MEASURING SLOVAKIA'S MACROECONOMIC PERFORMANCE WITH KALDOR'S MAGIC SQUARE

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Abstract: *The aim of this study is to evaluate the macroeconomic performance of Slovakia in the period 1993-2023 and to determine the impact of various social, political, and economic events on the development of the country's macroeconomic performance. To this end, a macroeconomic performance index was constructed based on the magic square method, which consists of economic growth, current account balance, inflation and unemployment variables. In order to test the consistency of this index, different indices based on different normalisation, weighting and aggregation methods were also derived. According to the index scores, the worst year in terms of macroeconomic performance was 2000 and the best year was 2018. The 2008 Economic Crisis, the Covid-19 pandemic and the Russia-Ukraine war significantly reduced Slovakia's macroeconomic performance.*

Keywords: *macroeconomic performance index, magic square, economic growth, current account balance, inflation, unemployment*

JEL Classification: C43, E24, E31, E60, O47

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1 Introduction

The primary objectives of economic policy include price stability, financial stability, economic growth, full employment, and balance of payments equilibrium. The extent to which these objectives are achieved reflects the level of macroeconomic performance. In this context, it is important to emphasise that the success indicator referred to as macroeconomic performance is not determined by a single objective. However, it remains unclear which of these indicators is prioritised when assessing the macroeconomic performance of countries or the economic success of a government. Additionally, it is uncertain whether there exists a hierarchy in terms of the importance attributed to these variables (Şanlısoy and Çetin, 2017).

Composite indicators are ideally designed to measure multidimensional concepts that cannot be adequately captured by a single variable. They offer several advantages: (i) they can be used to summarise complex or multidimensional issues, thereby supporting decision-makers; (ii) they help to attract public interest by providing a single summary figure that facilitates comparisons of performance across countries and tracks progress over time; and (iii) they contribute to reducing the number of individual indicators or allow for the extraction of more information within an existing size constraint (Saisana and Tarantola, 2002; OECD, 2008).

The first composite indicator developed to reflect the overall state of the economy and to assess the macroeconomic performance of countries is the Misery Index, introduced by Okun (1976). This index consists of two components—inflation and unemployment—and is calculated by summing the inflation rate and the unemployment rate. Calmfors and Driffill (1988) later developed the Calmfors-Driffill Index, which incorporates the unemployment rate and the current account deficit as a percentage of gross domestic product (GDP). Criticising the assumption of equal weighting of variables in these indices, Melyn and Moesen (1991) proposed the Leuven Index of Macroeconomic Performance. This is a two-stage, variable-weighted index based on four indicators: the rate of change in the GDP deflator, the real GDP growth rate, the current account balance as a percentage of GDP, and the unemployment rate. Barro (1999) developed the Barro Misery Index, an extension of the original Misery Index, by incorporating four variables. This version adds long-term interest rates and deviations of GDP from its long-run average to the traditional components of

inflation and unemployment. Asher et al. (1993) criticised the original Misery Index for omitting key social indicators such as income distribution and the poverty rate, arguing that this omission represents a significant shortcoming. They emphasised that incorporating unequal weights and additional components could yield markedly different outcomes. Similarly, Lovell et al. (1995) expanded the index by including environmental variables, specifically carbon and nitrogen emissions. Additionally, Kaldor (1971) highlighted that in the post-World War II period, governments increasingly prioritised full employment, balance of payments stability, economic growth, and wage growth through income policy as core objectives of economic policy. Within this Kaldorian framework, macroeconomic performance is assessed using four main indicators: the economic growth rate, the current account balance as a percentage of GDP, the inflation rate, and the unemployment rate (Al and Baday Yıldız, 2019).

The elements highlighted by Kaldor regarding the core objectives of economic policy align with the criteria that shape the economic structure of Slovakia. This structure has evolved since the country became an independent state in 1993 and later joined the European Union and the Eurozone. Economically, Slovakia can be characterised as a small, open, and export-oriented economy capable of attracting substantial foreign direct investment. The country possesses several economic advantages: the absence of foreign exchange risk due to its Eurozone membership, a strong industrial infrastructure, high export capacity, and stable fiscal policies. Additionally, Slovakia has deep integration with the global economy and a strategic geographical location. This means that social, political, and economic developments occurring in various parts of the world have a direct impact on its domestic economy.

