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External Shocks and Economic Fragility: Insights from Germany's Macroeconomic Response

Tunahan Aslan[1], Turgud Valiyev[2]

Abstract: This study investigates the macroeconomic effects of exogenous **Brent crude oil prices**, **World Uncertainty Index (WUI)**, **inflation**, **interest rates**, and **GDP** in Germany. The study is analyzed within the framework of SVAR model using monthly data for the period 2000:Q1-2023:11. The empirical findings are informed by variance decomposition. According to the variance decomposition results, the most effective shocks in interest rate were oil shock by 10.25%, World uncertainty index shock by 5.58%, inflation shock by 4.55% and finally GDP shock by 0.45%. The most effective shocks to inflation were 30.13% from the oil shock, 4.64% from the interest rate shock, 1.22% from the GDP shock and finally 0.51% from the World uncertainty index shock and the most effective shocks to GDP were 17.42% from the oil shock, 2.71% from the inflation shock, 2.43% from the World uncertainty index shock and finally 1.63% from the interest rate shock. These results show the significant vulnerability in the German economy against external shocks. This paper highlights the importance of proactive policy responses to mitigate economic fragility.

Keywords: Germany; External Shocks; SVAR; Economic fragility

JEL Classification: E60; F40; C32; E65

1. Introduction

The global economy is increasingly vulnerable to external shocks. This situation has become more pronounced due to factors such as fluctuations in energy prices, geopolitical uncertainties, interest rate changes and global inflation pressures. Advanced economies like Germany, which are highly dependent on energy imports, are more vulnerable to such exogenous shocks. In this study, Brent oil prices, World Uncertainty Index (WUI), inflation, interest rates and Gross Domestic Product variables are analysed within the framework of the structural vector autoregression (SVAR) model with monthly data from 2000:1-2023:11. The results show that sustainable energy investments and more robust policies should be implemented in order to make the macroeconomic structure more resilient and sustainable energy investments should be implemented in order to have important implications for policy makers by revealing the effects on the structural fragility of the German economy. . According to the results

[1] Ph.D. student in economics, Graduate School of Social Sciences, Yuzuncu Yıl University, Turkey, Address: Van, Turkey, Corresponding author: tunahanasln@gmail.com.
[2] M.Sc. student in Data Science and Business Analytics, Faculty of Economic Sciences, University of Warsaw, Poland, Address: Warsaw, Poland, E-mail: t.valiyev@student.uw.edu.pl.

obtained in the study, especially oil price shocks and global uncertainty shocks have a significant impact on interest rate, inflation, interest rate and GDP in the German economy.

What is the relative impact of market fluctuations in the oil price, global uncertainty index, inflation, gdp and interest rate changes of variance decomposition in the SVAR model on Germany's macroeconomic stability?

This question helps to understand and quantify different external shocks and their respective effects on various macroeconomic variables in Germany. According to the evidence on Petrol price effects, inflation dynamics and monetary policy adjustments, can Germany improve its macroeconomic resilience to unpredictable external shocks?

Through this question, we translate the empirical findings into actionable strategies for economic policy.

2. Literature Review

The impact of the external shocks on macroeconomic aspect has been widely investigated in the literature, which considers different variables, methodologies, and country-specific analyses. Several scientific papers have examined the influence of oil price fluctuations, inflation shocks, and interest rate changes on financial markets and economic growth. This part of the paper reviews key previous studies, dive into their datasets, variables, research questions, and findings to provide a comprehensive understanding of external shocks' effects on macroeconomic performance.

