



УДК 330; 330.4

DOI: <http://dx.doi.org/10.21686/2500-3925-2026-4-4-15>

Н.С. Айюбова, Р.Т. Гафарли

Бакинский Государственный Университет, Баку, Азербайджан

# Коинтеграционный анализ платежного баланса Азербайджана с использованием методологии ARDL

**Цель данного исследования** заключается в комплексной статистической и эконометрической оценке основных компонентов, формирующих динамику платежного баланса Азербайджана — внешнеторгового оборота, прямых иностранных инвестиций и экспорта нефти и газа.

**Материалы и методы.** На основе квартальных данных за период с первого квартала 2001 года по четвертый квартал 2024 года применена методология авторегрессионного распределенного лага (ARDL), выбор модели осуществлен по критерию Акаике. Наличие долгосрочных связей проверено с помощью теста на коинтеграцию (Bounds test), а надежность модели подтверждена диагностическими процедурами (Jarque-Bera, Breusch-Pagan, Durbin-Watson, CUSUM).

**Полученные результаты** показывают, что внешнеторговый оборот и прямые инвестиции оказывают статистически значимое влияние на текущий счет. Хотя внешняя торговля оказывает негативное влияние в краткосрочной перспективе, ослабляя баланс за счет увеличения импорта, она играет стабилизирующую роль в среднесрочной и долгосрочной перспективе. Прямые инвестиции ослабляют баланс в краткосрочной перспективе за счет репатриации и импортного спроса, но в долгосрочной перспективе укрепляют производственный и экспортный потенциал. Экспорт нефти и газа является ключевой

опорой текущего счета и оказывает положительное влияние как в краткосрочном, так и в долгосрочном периоде, однако высокая волатильность сектора делает необходимой диверсификацию экономики.

**Заключение.** С точки зрения экономической интерпретации, результаты подтверждают, что такая политика, как управление импортом, направление инвестиционных потоков на производство и экспорт, диверсификация энергетического сектора и развитие ненефтяных секторов, имеют решающее значение для повышения устойчивости платежного баланса. Научный вклад исследования состоит в том, что в рамках методологии авторегрессионного распределенного лага (ARDL) одновременно оценены краткосрочные и долгосрочные эффекты, а диагностические тесты подтвердили стабильность и надежность модели. Такой подход обеспечивает прочную эмпирическую основу для макроэкономической стабильности и повышения достоверности прогнозов в Азербайджане.

**Ключевые слова:** эконометрическое моделирование; платежный баланс; внешнеторговый оборот; прямые иностранные инвестиции; экспорт нефти и газа; стационарность; метод авторегрессионного распределенного лага (ARDL); коинтеграция.

Natavan S. Ayyubova, Ravan T. Gafarli

Baku State University, Baku, Azerbaijan

# Cointegration Analysis of Azerbaijan's Balance of Payments Using the ARDL Methodology

**The aim of this study** is a comprehensive statistical and econometric assessment of the main components shaping the dynamics of Azerbaijan's balance of payments: foreign trade turnover, foreign direct investment, and oil and gas exports.

**Materials and methods.** The Autoregressive Distributed Lag (ARDL) methodology was applied based on quarterly data covering the period from Q1 2001 to Q4 2024, with model selection conducted using the Akaike information criterion. The existence of long-run relationships was tested using the Bounds cointegration test, and the model's validity was confirmed through diagnostic procedures (Jarque-Bera, Breusch-Godfrey, Durbin-Watson, CUSUM).

**The results** obtained show that foreign trade turnover and direct investments have a statistically significant impact on the current account. Although foreign trade has a negative impact in the short term by weakening the balance through an increase in imports, it plays a stabilising role in the medium and long term. Direct investment weakens the balance in the short term through repatriation and import demand, but in the long term, it strengthens production and

export potential. Oil and gas exports constitute the primary driver of the current account and have a positive impact in both the short and long term, but the sector's volatility underscores the need for a diversification policy.

**In conclusion,** from an economic interpretation perspective, the results confirm that policies such as import management, channelling investment flows towards production and exports, diversification of the energy sector, and the development of non-oil sectors are critical to strengthening the sustainability of the balance of payments. The contribution of the study is that, within the ARDL methodology, both short-run and long-run effects have been estimated in the same structure, and the stability and robustness of the model have been demonstrated through diagnostic tests. This approach provides a strong empirical basis for Azerbaijan's macroeconomic stability and the reliability of forecasts.

