and Eastern European countries, depending on the typologies of economic crises identified over the last two decades. The main objectives of the research are to identify the typologies of economic crises and to highlight the current economic context regarding the economy's sensitivity to external factors and the potential severe systemic effects.

The work is structured in two interconnected sections. While the first part deals with identifying the phases of economic cycles, the second part uses the initial results to conduct a comparative study on the effects of external factors on economic growth.

## 3. Methodology

The empirical study involves a series of complex analyses on the typologies of economic crises, as well as the determination of external factors that have a significant impact on their management process.

In order to achieve this goal, the data used were seasonally adjusted and extracted from Eurostat's database, in quarterly frequency, from January 2005 to December 2023, for three strongly correlated developing countries from Central and Eastern European, namely the Czech Republic, Hungary, and Romania, to study the generalized correlated evolution of the economy in this geographical area. Table 1 shows the degree of correlation of quarterly economic growth rates between the three economies.

The paper is structured in two main parts. In the first part, we aim to determine the typologies of economic crises, using economic growth rates of the real Gross Domestic Product, to capture the phases of the economic cycle through the transition probabilities. At this stage, one of the most used methods is applied to identify the typologies of economic crises, namely the Markov-Switching model, which involves estimating the probabilities of being situated within two regimes of the economic cycle. This method was developed by Hamilton (1989), who argues that the rate of economic growth follows a first-order autoregressive process, which means that the value at time  $t$  always depends on the value at time  $t - 1$ . The MS-AR (1) model is defined by equation (1).

$$\Delta y_t = \mu_{S_t} + \beta_{S_t} \Delta y_{t-1} + \sigma \varepsilon_t \quad (1)$$

where,  $\mu_{S_t}$  represents the average of the growth rates related to each regime  $S_t$ ,  $\beta_{S_t}$  is the estimated coefficient related to the growth rate from time  $t - 1$ , and  $\sigma \varepsilon_t$  represents the variance of the estimated errors. The estimation of the model generates the transition probabilities, used to define the two time-horizons, which will capture separately the characteristics of the recession periods. After estimating the transition probabilities, they are subjected to filtering (Hamilton, 1989) and smoothing (Kim, 1994) algorithms to eliminate excessive variations. The model estimation was performed using the software program MATLAB, implemented by Engle (2005) for quarterly data series.

In the second part of the paper, we focus on the study of the impact of several external factors on the economic growth rate, such as the foreign producer price index (PPI for EU-27) to study the potential inflation implications, the real exchange rate and external debt to include the external debt burden and balance of payments disequilibrium effects, the foreign interest rate (3 months - EURIBOR) to capture the monetary policy measures in the economic crisis management process, as well as the Gross Domestic Product of the European Union, as a proxy of the foreign output. Methods such as the Augmented Dickey-Fuller Stationarity test (ADF), the Johansen Cointegration test, the Vector Error Correction Model (VECM) and the Granger causality test are applied to determine the relationship between external factors and the growth rate, on each of the two time-horizons.

In the analysis of time series, before applying the cointegration test to determine the short- and long-term dynamics of the variables, an analysis of the stationarity of the analysed variables must be performed. For this purpose, we apply the Augmented Dickey-Fuller (ADF) test. Therefore, to avoid false results, the analysis of the order of integration of all variables uses unit root tests, whose hypotheses are described by equation (2), and the validation of the null hypothesis captures the existence of the unit root.

$$\begin{cases} H_0: \beta = 0 \\ H_1: \beta < 0 \end{cases} \quad (2)$$

Therefore, the Johansen cointegration test is applied to all analysed variables that have the same integration order. Dwyer (2015) describes two types of Johansen cointegration tests with the same conclusion, namely, the maximum eigenvalue test and the trace test.

The trace test has the following hypotheses:

$$\begin{cases} H_0: \text{rank}(\Pi) = r_0 \\ H_1: r_0 < \text{rank}(\Pi) \leq n \end{cases} \quad (3)$$

where,  $\Pi$  represents the matrix of adjustment parameters and cointegration vectors, estimated based on a vector autoregressive model (VAR),  $r_0$  represents the rank of the matrix  $\Pi$ , and  $n$  represents the maximum number of cointegration vectors. The Johansen test is a test of the null hypothesis of no cointegration against the alternative of cointegration.

Similarly to Ndubuisi (2017), to determine the direction of causality between variables, we use the Granger causality test (Granger, 1969). The test is based on error correction (ECM). Thus, according to the Granger algorithm, there is a causal relationship between external factors and the growth rate only if the values of the external factors can be used to predict future values of growth rates.