Sadorsky (1999, p. 456) examined the relationship between oil price shocks and stock market activity using data from the United States. The study employed oil prices, stock returns, and interest rates as key variables to understand how energy market volatility affects financial markets. The research question sought to determine the extent to which oil price volatility translates into inflationary pressures and economic slowdowns. The results showed that oil price increases lead to higher inflation and lower GDP growth, with the effects being more pronounced in the short term (Smyth & Narayan, 2018). Bodenstein, Also the role of oil price shock shas been investigated in shaping inflation and monetary policy responses in advanced economies. The research question addressed how central banks respond to inflationary pressures triggered by oil price movements. The findings highlighted that central banks often implement contractionary monetary policies in response to rising oil prices, increasing interest rates to curb inflationary effects (Bodenstein, Guerrieri, & Kilian, 2012). Menna and Tobal studied the impact of financial crises and interest rate shocks on macroeconomic stability in emerging and advanced economies. The study utilized interest rate data, capital flows, and GDP growth rates as key variables. The primary research question examined how sudden changes in interest rates influence economic stability and financial markets. The findings suggested that interest rate shocks lead to capital flight, increased financial volatility, and economic contractions, particularly in economies with weaker financial institutions (Menna & Tobal, 2018).

In addition, the broader effects of macroeconomic shocks explored by Afonso and Sousa, including fiscal and monetary policy shifts, on long-term economic growth. Exchange rate effects is examined in developed economies, including Germany, using trade balance, inflation, and currency exchange rate data. The study aimed to understand how exchange rate fluctuations impact import prices and inflation levels. The research question investigated whether currency depreciation leads to higher consumer prices. The findings indicated that exchange rate movements significantly affect inflation, particularly

in highly open economies, where imported goods constitute a large share of consumption (Aron, Macdonald, & Muellbauer, 2014).

The unconventional monetary policy measures and their impact on liquidity are analyzed on credit risk, and macroeconomic stability in the Eurozone. One of the previous studies used data on central bank policies, bond yields, and credit spreads and via using the research question centered on how unconventional monetary interventions, such as quantitative easing, influence financial market conditions. The results indentified that such kind of policies effectively stabilize liquidity conditions and decrease credit risk however, might also cause distortions in financial markets over the long term (Peersman, 2011).

3. Methodology and Empirical Results

Table 1. Variance Decomposition of Brent Oil Prices

Variables	Variables Definition	Source
Brent Crude Oil	Brent Crude Oil (Nominal $)	Fred
WUI	World Uncertainty Index	Fred
GDP	Gross Domestic Product (Real, Seasonally Adjusted,$)	Destatis
Inflation	Inflation Rate (Annual Percentage Change, %)	Destatis
Interest Rate	German Central Bank Interest Policy Interest Rate (Annual %, Nominal)	Destatis

Source: own elaboration

In Table 1, we see the variables and their sources respectively. The Brent crude oil price and the World Uncertainty Index (WUI) data are from the Federal Reserve Economic Data (FRED), while inflation, interest rates and Gross Domestic Product (GDP) are from the German Federal Statistical Office (Destatis).

The same pre-tests applied in the VAR model also apply to the SVAR model. In order for the variables in our model to give accurate results, pre-tests such as stationary testing and determining the optimal lag length are important. At this stage, since our variables are not stationary at their level values, they are stationary at level 1 by taking their differences. At the same time, the lag length with the most stars (lag 1) in the Akaike Information Criterion (AIC) and Final Prediction Error (FPE) criteria was chosen (Enders, 2008). To ensure that our analysis does not contain the auto-correlation problem and provides reliable results, modulus values are less than 1 and AR unit root tests are applied which show that the our approach is reliable by determining that they are all within the circle.

In SVAR analysis, the order of the variables is important for the correct interpretation of the results (Sims, 1986). Therefore, the order of influence of variables (Brent crude oil prices, World Uncertainty Index (WUI), interest rate, inflation rate and GDP) is analyzed in accordance with economic theory.

Table 2. Variance Decomposition of Brent Oil Prices

Number of Periods	Brent Crude Oil	Wui	Interest Rate	Inflation	GDP
1	100.0000	0.000000	0.000000	0.000000	0.000000
2	96.97976	0.613893	0.797931	1.579676	0.028738
3	95.72933	0.605863	1.087895	2.501340	0.075570
4	95.31013	0.617045	1.150391	2.826216	0.096215
5	95.19353	0.616563	1.169845	2.914784	0.105283
6	95.16225	0.617037	1.174394	2.938612	0.107705
7	95.15448	0.617022	1.175615	2.944482	0.108403
8	95.15257	0.617040	1.175890	2.945933	0.108570
9	95.15211	0.61740	1.175959	2.946276	0.108613
10	95.15200	0.617041	1.175975	2.946358	0.108623

Source: own elaboration

Table 2 shows that Brent crude oil price shock is 100% affected by its own shock at the end of period 1, while it is not affected by other shocks at all. At the end of 10 periods, the most affected shocks were 95.15% from its own shock, 2.94% from the inflation shock, 1.17% from the interest rate shock, 0.61% from the World uncertainty index shock and finally 0.10% from the GDP shock.