**Keywords:** econometric modelling; balance of payments; foreign trade turnover; foreign direct investment; oil and gas exports; stationarity; ARDL method; cointegration.

## Introduction

The balance of payments is one of the key indicators that, in addition to reflecting a country's external economic relations, plays an important role in ensuring macroeconomic stability. Reflecting a country's overall position in foreign trade, services, investment and financial flows, this balance is of strategic importance in the formulation of economic policy. The structure and dynamics of the balance of payments serve as a crucial analytical tool for assessing economic resilience, particularly in economies based on energy resources.

As oil and gas exports play a leading role in the Azerbaijani economy, the balance of payments is highly sensitive to both changes in the global energy market and domestic macroeconomic policy. For this reason, the balance of payments is subject to the influence of exogenous factors, such as oil prices in world markets, international terms of trade, and foreign investment, as well as endogenous factors, such as the exchange rate, fiscal and monetary policy, and domestic capital investment. Consequently, the changes in the balance of payments and its interrelationship with other macroeconomic indicators have become one of the main areas of academic research.

The analysis of the balance of payments is not limited to the comparison of statistical indicators. In modern economic research, the interaction of components such as the current account balance, capital flows, foreign exchange reserves, and foreign and domestic investments is empirically investigated in this field using various econometric models (ARDL, VECM, ECM, and VAR). This approach provides a basis for the making of important decisions in the formulation of the country's economic policy, both theoretically and practically. At the same time, these models are used to assess the balance of payments' stability, resilience to shocks, and long-term equilibrium position, and to prepare forecasts for the prospective period.

The aim of the present study is to identify the main determinants of Azerbaijan's balance of payments, to assess their interrelationships using empirical models, and to analyse the potential risks and opportunities for macroeconomic stability in this context. To this end, both domestic and international literature have been reviewed, and the experiences of various countries have been analysed comparatively. The findings of the study can contribute to the formulation of more effective approaches for managing the balance of payments in Azerbaijan's economic policy.

## Literature review

The balance of payments and its impact on economic stability is one of the most extensively studied topics in international economics. Scientific

research conducted in this area demonstrates that the balance of payments not only reflects a country's interactions with the external sector, but also plays a significant role in shaping macroeconomic policy [1]. In particular, the balance of payments structure based on energy resource exports in developing countries is regarded as one of the key factors posing challenges to long-term economic sustainability [2]. Studies on Azerbaijan's balance of payments have primarily examined the mechanisms of influence on foreign trade and foreign exchange reserves within economic models dominated by the energy sector. The research conducted by Ayyubova [3] analyzed the relationship between Azerbaijan's balance of payments and the world market prices of WEST and BRENT crude oil over the period 2011–2021 using econometric methods. Employing regression and correlation analysis, Dickey-Fuller and Granger causality tests, the study established that volatility in world oil prices has a significant impact on the balance of payments. Ayyubova [4, 5] further investigated the cointegration relationships between world oil prices and Azerbaijan's balance of payments using the Johansen test and the VECM model, identifying the existence of a long-run equilibrium. In addition, the author analyzed the dynamics of the balance of payments through the Error Correction Model (ECM) and demonstrated the existence of an adjustment mechanism in response to short-term shocks.

Mushendami and Manuel [6] evaluated whether the monetary approach to the balance of payments holds in Namibia using a VECM model. The results indicate that an increase in domestic credit exerts a negative effect on net foreign assets (NFA), while an improvement in the fiscal balance leads to an increase in NFA in the short run. The Granger causality test revealed a unidirectional effect running from GDP, fiscal balance, exchange rate, and domestic credit toward NFA. The authors demonstrated that both monetary and non-monetary factors play a role in explaining changes in NFA. Eita and Gaomab [7] examined the macroeconomic determinants of the balance of payments in Namibia over the period 1999–2009 using a cointegrated VAR model. The findings identify fiscal balance, GDP, and interest rate as the principal determinants of the balance of payments. Increases in GDP and the interest rate were associated with more favorable balance of payments outcomes, while fiscal stability contributed to a strengthening of the overall external position. The study underscores the importance of both monetary and fiscal policy in the management of the balance of payments.