When the literature is examined, it is observed that there are few studies examining the macroeconomic performance of Slovakia using the magic square method. Masarova et al. (2022) assessed the macroeconomic performance of Slovakia, Czechia, Hungary, and Poland through the magic square approach, focusing solely on the years 2009, 2019, and 2020, and explored the effects of the 2008 Crisis and the Covid-19 pandemic. Similarly, Cíbik and Richvalský (2023) analysed the impact of the Covid-19 pandemic on macroeconomic performance across 27 EU member states, including Slovakia, using the same methodology. In their study, they compared the average values of macroeconomic indicators for the 2015–2019 period with the corresponding

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values for 2020. However, in studies involving multiple countries, it is important to note that the scaling of values is based on the minimum and maximum values observed across all countries in the sample. This approach may result in the extreme values of other countries' variables influencing the index score of a given country, potentially leading to distortions in the results. Furthermore, existing studies evaluate Slovakia's macroeconomic performance only for a limited number of specific years. A review of the literature reveals that no study to date has adopted a comprehensive approach that examines the evolution and development of Slovakia's macroeconomic performance since its establishment, nor one that measures it using a continuous index score over time.

Based on this, the aim of this study is to measure Slovakia's macroeconomic performance over the period 1993–2023 and to assess the effects of both country-specific and global social, political, and economic events - such as EU membership, the 2008 Economic Crisis, the Covid-19 pandemic, and the Russia–Ukraine war - on its macroeconomic performance. To this end, a macroeconomic performance index (MPI) is constructed based on the magic square method. In addition, to evaluate the robustness and consistency of this approach, alternative macroeconomic performance indices are developed using different normalisation, weighting, and aggregation techniques, and their results are compared with those obtained from the magic square method.

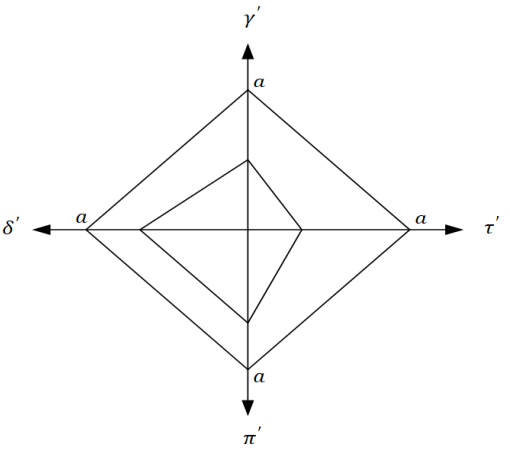
The study is structured into five chapters. The second chapter explains the magic square method and reviews the relevant literature on measuring macroeconomic performance using this approach. The third chapter outlines the methodology employed in the study. The fourth chapter presents the empirical findings. Finally, the fifth chapter offers an evaluation of the results and provides concluding remarks.

2 Magic Square Method

Kaldor (1971), who conducted an extensive analysis of the post-war British economy, re-examined the fundamental macroeconomic relationships—both logically and empirically—that are essential for achieving key economic policy objectives. Drawing in part on the policy priorities of successive UK governments, he focused on four main macroeconomic variables: economic growth, trade balance, inflation, and unemployment. Notably, Kaldor's

original work did not include any graphical representation of these variables. However, during the period 1966–1969, German Minister of Economics Karl Schiller and Minister of Finance Franz J. Strauss applied a graphical interpretation of these four indicators to guide economic policymaking in Germany. The combination of these variables was depicted in the form of a square, commonly referred to as "Kaldor's magic square" (Braun, 2003; Firme and Teixeira, 2014). Subsequently, some OECD economists revised Kaldor's (1971) framework by replacing the wage growth–income policy variable with inflation and used a diagram comprising these four updated variables to compare the macroeconomic performance of countries. This diagram, known as the "magic diamond" by the OECD, is also referred to in the literature as the "magic polygon," "magic square," or "magic rectangle" (Al and Baday Yıldız, 2019). The magic square is illustrated in Figure 1.

Figure 1: Magic Square



Source: Medrano-B and Teixeria, 2013.

The interpretation of the magic square is based on the assumption of an ideal country or economy. Under this ideal scenario, where the best possible values are achieved for each of the four variables, the area of the magic square is equal to one square unit. As actual values deviate from these ideals, the area of the square diminishes, approaching zero. In summary, when the MPI is constructed using the magic square method, its values range between 0 and 1, where 0 represents the worst macroeconomic performance and 1 indicates the best.

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In the economic literature, there is no consensus on the optimal numerical values for growth, current account balance, inflation, and unemployment rates that define an ideal economy. These optimal values are typically expressed as ranges rather than fixed numbers. For instance, an inflation rate between 1% and 3% is generally regarded as optimal, although both the United States and the European Union have adopted 2% as their official target. In this context, an economy exhibiting values within these optimal ranges is considered ideal; the area of the magic quadrilateral representing such an economy is normalised to one square unit, and the MPI consequently attains its maximum value of 1. This value is interpreted as reflecting the highest possible macroeconomic performance. However, Medrano-B and Teixeira (2013) took a different approach by constructing the ideal area based on the maximum and minimum observed values within their sample.