Table 3. Wui Variance Decomposition

Number of Periods	Brent Crude Oil	Wui	Interest Rate	Inflation	GDP
1	0.240448	99.75955	0.000000	0.000000	0.000000
2	1.502422	97.68534	0.408181	0.262226	0.141828
3	1.505466	97.49227	0.543811	0.262101	0.196357
4	1.501417	97.46121	0.542649	0.297745	0.196982
5	1.500941	97.45121	0.547660	0.300896	0.199291
6	1.500852	97.44906	0.547630	0.303183	0.199278
7	1.500862	97.44843	0.547843	0.303474	0.199393
8	1.500865	97.44829	0.547847	0.303600	0.199395
9	1.500867	97.44826	0.547856	0.303620	0.199401
10	1.500867	97.44825	0.547856	0.303627	0.199401

Source: own elaboration

Table 3 displays that World uncertainty index (Wui) shocks are 99.75% affected by its own shock and 0.24% affected by the oil shock at the end of period 1, while it is not affected by other shocks at all. At the end of 10 periods, the most affected shocks were 97.44% from its own shock, 1.50% from oil shock, 0.54% from interest rate shock, 0.30% from inflation shock and finally 0.19% from GDP shock.

Table 4. Interest rate Variance Decomposition

Number of Periods	Brent Crude Oil	Wui	Interest Rate	Inflation	GDP
1	6.256557	6.161156	87.58229	0.000000	0.000000
2	10.35769	5.595623	79.58089	3.772789	0.423008
3	10.28541	5.588961	79.32837	4.359300	0.437956
4	10.26020	5.590280	79.19089	4.502643	0.451177
5	10.25929	5.587131	79.15635	4.540398	0.455921
6	10.25913	5.586722	79.14625	4.550802	0.456934
7	10.25909	5.586515	79.14383	4.553290	0.457237
8	10.25909	5.586481	79.14322	4.553905	0.457306
9	13.06358	5.586470	79.14307	4.554048	0.457324
10	10.25908	5.586468	79.14304	4.554082	0.457328

Source: own elaboration

Table 4 represents that interest rate shocks are affected by 87.58% of its own shock, 6.25% of oil shock and 6.16% of World uncertainty index shock at the end of 1 period, while it is not affected by other shocks at all. At the end of 10 periods, the most affected shocks were 79.14% from its own shock, 10.25% from oil shock, 5.58% from World uncertainty index shock, 4.55% from inflation shock and finally 0.45% from GDP shock.

Table 5. Inflation Rate Variance Decomposition

Number of Periods	Brent Crude Oil	Wui	Interest Rate	Inflation	GDP
1	34.77614	0.245356	3.489173	61.48933	0.000000
2	31.18238	0.363529	4.302137	63.20046	0.951495
3	30.35731	0.518198	4.535621	63.43741	1.151464
4	30.18432	0.514556	4.621356	63.47142	1.208348
5	30.14353	0.518868	4.635934	63.48257	1.219105
6	30.13434	0.518894	4.640159	63.48461	1.222194
7	30.13215	0.518847	4.640979	63.48518	1.222836
8	30.13166	0.518841	4.641247	63.48529	1.223005
9	30.13154	0.518847	4.641247	63.48532	1.223041
10	30.13152	0.518847	4.641259	63.48533	1.223050

Source: own elaboration

Table 5 displays that at the end of period 1, inflation shocks are affected by 61% by own shock, 34.77% by oil shock, 0.24% by World uncertainty index shock, 3.48% by interest rate shock, but not by GDP shock. At the end of the 10 period, the most affected shocks were 63.48% from own shock, 30.13% from oil shock, 4.64% from interest rate shock, 1.22% from GDP shock and finally 0.51% from World uncertainty index shock.