In another study [8], a systematic approach was applied, utilizing statistical, cluster, and non-parametric analysis methods to identify the principal trends in the dynamics of the balance of payments of the Russian Federation. These trends include the synchronization of changes in transactions related to

goods, services, and income, the maintenance of a positive balance position, and the accumulation of reserve assets. Among the significant indicators, assets and liabilities, debt instruments, portfolio investments, credit, and export operations occupy a particularly prominent place. The study in [9] was conducted with the aim of assessing the monetary character of the balance of payments in Algeria over the period 1980–2019, employing the ARDL bounds test alongside the novel statistical approach of Kripfganz and Schneider (2020). The results demonstrate that an expansion in domestic credit exerts a negative effect on net foreign assets, confirming that balance of payments disturbances are primarily attributable to monetary disequilibrium. Furthermore, the existence of a long-run relationship among the variables was established, and the propositions of the monetary approach were empirically validated. The principal contribution of the study lies in the combination of the conventional ARDL method with the new p-value approach, yielding more robust estimates. In a subsequent study [10], the macroeconomic determinants of Sierra Leone's balance of payments over the period 1980–2020 were analyzed using the ARDL model. Both the real interest rate and the exchange rate were found to exert significant effects on the balance of payments in both the short and long run. A negative relationship between FDI and the balance of payments was identified, suggesting that foreign investment is largely associated with import-oriented activities and the repatriation of profits to investor countries. Abaidoo [11] empirically investigated the applicability of Thirlwall's Law and the balance of payments constrained growth model in the case of Ghana, employing both the Johansen cointegration test and the ARDL bounds test. While the ARDL test results proved inconclusive, the analysis based on data spanning 1965–2004 confirmed through the Johansen test the existence of a long-run relationship between GDP growth and export growth. The study in [12] examined the theoretical and empirical relationship between the current account balance and macroeconomic variables in Turkey over the period 1987–2009 using the ARDL model. The findings indicate that inflation exerts a positive effect on the current account balance, whereas economic growth, trade openness, oil prices, and real exchange rate appreciation contribute to a deterioration of the balance. Following any given shock, the balance converges to its long-run equilibrium within approximately one year following a shock.

## Methodology

The present study investigates the long-run and short-run determinants of Azerbaijan's balance of payments. The current account of the balance of payments was selected as the dependent variable, while foreign trade turnover, investment flows, exports from the oil and gas sector, and economic

factors affecting the balance of payments were selected as independent variables.

The study is based on quarterly data obtained from official sources [13], covering the period from 2001Q1 to 2024Q4, and addresses the issues of constructing an AutoRegressive Distributed Lag (ARDL) model. Drawing on the capabilities of this model, the analysis is designed to examine both the long-run and short-run relationships between the current account of Azerbaijan's balance of payments and such variables as foreign trade turnover, foreign direct investment, and the volume of exports in the oil and gas sector. It should be noted that the analysis of long-run relationships within the balance of payments provides a basis for explaining the dynamics of its development and, more broadly, for shaping the strategic development of the national economy, its external trade relations, and its integration into global markets.

At the same time, the examination of short-run dynamic relationships among these indicators is of considerable importance. The mechanism through which shocks are transmitted between variables in short-run dynamics constitutes one of the principal objects of investigation in this study. The effective management of short-run fluctuations is essential for the sustainability of economic growth. The analysis of this aspect contributes to determining the extent to which the economy is resilient in the face of current economic shocks [14, 15].

As a country engaged in oil exports, Azerbaijan faces instability in its balance of payments arising from dependence on oil revenues and fluctuations in world oil prices, along with other adverse consequences generated by this dependence — circumstances that substantiate the relevance of the present research topic [16]. The application of the ARDL framework is of significant importance for explaining these problems, identifying economic risks, and constructing a scientifically grounded econometric model. Furthermore, econometric modeling is of considerable value in terms of assessing indicators and the relationships among them across various sectors of the economy, as well as enhancing the effectiveness of economic policy. The EViews 12 software package was utilized to support the computational procedures of the study.