The normalisation process in the magic square method is based on the min-max normalisation technique. Normalisation can be expressed as shown in Equation 1, assuming, for example, that the minimum and maximum values of the current account balance (τ) variable in a country are as follows (Medrano-B and Teixeira, 2013):

$$-2 \leq \tau \leq 4 \tag{1}$$

In this case, the normalised current account balance (τ') will be expressed as in Equation 2.

$$0 \leq \tau' \leq a \tag{2}$$

The quadrilateral and magic square resulting from the normalisation of all variables as described above are illustrated in Figure 1. According to Medrano-B and Teixeira (2013), the outer quadrilateral in this figure forms a rhombus, with each side length denoted by a, representing the ideal country/economy/region. The area of this rhombus is numerically equal to 1 and is calculated using Equation 3.

$$A = 4 \times \frac{1}{2} a^2 = 1 \tag{3}$$

Therefore:

$$a^2 = \frac{1}{2} \tag{4}$$

In this case, the normalised value of each variable should be in the range $[0, \sqrt{2}/2\,]$.

$$0 \le \gamma' \le \frac{\sqrt{2}}{2}, 0 \le \tau' \le \frac{\sqrt{2}}{2}, 0 \le \pi' \le \frac{\sqrt{2}}{2}, 0 \le \delta' \le \frac{\sqrt{2}}{2} \tag{5}$$

The area of the small quadrilateral in the figure represents the macroeconomic performance of the country in the period in question and is calculated using Equation 6.

$$MPI_t = \frac{1}{2}(\gamma_t'\tau_t' + \tau_t'\pi_t' + \gamma_t'\tau_t' + \delta_t'\gamma_t') \tag{6}$$

where; P_t is the macroeconomic performance in t; $\gamma_t', \tau_t', \pi_t'$ ve δ_t' are the normalised values of growth, current account balance/GDP, inflation and unemployment rates in t, respectively.

Saavedra-Rivano and Teixeira (2017) noted that the results derived from the equation used by Medrano-B and Teixeira (2013) are sensitive to the orientation of the axes on which the variables are plotted. To address this issue, they proposed a mathematical method known as the Magic Hypercube. Accordingly, the MPI should be calculated as outlined in Equation 7.

$$MPI_t = \tilde{\gamma}_t \times \tilde{\tau}_t \times \tilde{\pi}_t \times \tilde{\delta}_t \tag{7}$$

where; MPI_t is the index score of the country in the period t; $\tilde{\gamma}_t, \tilde{\tau}_t, \tilde{\pi}_t, \tilde{\delta}_t$ is the revised normalised values of growth, current account balance/GDP, inflation and unemployment variables in the period t, respectively. When defined in this manner, the maximum possible value of the index is 1.

However, when evaluating annual performance, if the worst values of different variables occur in different years, multiple zero values may arise. In other words, the presence of the worst value for any variable in a given year overrides the positive outcomes of other variables in that same year,

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causing the macroeconomic performance of the country to be reduced to zero. To address this issue, Al and Baday Yıldız (2019) proposed determining the normalised value of the worst observation for each variable by referencing the normalised value of the second worst year and adjusting it proportionally based on the ratio of the actual values. Consequently, the normalised value of the worst data point approaches zero but never reaches it. This approach eliminates the problem of attrition in the multiplicative calculation of the index, preventing a single variable's worst value from reducing the overall macroeconomic performance score to zero.

Several studies have investigated macroeconomic performance using the magic square method: Welsch (2007) for 12 EU member states; Porhel (2008) for Kenya; Kučera (2012) for Czechia; Fitoussi and Saraceno (2013) for the United States, Germany, France, and Italy; Firme and Teixeira (2014) for Brazil, Russia, China, the United States, the Euro Area, and newly industrialised Asian countries (South Korea, Hong Kong, Singapore, Taiwan); Picek (2017) for 11 countries in the Euro Area; Al and Baday Yıldız (2019) for Turkey; Ozkaya and Alhuwesh (2021) for Yemen; Cíbik and Richvalský (2023) for EU member states; and Piaser (2024) for France.

3 Data and Methodology

3.1 Data

Data were sourced from the Statistical Office of the European Union (Eurostat), encompassing economic, financial, demographic, and social indicators. The dataset consists of annual observations spanning the period from 1993 to 2023. A summary of the dataset is provided in Table 1.

Table 1: Data Set

Variables	Abbreviation	Symbol	Source	Description
Economic Growth	GDP	γ	Eurostat-Economy and Finance	GDP growth (annual, %)
Current Account Balance	CAB	τ	Eurostat-Economy and Finance	Current account balance (% of GDP)

Inflation	INF	π	Eurostat-Economy and Finance	Consumer prices (annual, %)
Unemployment	UNE	δ	Eurostat-Population and Social Conditions	Unemployment, total (% of total labour force)

Source: own processing.