The estimation of the model was performed using the EViews econometric software. Therefore, applying the methodology described above, we capture economic relationships that can provide valuable information on the economy's sensitivity to the external factors, both during the global financial crisis and during the health crisis. These may highlight the current state of the economy and directions for economic policy measures in the management process of economic crises.

#### 4. Data and results

To achieve the study objectives, three Central and Eastern European countries were analyzed, whose economic growth rate series are strongly correlated since 2005. Table 1 shows the degree of correlation of quarterly economic growth rates, from January 2005 to December 2023. It can be observed, a strong correlation of 75% between the Czech economy and the other two economies and a correlation of 68.02% between Romania and Hungary. Therefore, the analysis of the three countries can provide valuable information about the generalized correlated evolution of the economy in this geographical area.

**Table 1.** Correlation analysis of Economic growth series

Country	Czechia	Hungary	Romania
Czechia	100.00%	74.85%	75.30%
Hungary	74.85%	100.00%	68.02%
Romania	75.30%	68.02%	100.00%

**Source:** Authors' own research.

Although the systemic effect of the global economic crisis has had a severe impact on the three economies, the measures taken by each of the three countries analyzed, both in the crisis and in the post-crisis period, have resulted in slow and fast economic recoveries, depending on the specifics of the economic crisis. The study consists of two interconnected parts. While the first section provides an overview of the economic cycles of the three

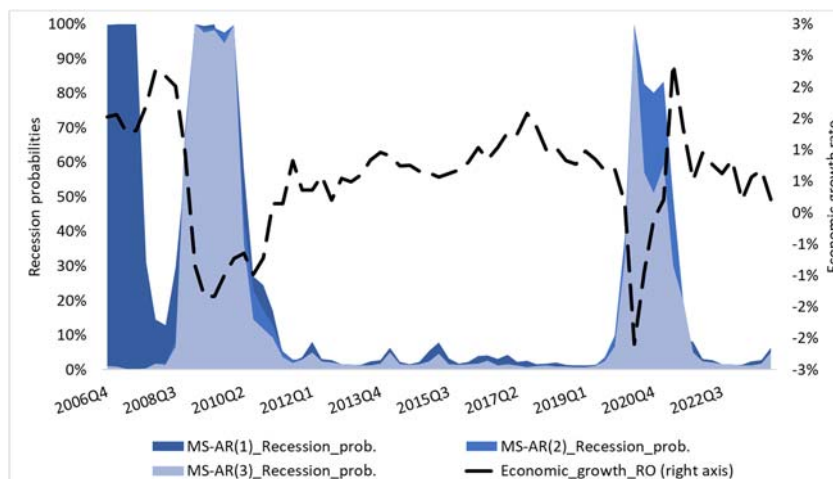
countries, the second section proposes a detailed analysis of the relationship between growth rates and the evolution of external factors, over two time-horizons.

### 1.1. Economic cycle overview

When we talk about forecasting recession periods in the real economy, the phases of business cycles are considered unobservable, and the best-known model for estimating transition probabilities, using unobservable state variables, is the Markov-Switching (MS) model. In general, the estimation of the MS model assumes that the economic growth rate follows a first-order autoregressive process (AR). However, we estimated the MS-AR models up to the third order, as the current value of economic growth may also depend on the values recorded in the last year, to capture the long-term evolution of the economy.

Figure 1 captures the probabilities of entering the recession phase in Romania, for each of the three estimated MS-AR models.

**Figure 1.** Markov-Switching smoothed probabilities – Romania



**Source:** Authors' own research.

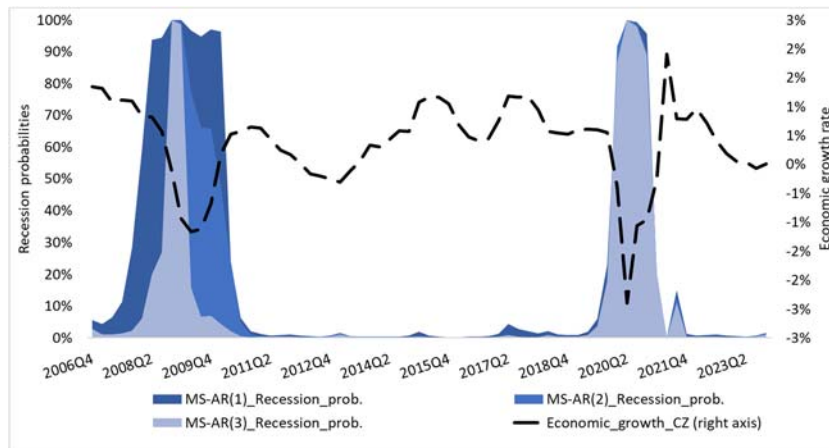
In the case of Romania, there are two periods of concentration, in which all three models capture high probabilities of recession, namely the period of the global financial crisis from 2008-2010 and the recent period associated with the health crisis, starting with the second quarter of 2020. There is also a differentiation between the estimated models, which argues that higher-order-based models provide greater stability of the estimated probabilities. Thus, the MS-AR (1) model identifies a period of short-term instability during 2007, which is not captured in the other models. As for the recent period, the recession probabilities are high, reaching values of about 95% in 2021.

