

Changes in the Volatility of the Business Cycles and the Role of Fiscal Policy: Evidence from Azerbaijan

Ramiz Rahmanov
PhD student
Azerbaijan State University of Economics (UNEC)
Baku, Azerbaijan
rahmanovrr@gmail.com

Abstract—This paper examines the evolution of Azerbaijan’s GDP volatility, focusing on the role of fiscal policy shocks in the non-oil sector. While the mid-2000s oil boom caused high volatility in oil-gas GDP, stabilization in hydrocarbon production reduced total GDP fluctuations in the following decade. However, fiscal expansion led to increased non-oil GDP volatility in the 2010s. By the 2020s, improved fiscal management stabilized budget spending shocks. Variance decomposition analysis highlights fiscal policy as a key driver of non-oil GDP volatility. The findings underscore the growing resilience of Azerbaijan’s economy through diversification and enhanced policy frameworks.

Keywords— *business cycle volatility, fiscal policy shocks, Azerbaijan economy, structural VAR model, non-oil-gas GDP*

I. INTRODUCTION

The volatility of business cycles, characterized by fluctuations in economic output and employment, has profound implications for the stability and growth of economies. Understanding the drivers of these fluctuations is critical for designing effective policies that can mitigate adverse impacts and foster sustainable development. In resource-rich countries like Azerbaijan, business cycle volatility has traditionally been closely tied to fluctuations in commodity production and prices. However, as Azerbaijan pursues economic diversification and reduces its dependence on oil and gas, understanding the dynamics of the non-oil sector is becoming increasingly important for ensuring long-term economic stability.

Globally, the question of whether economic fluctuations have become less volatile over time, and why, has been widely studied, particularly in advanced economies. For instance, research on OECD countries highlights a decline in output volatility since the mid-1980s, attributed to structural economic changes, improved macroeconomic policies, and smaller exogenous shocks [1]-[5]. In particular, enhanced monetary policy, shifts toward service-oriented economies, and innovations in inventory management have been identified as major contributors to this "Great Moderation."

In contrast, studies on developing economies are less extensive but highlight the importance of structural reforms and policy improvements in reducing volatility. For example, Reference [6] documented reduced GDP volatility in South Africa due to advancements in monetary policy and financial sector development. Similarly, Reference [7] found that China's GDP volatility declined significantly after the 1990s, driven by smaller external shocks. Reference [8] emphasized the role of fiscal rules, structural reforms, and financial deepening in reducing macroeconomic volatility across African economies.

In Azerbaijan, the study of business cycles has evolved from analyzing oil dependency to employing advanced

methodologies to track and predict economic fluctuations. Early research highlighted the high volatility and persistence of GDP and industrial production, largely driven by oil exports [9]. It was also noted that private consumption and investment lead economic cycles, while global demand fluctuations significantly impact Azerbaijan’s economy. Subsequent work developed a composite leading indicator system for the non-oil sector, identifying key phases of expansion and contraction [10].

More recent studies employed sophisticated filtering and spectral analysis techniques to provide deeper insights into Azerbaijan’s business cycles [11]-[12]. Reference [11] revealed procyclical behaviors across key macroeconomic variables, highlighting Azerbaijan’s economic interdependence with major trade partners like Russia and Turkey. Reference [12] confirmed that Azerbaijan experiences higher economic volatility than advanced economies, particularly during global crises.

Despite these contributions, the existing literature does not analyze the evolution of total and non-oil GDP volatility in Azerbaijan over time or examine the role of fiscal policy in shaping economic stability. This paper seeks to fill this gap by investigating the evolution of the business cycle volatility and how fiscal policy has influenced the volatility of Azerbaijan’s non-oil sector since 2001.

Fiscal policy, encompassing government spending and taxation, is one of the most effective tools available to governments for stabilizing economic fluctuations. Its impact, however, is not always straightforward and depends on factors such as the magnitude and timing of fiscal shocks, private-sector responses, and the broader macroeconomic environment. While fiscal interventions can smooth business cycle volatility, they may also exacerbate it under certain conditions. Understanding these dynamics is particularly critical for Azerbaijan as it transitions toward a more diversified economy, with the non-oil-gas sector playing a vital role.

By adopting a decade-by-decade approach, the study examines how the volatility of non-oil GDP has evolved and assesses the relative importance of fiscal shocks in shaping these fluctuations. To evaluate the dynamic effects of fiscal policy shocks on non-oil GDP in Azerbaijan, this paper uses a structural vector autoregressive (SVAR) model. Variance decomposition provides insights into whether fiscal policy has acted as a stabilizing or destabilizing force in Azerbaijan’s non-oil economy.

This research contributes to the broader literature on business cycle volatility in resource-rich economies and the role of fiscal policy in stabilizing non-resource sectors. The findings will provide policymakers with valuable insights into the effectiveness of fiscal interventions in mitigating

economic volatility and offer practical recommendations for fostering stability and growth in Azerbaijan's non-oil-gas economy.

The paper is structured as follows: Section 2 outlines the methodology, detailing the SVAR model. Section 3 describes the data and their sources. Section 4 presents the empirical results and their interpretation. Finally, Section 5 concludes with key findings.