3.2 Methodology

A composite index is constructed by combining multiple variables related to a specific topic, resulting in a single indicator that captures the various dimensions of that topic. The processes of data normalisation and variable weighting are particularly crucial when constructing such an index (OECD, 2008).

i. Normalisation: Since variables often have different units and scales, it is necessary to transform them to a common scale through normalisation. In this context, normalisation refers to a mathematical transformation that converts raw variable values with diverse units and scales into a standardised range, such as 0–α, 0–1, or 0–100 (Nahman et al., 2016).

The min-max normalisation method was employed in this study. Its main advantage lies in its simplicity and ease of application, as it compresses the data into a defined range. However, a notable drawback is its sensitivity to outliers; the introduction of new values beyond the existing minimum or maximum can alter the scaling. This method can be formally expressed using Equations 8 and 9:

$$X'_t = \frac{X_t - min\,(X)}{(X)\ - min\,(X)} \tag{8}$$

$$X'_t = \frac{max(X) - X_{jt}}{(X)\ - min\,(X)} \tag{9}$$

In these equations, X'_t is the normalised value of variable X in t, $max(X)$ is the highest value of X in the whole sample $min(X)$ is the lowest value of X in the whole sample, X_t is the original value of X in t.

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In the normalisation process, Equation 8 is applied to variables with a positive effect (such as growth rate and current account balance), while Equation 9 is used for variables with a negative effect (such as inflation and unemployment). The resulting normalised values fall within specified ranges, where values closer to the lower bound indicate poor performance and values near the upper bound indicate good performance.

ii. Weighting and Aggregation: Following normalisation, a composite index is constructed by assigning weights to each variable. The selection of these weights significantly influences the final index scores and can therefore shape the results. Consequently, determining appropriate variable weights is critical, although it is impossible to entirely eliminate this challenge.

The weights of variables can be determined either by reference to theoretical literature or through statistical methods. This study employs both approaches in assigning variable weights within the index. Specifically, the equal weighting method, grounded in the literature, was applied, alongside alternative indices constructed by deriving weights through principal component analysis (PCA) based on the dataset. The PCA was conducted using Stata 14 software.

Aggregation methods also vary depending on the context. Linear aggregation is appropriate when all individual indicators share the same measurement unit and certain mathematical properties are satisfied. In contrast, geometric aggregation is preferable when the model requires a degree of non-compensability among individual indicators or dimensions. Moreover, linear aggregation rewards base indicators proportionally to their weights, while geometric aggregation tends to reward indicators with higher scores more heavily (OECD, 2008). Both aggregation methods were applied in this study. The linear aggregation method can be expressed as shown in Equation 10.

$$MPI_t = \sum w_i \, x'_{it} \tag{10}$$

The geometric aggregation method can be expressed as in Equation 11.

$$MPI_t = \prod_{i=1}^{n} X_{it}{}^{w_i} \tag{11}$$

In Equations 10 and 11, w_i is the weight ratio of the variable i in the index; and x'_{it} is the normalised value of the variable i in t.

When calculating the Human Development Index, the United Nations Development Programme (UNDP) assumes that all variables hold equal importance and aggregates them by taking their geometric mean, which is then converted into a composite index. Following this approach - hereafter referred to as the UNDP method - the MPI score is calculated using Equation 12.

$$MPI_t = \sqrt[4]{\gamma'_t . \tau'_t . \pi'_t . \delta'_t} \tag{12}$$

In its OECD/INFE 2023 International Survey of Adult Financial Literacy, the OECD employed equal weights and a linear summation method to construct the financial literacy index. Following this approach - referred to here as OECD1 - the MPI score is calculated using Equation 13.

$$MPI_t = 0.25\gamma'_t + 0.25\tau'_t + 0.25\pi'_t + 0.25\delta'_t \tag{13}$$

Additionally, the MPI score calculated using the variable weights derived from the PCA analysis - referred to as the OECD2 method - is obtained using Equation 14.

$$MPI_t = w_1\gamma'_t + w_2\tau'_t + w_3\pi'_t + w_4\delta'_t \tag{14}$$

where; $w_1, w_2, w_3, and\ w_4$, denote the weight ratios obtained from the PCA analysis using the normalised values of growth, current account balance, inflation and unemployment variables, respectively.

4 Results

The raw values of the variables are first normalised using the min-max normalisation method, as shown in the equations below. This process brings all values onto a common scale, expressed within the range of 0 to α.