Table 6. GDP Variance Decomposition

Number of Periods	Brent Crude Oil	Wui	Interest Rate	Inflation	GDP
1	3.387287	1.383509	1.654839	0.077386	93.49698
2	16.02583	2.353990	1.384807	1.058187	79.17719
3	17.53825	2.448499	1.497928	1.997254	76.51807
4	17.48432	2.431029	1.635837	2.465957	75.98285
5	17.44204	2.433507	1.671023	2.642560	75.81087
6	17.43087	2.431986	1.681743	2.692370	75.76303
7	17.42815	2.431895	1.684216	2.705867	75.74987
8	17.42755	2.431799	1.684880	2.709202	75.74657
9	17.42741	2.431787	1.685031	2.710028	75.74575
10	17.42738	2.431781	1.685069	2.710224	75.74555

Source: own elaboration

Finally, Table 6 shows that GDP shocks are 93.49% affected by its own shock, 3.38% affected by oil shock, 1.38% affected by World uncertainty index shock, 1.65% affected by interest rate shock and 0.07% affected by inflation shock at the end of period 1. At the end of 10 period, the most affected shocks were 75.74% from own shock, 17.42% from oil shock, 2.71% from inflation shock, 2.43% from World uncertainty index shock and finally 1.63% from interest rate shock.

4. Conclusion

In this study, exogenous Brent crude oil prices, World Uncertainty Index (WUI), inflation, interest rates and GDP variables in Germany are analysed by Structural Vector Autoregression (SVAR) with monthly frequency for the period 2000:Q1-2023:11. According to the variance decomposition results, the most

effective shocks on the interest rate were the oil shock with 10.25%, the World Uncertainty Index shock with 5.58%, the inflation shock with 4.55% and finally the GDP shock with 0.45%. The most effective shocks on inflation were the oil shock with 30.13%, the interest rate shock with 4.64%, the GDP shock with 1.22% and finally the world uncertainty index shock with 0.51%, while the most effective shocks on GDP were the oil shock with 17.42%, the inflation shock with 2.71%, the world uncertainty index shock with 2.43% and finally the interest rate shock with 1.63%. Our findings reveal that Germany, which is highly energy dependent, is particularly adversely affected by oil price shocks, followed by world uncertainty shocks. These results reveal that Germany is significantly affected by oil price shocks as it is an energy-dependent economy. Moreover, global uncertainty shocks have negative effects on both interest rates and GDP. Overall, the findings suggest that the German economy is vulnerable to exogenous shocks.

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Appendix

Table 6. VAR Stability Test

Root	Modulus
0.480458	0.480458
-0.391280	0.391280
0.320096	0.320096
0.040466-0.145696i	0.151211
0.040466+0.145696i	0.151211

Source: own elaboration

Table 6 illustrates the root and modulus results from the Vector Autoregression (VAR) Stability Test. Stability is confirmed as all moduli are less than 1 and these results are supporting the main analysis's assumption of a stable VAR model which is discussed in Methodology section.

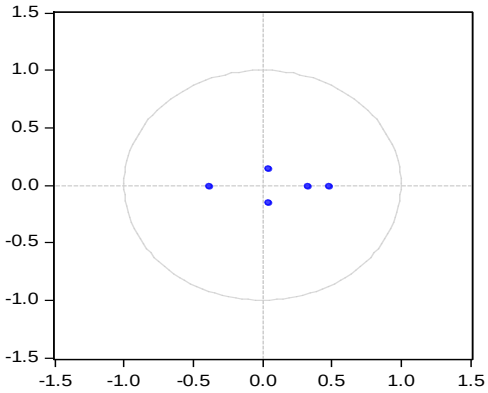

Figure 1. Inverse Roots of AR Characteristic Polynomial

The Figure 1 shows the inverse roots of the Autoregressive (AR) characteristic polynomial plotted within the unit circle. All roots are located inside the circle which display the AR model used in the analysis. This figure is explained in the Methodology section.