II. METHODOLOGY

The analysis of the evolution of the business cycle volatility usually rests on the analysis of the standard deviation of percentage changes in macroeconomic indicators, mainly GDP in different periods [2]. A change in the volatility of growth rates signals a change in short-run economic fluctuations. Therefore, to analyze the volatility of the business cycles in Azerbaijan, I will compute annual growth rates of quarterly output (total GDP, oil-gas GDP, and non-oil-gas GDP) data and then compute the standard deviation of annual growth rates over available decades.

To identify fiscal policy shocks and measure their role in the evolution of the Azerbaijani non-oil-gas business cycles, I will estimate the SVAR model [13]. Regarding the identification of the shock structure, I focus on the case when budget spending comes first as it matches the reality:

$$Y_t = A(L, q)Y_{t-1} + u_t \quad (1)$$

where $Y_t = [G_t, T_t, X_t]'$ are the logarithms of quarterly budget spending, non-oil-gas taxes, and non-oil-gas GDP, respectively; $u_t = [u_t^g, u_t^t, u_t^x]'$ is the vector of reduced form residuals. The reduced form residuals are combinations of the structural shocks $[e_t^g, e_t^t, e_t^x]'$:

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & -a_1 \\ -c_2 & -c_1 & 1 \end{bmatrix} \begin{bmatrix} u_t^g \\ u_t^t \\ u_t^x \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ a_2 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} e_t^g \\ e_t^t \\ e_t^x \end{bmatrix} \quad (2)$$

Unexpected movements in budget spending (u_t^g), within a quarter, are due to, structural shocks to spending (e_t^g). Unexpected movements in non-oil-gas taxes, within a quarter, are due to unexpected movements in non-oil-gas GDP (u_t^t), structural shocks to budget spending (e_t^g), and to structural shocks to non-oil-gas taxes (e_t^t). Unexpected movements in non-oil-gas GDP, within a quarter, are due to unexpected movements in non-oil-gas taxes (u_t^t), unexpected movements in budget spending (u_t^g), and to structural shocks to non-oil-gas GDP (e_t^x). The coefficients a_1 , c_1 , and c_2 which are estimated separately are 1.02, -0.02, and 0.61 respectively. a_2 is estimated within the SVAR.

III. DATA DESCRIPTION

For the analysis of the business cycle volatility, I use the total GDP, oil-gas GDP, and non-oil-gas GDP quarterly time series from 2001:1 to 2024:3 from the National Accounts Statistics of the State Statistical Committee of Azerbaijan (SSCA). The oil-gas GDP series is proxied by Mining and quarrying. The non-oil-gas GDP series is proxied by subtracting Mining and quarrying and Net taxes from the total GDP. The series are in 2005 prices and were seasonally adjusted using the X11 procedure. For the analysis, the series was transformed to annual growth rates.

For the structural VAR model, in addition to the non-oil-gas GDP data, I use the data on the budget expenditure and non-oil-gas tax revenues, which come from the SSCA. All series are seasonally adjusted using the X11 procedure and transformed in the logarithmic form.

IV. EMPIRICAL RESULTS

Table I reports the sample standard deviation of total GDP, oil-gas GDP, and non-oil-gas GDP by decade (the last decade includes only four years and three quarters). Each decade's standard deviation is shown in relation to the overall sample standard deviation, with values below one indicating a period of comparatively low volatility. Total GDP and non-oil-gas GDP were less volatile but oil-gas GDP was more volatile in the 2000s than over the full sample. High volatility in the oil-gas GDP is due to the oil boom that Azerbaijan's economy experienced in the mid-2000s. In the 2010s, the relative standard deviations of total GDP and oil-gas GDP were less volatile than in the 2000s. The decline in the volatility is due to the stabilization of the oil and natural gas production. The non-oil-gas GDP instead had an increase in volatility in the same period, which can be explained by a fiscal expansion that accelerated the growth of the non-oil-gas sector. In the early 2020s, during the COVID and post-COVID periods, the volatility of total GDP and oil-gas GDP increased relatively to that of the 2010s. The increase in the magnitude of fluctuations is linked with the increase in the volatility of hydrocarbon production. Overall, the data shows a trend toward reduced volatility over time, in total GDP, which is due to stabilization of the oil-gas GDP. The non-oil-gas sector shows consistent stability, potentially positioning it as a more resilient part of the economy over time.

TABLE I. STANDARD DEVIATIONS OF ANNUAL GROWTH RATES, BY DECADE

	Standard deviation 2001-2024Q3	Standard deviation relative to 2001-2024Q3		
		2001- 2009	2010- 2019	2020- 2024Q3
Total GDP	8.68	0.99	0.32	0.49
Oil-gas GDP	16.79	1.24	0.25	0.28
Non-oil-gas GDP	5.44	0.77	0.98	0.89

^a. Author's calculations

Table II reports the standard deviation of the fiscal policy shocks obtained from the structural VAR model by decade relative to the standard deviation in the whole period. The results suggest a notable increase in the variability of fiscal policy shocks in 2010-2019 relative to 2001-2009. Meanwhile, the recent period has witnessed a substantial decrease in the volatility of fiscal shocks which hit historically low levels. The causes behind the decline in the volatility of fiscal policy shocks include the improvement in fiscal policy management driven by the lessons learned in 2015-2016 and by the implementation of the fiscal rule.