Similarly, Figure 2 captures the probabilities of entering the recession phase in the Czech Republic, for each of the three estimated MS-AR models.

In the case of the Czech Republic, there are also two periods of concentration, in which all three models have a high probability of recession, namely the period of the global financial crisis of 2008-2010 and the recent period associated with the health crisis. Unlike the

Romanian economy, the MS-AR (3) model identifies a shorter period affected by the global financial crisis, being marked by the fast recovery of the economic growth at the end of 2009. However, the recent period had high probability of recession caused by the negative rates at the end of 2020.

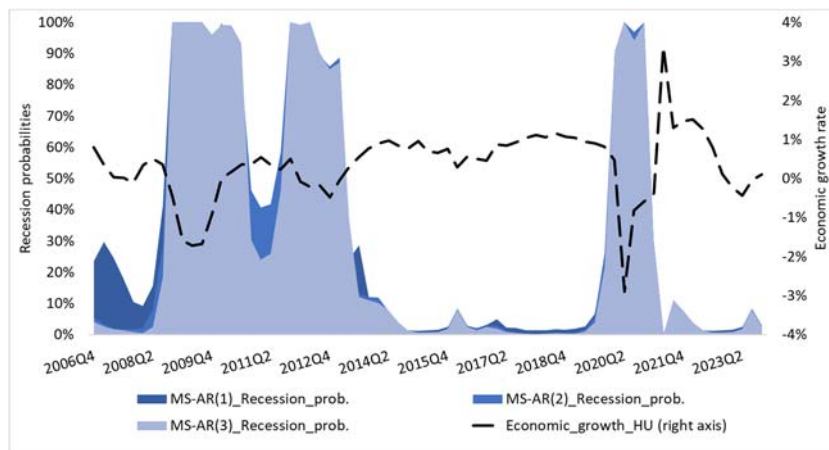
**Figure 2.** *Markov-Switching smoothed probabilities – Czechia*



**Source:** Authors' own research.

Figure 3 captures the probabilities of entering the recession phase in Hungary for each of the three estimated MS-AR models.

**Figure 3.** *Markov-Switching smoothed probabilities – Hungary*



**Source:** Authors' own research.

In the case of Hungary, there are also two periods of concentration, in which all three models have a high probability of recession. Furthermore, the sovereign debt crisis is identified since the Hungarian economy was severely affected by it in 2012. However, a lower probability of recession than during the financial and health crisis can be observed.

Also, no significant differences were identified between the estimated models in terms of periods with high probability of recession.

Based on the analysed models, for the three economies, we capture two periods of concentration, representing the financial and health crises. While the Romanian economy is characterized by longer periods with negative rates of economic growth, the economies of the Czech Republic and Hungary indicate faster economic recoveries. Based on these, two equal time-horizons were defined, which separately capture the two extreme events: January 2005 - December 2013, and January 2014 - December 2023, respectively.

## 1.2. Relationship between external factors and economic growth

Methods such as the Augmented Dickey-Fuller Stationary Test (ADF), the Johansen Cointegration Test, the Vector Error Correction Model (VECM) and the Granger causality test were applied to determine the relationship between external factors and the growth rate, on each of the two time-horizons.

In the analysis of the time series, before applying the cointegration test to determine the short- and long-term dynamics of the variables, an analysis was performed to evaluate the stationarity of the variables. The values of the p-value statistic related to the ADF test are above the 5% threshold for the levels, on both time-horizons. Thus, the results of the ADF test show that all the variables are not stationary at levels but become stationary after the application of the first difference, having the same order of integration, respectively I (1).

Subsequently, the Johansen cointegration test was applied, which allows the identification of several cointegration relationships, on each of the two time-horizons. The test does not validate the null hypothesis regarding the lack of cointegration relations at a significance level of 5%. Therefore, we can conclude that there is at least one cointegration relationship between the economic growth rate and external factors, which argues that, regardless of short-term fluctuation, these variables tend to return to the long-term equilibrium.

In the following, to determine the direction of causality between variables, we use the Granger causality test based on the error correction model to study the causal relationship between the evolution of the growth rate and external factors.

The results of the Granger causality test application, in the case of Romania, on each of the two time-horizons are presented in Table 2.