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$$\gamma' = \frac{1}{\sqrt{2} \times 16.31}(5.50 + \gamma) \quad (15)$$

$$\tau' = \frac{1}{\sqrt{2} \times 12.87}(9.59 + \tau) \quad (16)$$

$$\pi' = \frac{1}{\sqrt{2} \times 23.8}(23.28 - \pi) \quad (17)$$

$$\delta' = \frac{1}{\sqrt{2} \times 13.3}(19.14 - \delta) \quad (18)$$

The weighting process is conducted on normalised values. Initially, based on theoretical literature, variables are assigned equal weights, and macroeconomic performance scores are calculated accordingly. In the alternative weighting approach, statistical information from the variables is utilised. Specifically, principal component analysis (PCA) is applied to the normalised values of all variables. Component loadings for each variable are calculated, and their absolute values are summed to determine the total loading. Subsequently, the weight of each variable is derived by dividing its absolute loading by the total loading. Using the min-max normalisation approach, the calculated weight ratios for GDP, current account balance (CAB), inflation (INF), and unemployment (UNE) are 0.3329, 0.2027, 0.1172, and 0.3473, respectively.

Table 2 presents the aggregated scores of five different macroeconomic performance indices derived using various normalization, weighting, and aggregation approaches. According to 4 out of 5 indices of macroeconomic performance, the worst year for the Slovak economy was 2000, while the best year according to all indices was 2018.

Table 1: Data Set

Years	MS	MH	UNDP	OECD1	OECD2	Years	MS	MH	UNDP	OECD1	OECD2
1993	0.17	0.03	0.40	0.42	0.46	**2009**	0.25	0.02	0.37	0.50	0.42
1994	0.40	0.12	0.59	0.64	0.63	**2010**	0.31	0.10	0.56	0.61	0.56
1995	0.41	0.15	0.62	0.64	0.63	**2011**	0.25	0.06	0.50	0.52	0.48
1996	0.27	0.05	0.48	0.55	0.56	**2012**	0.38	0.11	0.58	0.62	0.54
1997	0.26	0.05	0.48	0.53	0.54	**2013**	0.43	0.12	0.59	0.66	0.56

1998	0.22	0.04	0.44	0.49	0.49	**2014**	0.54	0.25	0.71	0.73	0.66
1999	0.14	0.02	0.36	0.38	0.34	**2015**	0.48	0.22	0.68	0.70	0.65
2000	0.13	0.00	0.26	0.37	0.31	**2016**	0.49	0.21	0.67	0.70	0.64
2001	0.10	0.00	0.26	0.38	0.33	**2017**	0.51	0.24	0.70	0.72	0.69
2002	0.13	0.01	0.29	0.45	0.38	**2018**	0.57	0.30	0.74	0.76	0.75
2003	0.26	0.03	0.43	0.52	0.47	**2019**	0.49	0.20	0.66	0.70	0.70
2004	0.07	0.00	0.26	0.39	0.36	**2020**	0.44	0.11	0.57	0.68	0.63
2005	0.13	0.01	0.35	0.48	0.44	**2021**	0.49	0.20	0.67	0.71	0.72
2006	0.24	0.04	0.46	0.56	0.57	**2022**	0.21	0.01	0.35	0.47	0.53
2007	0.43	0.17	0.64	0.70	0.71	**2023**	0.39	0.14	0.61	0.64	0.67
2008	0.36	0.10	0.56	0.61	0.62						

Source: Eurostat (2024), own processing.

Figure 2 illustrates the changes in Slovakia's macroeconomic performance indices over the period 1993–2023. Analysis of the figure shows that all indices generally exhibit similar trends, indicating consistency among them. As observed, macroeconomic performance began to improve following Slovakia's EU membership in 2004, but declined sharply in 2008 and 2009 due to the impact of the Economic Crisis. From 2010 onward, the country's macroeconomic performance showed a steady upward trajectory, with 2018 identified as the peak year. However, performance dropped significantly in 2020 as a result of the Covid-19 pandemic. In 2022, another marked decline occurred, driven by the Russia-Ukraine war, which began after the economic recovery in 2021, along with the consequent rise in energy prices and global inflation. In 2023, macroeconomic performance showed signs of recovery.

Since its accession to the EU in 2004, Slovakia has undergone a significant macroeconomic transformation characterised by rapid structural reforms, growing foreign investment, and industrial expansion. EU membership enhanced investor confidence and facilitated large inflows of foreign capital, particularly into the automotive and electronics sectors, which became the driving forces of industrial growth. The government's implementation of market-oriented reforms—such as a flat tax system, fiscal discipline, and labour market liberalisation—further strengthened the country's competitiveness and contributed to sustained economic growth. The adoption of the euro in 2009 reinforced financial stability and reduced exchange rate risks, although