Table 2. Changes in the standard deviations of budget spending shocks, by decade

TABLE II. CHANGES IN THE STANDARD DEVIATIONS OF BUDGET SPENDING SHOCKS, BY DECADE

Standard deviation 2004-2024Q3	Standard deviation relative to 2004-2024Q3
--------------------------------------	---

	2001-2009	2010-2019	2020-2024Q3
0.13	1.00	1.12	0.71

^b. Author's estimations.

However, the reduction in the fluctuations of fiscal policy shocks should not necessarily explain the moderation in the volatility of the non-oil-gas GDP. Whether the reductions in the variances of the fiscal policy shocks are responsible for the decline in the volatility of the non-oil-gas output depends on the importance of these shocks in determining non-oil-gas GDP growth. The variance decomposition analysis shows that at a three-year horizon, 27.3% of the non-oil GDP variation is explained by the budget expenditure policy shocks. This finding implies that the reduction in the volatility of fiscal policy plays a significant role in the non-oil-gas GDP volatility reduction observed in the recent period. In practical terms, it indicates that in Azerbaijan, the stabilization of the fiscal policy is necessary to stabilize non-oil-gas GDP growth.

V. CONCLUSIONS

The analysis of Azerbaijan's GDP volatility by decade reveals that while oil-gas GDP experienced high volatility during the mid-2000s, stabilization in hydrocarbon production in the following decade contributed to a reduction in the volatility of total GDP. Conversely, the non-oil-gas sector exhibited increased volatility in the 2010s, largely due to fiscal expansion, which underscores the role of domestic policy decisions in shaping economic stability. In the early 2020s, a renewed rise in volatility for total GDP and oil-gas GDP emerged due to an increase in the volatility of hydrocarbon production. However, overall, a general trend toward reduced GDP volatility has emerged over time, largely driven by the stabilization of oil-gas production and diversification of the economy, positioning the non-oil-gas sector as potentially more resilient.

On the fiscal policy side, volatility in policy shocks peaked in the 2010s but has since stabilized, reaching historic lows. This stabilization reflects improvements in fiscal policy management. The variance decomposition analysis indicates that the fiscal factor plays a major role in non-oil-gas GDP volatility.

REFERENCES

- [1] C. D. Romer, "Changes in business cycles: Evidence and explanations," *Journal of Economic Perspectives*, vol. 13, no. 2, pp. 23–44, 1999.
- [2] J. H. Stock and M. W. Watson, "Has the business cycle changed and why?" NBER Working Papers 9127, National Bureau of Economic Research, Inc., 2002.
- [3] T. Dalsgaard, J. Elmeskov, and C. Park, "Ongoing changes in the business cycle: Evidence and causes," OECD Economics Department Working Papers, no. 315, OECD Publishing, Paris, 2002.
- [4] J.-P. Cotis and J. Coppel, "Business cycle dynamics in OECD countries: Evidence, causes, and policy implications," in *The Changing Nature of the Business Cycle*, C. Kent and D. Norman, Eds., RBA Annual Conference Volume (Discontinued), Reserve Bank of Australia, 2005.
- [5] H. E. Duran, "Structural change and output volatility reduction in OECD countries: Evidence of the second great moderation," *Economic Structures*, vol. 8, no. 38, 2019.
- [6] P. Burger, "The changing volatility of the South African economy," *South African Journal of Economics*, vol. 76, pp. 335–355, 2008.
- [7] C. Zhang and C. Li, "The great moderation in China: A disaggregated analysis," *Emerging Markets Finance and Trade*, vol. 50, no. 1, pp. 150–163, 2014.
- [8] S. Krantz, "Africa's great moderation," *Journal of African Economies*, vol. 33, no. 5, pp. 515–537, 2024.
- [9] S. Huseynov and V. Ahmadov, "Business cycles in oil-exporting countries: A declining role for oil?" IHEID Working Papers, no. 03-2014, Economics Section, The Graduate Institute of International Studies, 2014.
- [10] F. Mammadov and S. Adigozalov, "Indicator-based forecasting of business cycles in Azerbaijan," MPRA Paper 64367, University Library of Munich, Germany, 2014.
- [11] R. Rahmanov, "Stylized facts on Azerbaijani business cycles," in *The Proceedings of the 2nd International Conference on Economics "Regional Development - Digital Economy"*, 2023.
- [12] Y. Hasanli and R. Rahmanov, "Analyzing business cycles in Azerbaijan: Application of various filters and spectral analysis," in *The Proceedings of the International Conference on Future of Business, Management and Economics*, vol. 1, no. 1, pp. 37–46, 2024.
- [13] O. Blanchard and R. Perotti, "An empirical characterization of the dynamic effects of changes in government spending and taxes on output," *The Quarterly Journal of Economics*, vol. 117, no. 4, pp. 1329–1368, 2002.