**Table 2.** VEC Granger Causality Test results – Romania

Time horizon	2005 - 2013		2014 - 2023	
	Chi-sq.	Prob.	Chi-sq.	Prob.
D(ECONOMIC_GROWTH_EU27)	11.989060	0.25%	1.719886	18.97%
D(EURIBOR_3M)	2.513166	28.46%	0.511088	47.47%
D(EURRON)	4.708021	9.50%	0.398488	52.79%
D(EXTERNAL_DEBT_RO)	9.412691	0.90%	1.207759	27.18%
D(PPI_EU27)	1.619947	44.49%	0.815193	36.66%

**Source:** Authors' own research.

Thus, according to the Granger algorithm, a causal relationship between external factors and the growth rate exists only if the values of the external factors can be used to predict future values of the economic growth rate.



Table 2 shows only three significant causal relationships in the first time-horizon, while in the recent period the growth rate is not sensitive to changes in external factors, at a significance level of 10%. Therefore, we observe a unidirectional causality relationship between the economic growth rate of the European Union, the EURRON exchange rate, the external debt and economic growth rate of Romania in the first time-horizon, which argues that the three indicators can be used to predict the evolution of the economy as a whole during the time-horizon associated to the financial crisis.

However, the effect of external factors on economic growth in the second time-horizon cannot be completely ruled out, as uncertainties caused by mutations in the viral genome may lead to delayed effects of the economic decline in the financial sector, caused by rising inflation and the need for additional financing sources.

The results of the Granger causality test application on Hungary and Czech Republic, on each of the two time-horizons are presented in Table 3 and Table 4.

**Table 3.** VEC Granger Causality Test results – Hungary

Time horizon	2005 - 2013		2014 - 2023	
	Chi-sq.	Prob.	Chi-sq.	Prob.
Independent variable / Statistic				
D(ECONOMIC_GROWTH_EU27)	10.37068	0.56%	5.36296	6.85%
D(EURIBOR_3M)	2.296047	31.73%	6.303885	4.28%
D(EURRON)	8.325041	1.56%	1.752705	41.63%
D(EXTERNAL_DEBT_RO)	8.265835	1.60%	2.185457	33.53%
D(PPI_EU27)	5.522411	6.32%	2.814411	24.48%

**Source:** Authors' own research.

**Table 4.** VEC Granger Causality Test results – Czechia

Time horizon	2005 - 2013		2014 - 2023	
	Chi-sq.	Prob.	Chi-sq.	Prob.
Independent variable / Statistic				
D(ECONOMIC_GROWTH_EU27)	3.573166	16.75%	0.092759	76.07%
D(EURIBOR_3M)	5.209092	7.39%	4.636419	3.13%
D(EURRON)	1.203848	54.78%	0.043419	83.49%
D(EXTERNAL_DEBT_RO)	0.099572	95.14%	2.542594	11.08%
D(PPI_EU27)	1.163417	55.89%	0.203342	65.20%

**Source:** Authors' own research.

Unlike the Romanian economy, the results of the Granger causality test applied to the Czech Republic and Hungary capture the causal relationship between the external interest rate and the internal economic growth rate, on the second time-horizon, at a significance level of 10%. Moreover, in the first time-horizon, in the case of Hungary, there is a significant causal relationship between the growth rate and most external factors, which captures the more severe effects of the financial crisis, unlike Romania and Hungary, where the factors did not directly impact the evolution of economic growth.

## 5. Conclusions

The empirical study involves a series of complex analyses on the typologies of economic crises, as well as the determination of external factors that have a significant impact on their management process.

The results of the Markov-Switching models capture two periods of concentration, representing the financial and health crises. While the Romanian economy is characterized by longer periods with negative economic growth rates, the Czech Republic and Hungary indicate faster recoveries after economic crises. The Granger causality test also shows a higher sensitivity of economic growth rates to external factors during the first time-horizon, whereas in the second horizon, the causal relationship remains significant only in the case of Hungary and the Czech Republic.

Given the current state of the economy, the recent period is less sensitive to external factors. However, there may be delayed effects of the economic downturn in other sectors, caused by rising inflation and the need for additional financing, which can also be a major source of uncertainty in the economy.

In conclusion, the study assists policy makers to adopt policies that will mitigate the negative effects of external shocks on the economic growth and to reduce the dependence on external debt to finance economic growth, considering the characteristics of economic crisis. However, the results must be taken with caution since they are based on a given econometric methodology with sample dimension limitations, over a certain period and on a predefined set of countries. Additionally, we believe that more research is required to better understand and quantify the different effects of external factors on economic growth in the short and long run, considering the importance of policy implications.

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