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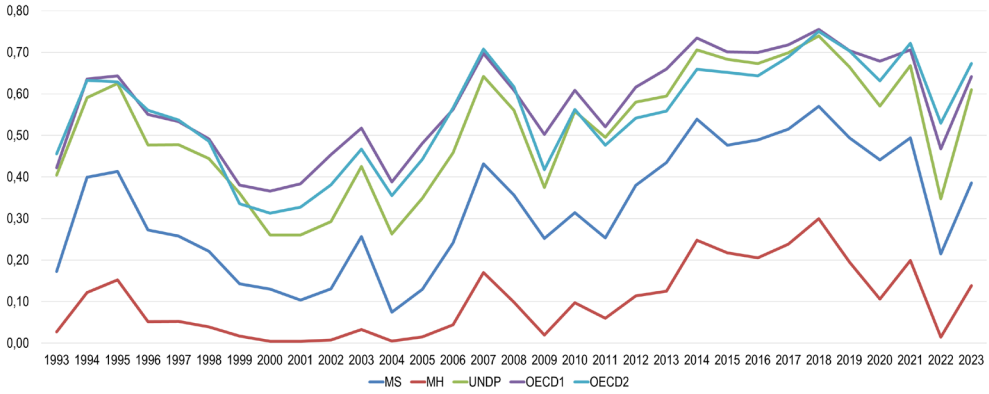
it limited the scope for independent monetary policy. Despite a temporary downturn during the global financial crisis due to Slovakia's dependence on export-oriented manufacturing, the economy recovered in the following decade, marked by stable growth, low inflation, and improving employment conditions. However, after 2020, the Covid-19 pandemic, energy price shocks, and global supply chain disruptions temporarily hindered economic performance. Nevertheless, Slovakia has continued to benefit from EU structural and recovery funds, focusing increasingly on digitalization, innovation, and the green transition. Overall, Slovakia's post-2004 macroeconomic performance reflects the successful integration of market reforms, EU membership benefits, and industrial competitiveness within a stable fiscal and institutional framework.

Figure 2: Slovak Macroeconomic Performance for the Period 1993-2023

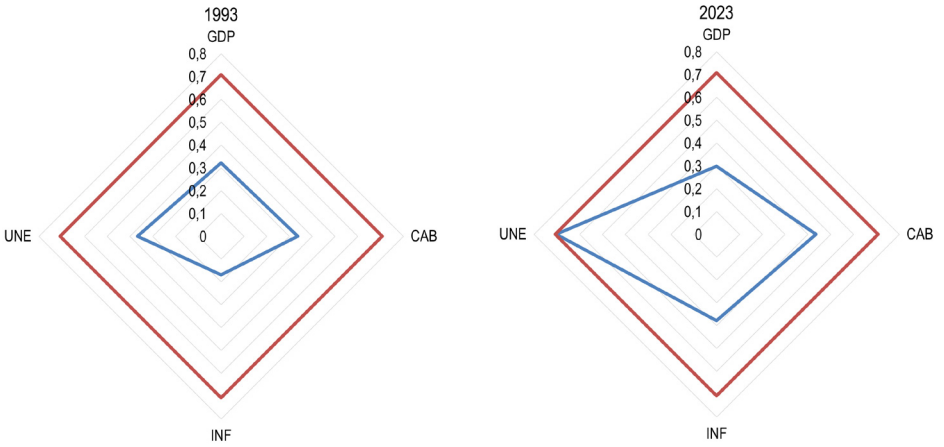


Source: own calculations and processing.

In order to determine which variables are responsible for the changes in macroeconomic performance, magic squares for selected years obtained from normalised values are presented. In this context, Figure 3 presents the magic squares for 1993 and 2023, the first and last years of the sample period. In 1993, inflation was the most important problem, while growth and unemployment were other important problems. Compared to 1993, macroeconomic performance has improved in 2023 as a result of positive developments in the inflation problem. In particular, it can be said that the unemployment problem has been solved to a large extent and the most important contribution to the increase in macroeconomic performance has been made by the decline in

unemployment rates.

Figure 3: Macroeconomic Performance at the Beginning and End of the Research Period



Source: own calculations and processing.

In order to visualise the impact of the 2008 Global Economic Crisis on Slovakia's macroeconomic performance, the magic squares for the pre-crisis and post-crisis years are presented in Figure 4. In 2007, the pre-crisis year, Slovakia performed quite well in terms of growth and inflation, but had a current account deficit problem. However, it is noteworthy that in the post-crisis year 2009, growth declined significantly due to the lack of global demand. This was because the country is an important exporting country and exports were adversely affected by the decline in foreign demand. In addition, the decline in domestic demand also led to a contraction in the economy. However, there has been some improvement in the current account balance. One of the reasons for this is the large share of machinery-equipment and intermediate goods in the country's imports. The sharp fall in imports in line with the decline in external demand allowed the current account balance to improve slightly.

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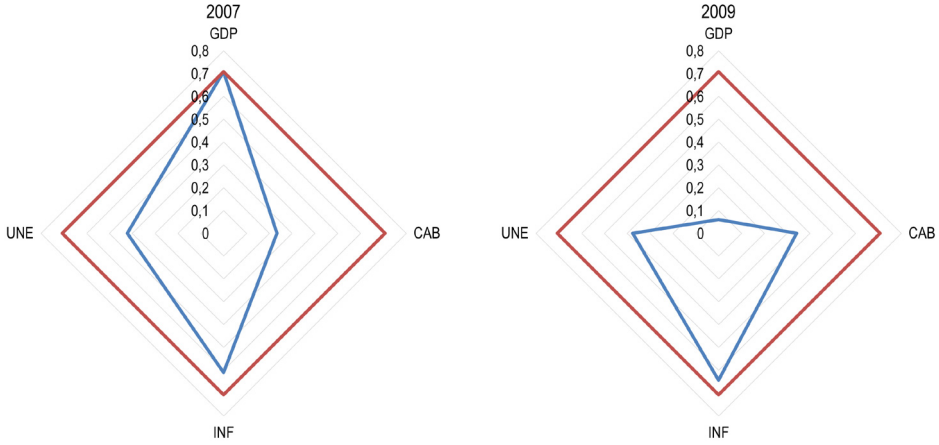
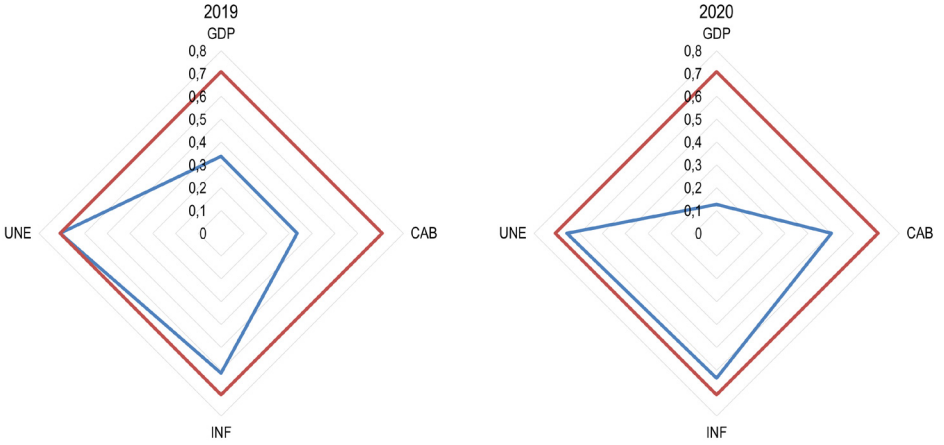
Figure 4: Macroeconomic Performance Before and After the 2008 Economic Crisis



Source: own calculations and processing.

To visually illustrate the impact of the Covid-19 pandemic on Slovakia's macroeconomic performance, the magic squares for the pre-pandemic and pandemic periods are presented in Figure 5. The first Covid-19 case in Slovakia was observed on 6th March 2020. According to the number of cases and mortality rates in Slovakia, 2021 was the most common year of the pandemic, while 2020 was the most economically difficult year due to measures such as the closure of workplaces, limited opening hours, curfews, and other restrictions within the framework of pandemic measures, as well as the chip crisis that started with the impact of the pandemic and disruptions in logistics. Compared to 2019, macroeconomic performance declined significantly in 2020 due to a declined economic growth. Despite this decline in economic growth, unemployment rates did not increase, which is a result of the measures taken by the government to protect employment. Moreover, the current account balance improved slightly in this period. As mentioned above, the reason for this is the relatively high weight of investment goods in imports. During periods of economic contraction, imports of investment goods also decline significantly. Moreover, the sharp decline in energy prices due to the fall in demand during the pandemic also reduced Slovakia's energy-related import costs, which contributed positively to the current account balance.

Figure 5: Macroeconomic Performance Before and During the Covid-19 Pandemic



Source: own calculations and processing.

In 2022, the Russia-Ukraine war started and the magic squares for the pre-war and war period are presented in Figure 6 to visually illustrate its impact on Slovakia's macroeconomic performance. It should be noted that these years were a period when the economic impact of the Covid-19 pandemic continued. When the macroeconomic performance of 2021, which refers to the pre-war period, is analysed, it is noteworthy that the negative situation arising from economic growth due to the pandemic has disappeared and the macroeconomic performance has increased, especially due to growth. However, the increase in energy prices due to the impact of the war and the fact that Slovakia's energy imports come from Russia caused Slovakia's industrial sector to be adversely affected. On the other hand, due to supply shocks such as the chip crisis, disruption of supply chains and logistics problems that emerged during the pandemic, the expansionary monetary and fiscal policies implemented during the pandemic increased demand, and the increase in energy demand with the end of the pandemic increased energy prices, inflation rose significantly in Slovakia as in the rest of the world. The rise in both demand- and supply-driven inflation weakened Slovakia's macroeconomic performance. Moreover, the rise in energy costs led to a significant deterioration in the current account balance.

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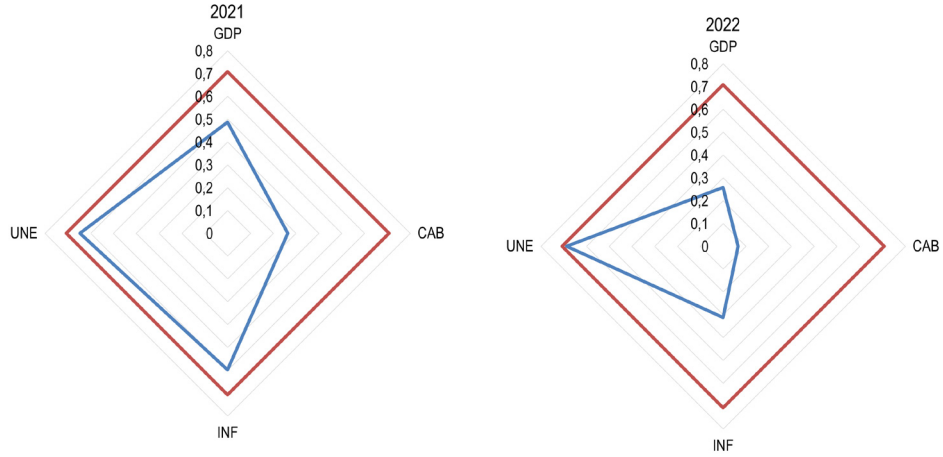
Figure 6: Macroeconomic Performance Before and During the Covid-19 Pandemic



Source: own calculations and processing.

5 Conclusion

This study investigates the macroeconomic performance of Slovakia over the period 1993–2023 using the magic square method. To this end, an MPI was constructed, incorporating the values of economic growth, current account balance, inflation, and unemployment variables as proposed by Kaldor (1971). Additionally, to test the robustness of this approach, alternative macroeconomic performance indices based on different normalization, weighting, and aggregation techniques were developed and compared. Although the scores of these indices differ, their overall trends move consistently throughout the entire period, indicating that the magic square method aligns well with other methodologies. According to the magic square method, Slovakia's lowest macroeconomic performance occurred in 2000, while the highest was observed in 2018.

An analysis of these indices reveals that Slovakia's macroeconomic performance notably declined during the 2008 Economic Crisis, the Covid-19 pandemic, and the Russia-Ukraine war. Given the country's openness to foreign trade and export-oriented economic structure, the economic crises had a significant adverse effect on economic growth due to reduced external demand, which in turn negatively impacted overall macroeconomic performance. However, examining the composition of the country's imports reveals that the high proportion of capital goods imports results in a sharp contraction in imports

during periods of economic slowdown. Despite the decline in exports caused by diminished foreign demand, the larger decrease in imports led to an improvement in the current account balance. Indeed, the current account balance showed some improvement during the crisis, partially offsetting the negative impact of reduced growth on macroeconomic performance.

A similar pattern was observed during the Covid-19 pandemic. The economic contraction during this period is generally considered to have been supply-driven rather than demand-driven. This was largely due to lockdown measures, border closures, disruptions in supply chains, logistical challenges, and the global chip shortage, all of which negatively affected total supply. Unlike the economic crisis period, the unemployment rate remained relatively stable despite the economic contraction. This resilience can be primarily attributed to government policies and support measures aimed at protecting employment during the pandemic. Likewise, the current account balance showed some improvement as a result of the economic slowdown during this period.

The Russia-Ukraine war, which began while the effects of the pandemic were still unfolding, further diminished Slovakia's macroeconomic performance. In addition to the rise in international energy prices driven by increasing demand as the pandemic subsided, the war exacerbated energy costs in Europe. This surge in energy prices contributed to cost-push inflation and deteriorated Slovakia's current account balance, given its status as a significant energy importer. Furthermore, the economic slowdown across Europe—particularly in Germany, Slovakia's key trading partner—exerted additional downward pressure on Slovakia's economic growth, thereby negatively impacting its overall macroeconomic performance.

For the Slovak economy, a trade-off exists between economic growth and the current account balance. To mitigate import dependency, especially in strategic sectors such as energy, intermediate goods, and technology, the government can promote localisation programmes. Additionally, supporting alternative sectors—such as high value-added electronics, green energy equipment, and digital services—can enhance product diversification. Export promotion efforts should focus on expanding into emerging markets in Asia, North Africa, and the Middle East to counteract risks posed by trade barriers, such as U.S. tariffs on key sectors like automotive, thereby fostering market diversification. Furthermore, increasing renewable energy capacity is essential to reduce reliance on energy imports and bolster energy security.

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