The capacity of the ARDL model to analyze both long-run equilibrium relationships and short-run dynamics among variables is essential for identifying the permanent as well as transitory effects of the factors influencing the balance of payments. The ARDL model facilitates the implementation of cointegration testing in a more straightforward manner and employs lagged variables to mitigate the problem of endogeneity, thereby contributing to the greater reliability of the study's findings. Prior to constructing the ARDL model, it is important to pay careful attention to the quality and adequacy of the statistical data. The execution of necessary

transformations and the detection and treatment of outliers are indispensable steps in this process. Once the model has been estimated, diagnostic tests must be conducted in order to ensure the adequacy and validity of the model.

The general form of the ARDL model is expressed as follows:

$$\Delta Y_t = \alpha_0 + \sum_i [\alpha_i \Delta Y_{t-i}] + \sum_i [\beta_i \Delta X_{t-i}] + \gamma_1 Y_{t-1} + \gamma_2 Y_{t-1} + \varepsilon_t \quad (1)$$

where:

$\Delta$  - first difference operator;  $Y_t$  - dependent variable;  $X_t$  - set of independent variables;  $\alpha_0$  - constant term (intercept);  $\alpha_i$  - coefficients of the lagged values of the dependent variable;  $\beta_i$  - coefficients of the lagged values of the independent variables;  $\gamma_1$  - coefficient of the lagged level of the dependent variable;  $\gamma_2$  - coefficient of the lagged level of the independent variable;  $\varepsilon_t$  - stochastic error term.

The selection of the ARDL method in this study is justified by a number of methodological advantages. This approach allows for the simultaneous inclusion in the model of both  $I(0)$  variables - that is, those stationary at levels - and  $I(1)$  variables that become stationary upon taking first differences. However, a fundamental requirement of the ARDL method is that none of the variables under investigation should be integrated of order  $I(2)$  or higher. The presence of such a condition would undermine the validity of both the ARDL framework and the Bounds cointegration test. It is for this reason that the conduct of unit root tests should be regarded not merely as a formal procedural step, but as a necessary condition ensuring the integrity of the model.

Three unit root tests were employed in the study. For the Augmented Dickey-Fuller (ADF) test, the optimal lag length for each variable was determined on the basis of the Akaike Information Criterion (AIC) and the Schwarz Information Criterion (SIC/BIC), and the test was conducted at both level and first difference [17]. The Phillips-Perron (PP) test was selected as an alternative test complementing the ADF test, owing to its robustness to heteroskedasticity and autocorrelation. Finally, given that the data encompass the economic shocks of 2008, 2015, and 2020, the Zivot-Andrews test, which accounts for the presence of structural breaks, was also applied.

The results of the unit root tests confirmed that all variables are stationary at first differences, thereby providing a methodologically sufficient basis for the application of the ARDL approach. An ARDL( $p, q_1, q_2, q_3$ ) model was constructed, combining levels and first differences with varying lag lengths within the same equation, and the optimal lag lengths were determined by means of the Akaike Information Criterion (AIC):

$$Y_t = c + \sum_{i=1}^p \alpha_i Y_{t-i} + \sum_{j=0}^{q_1} \beta_{1j} X_{1,t-j} + \sum_{k=0}^{q_2} \beta_{2k} X_{2,t-k} + \sum_{m=0}^{q_3} \beta_{3m} X_{3,t-m} + \varepsilon_t \quad (2)$$

where  $Y_t$  - current account (as quarterly indicators);  $X_{1t}, X_{2t}, X_{3t}$  - three independent variables, respectively;  $c$  - constant term of the model;  $\alpha_i$  - coefficients on the lagged values of the dependent variable;  $\beta_{ij}$  - parameters measuring the short-run effect of the current and past values of the independent variables on the dependent variable;  $\varepsilon_t$  - is the error term..

Based on the ARDL model, which allows for the simultaneous assessment of short-run dynamics and long-run equilibrium relationships within a unified framework, the Bounds test was conducted and the existence of cointegration among the variables was empirically confirmed; the F-statistic exceeding the upper critical bound warranted the estimation of the long-run relationship [18]. The Error Correction Model (ECM), which presents both the long-run equilibrium and short-run dynamics simultaneously, is specified as follows:

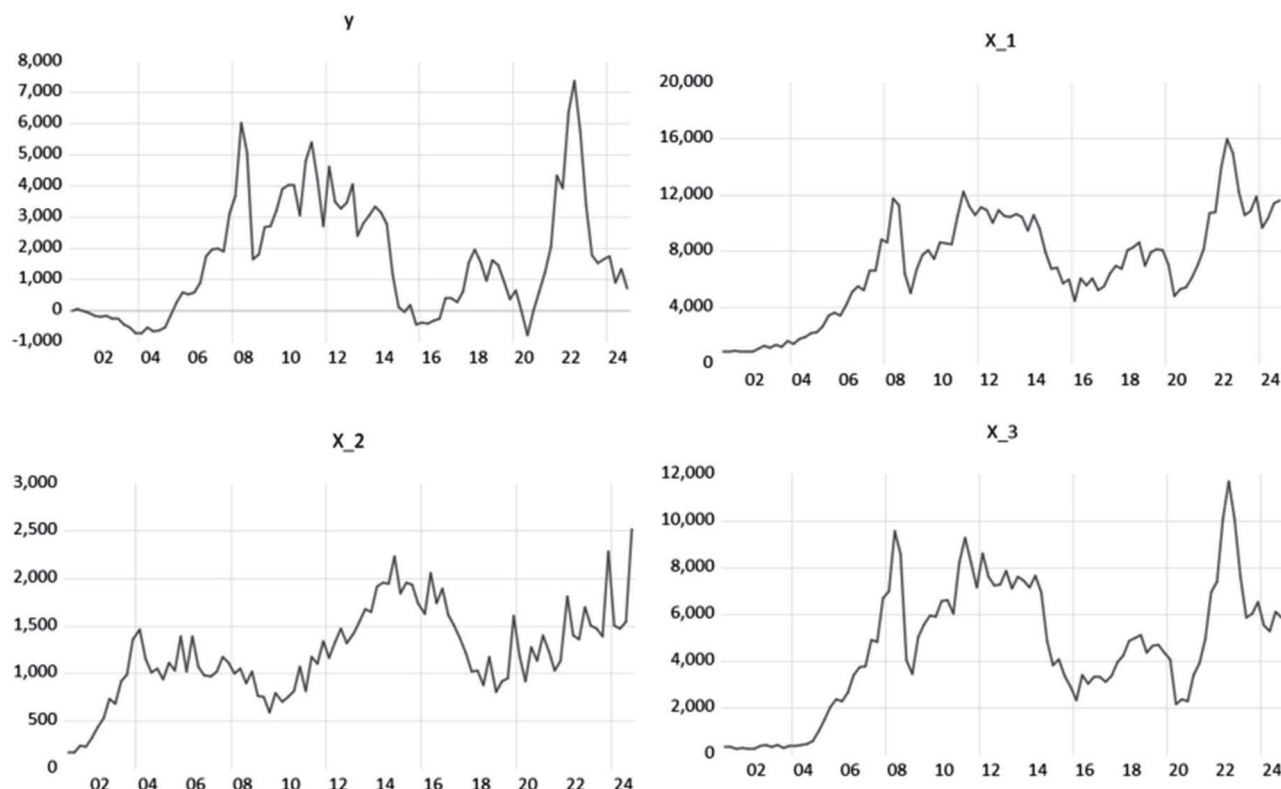
$$\Delta Y_t = \gamma_0 + \phi ECT_{t-1} + \sum_{i=1}^{p-1} \delta_i \Delta Y_{t-i} + \sum_{j=0}^{q_1-1} \pi_{1j} \Delta X_{1,t-j} + \sum_{k=0}^{q_2-1} \pi_{2k} \Delta X_{2,t-k} + \sum_{m=0}^{q_3-1} \pi_{3m} \Delta X_{3,t-m} + \mu_t \quad (3)$$

$$ECT_{t-1} = Y_{t-1} - \theta_1 X_{1,t-1} - \theta_2 X_{2,t-1} - \theta_3 X_{3,t-1} \quad (4)$$

where  $\phi$  - is the error correction coefficient, indicating the speed at which the system returns to equilibrium following a deviation from the long-run equilibrium;  $\theta_1, \dots, \theta_3$  - are the long-run coefficients of the independent variables;  $\delta_i$  and  $\pi_{ij}$  - are the respective short-run dynamic coefficients;  $\mu_t$  - is the error term. A negative and statistically significant value of the coefficient  $\phi$  confirms the existence of cointegration and the convergence of the system toward long-run equilibrium.

## Empirical results

The variables included in the model are as follows: the dependent variable  $Y$  - CA, representing the current account of the balance of payments; and the independent variables  $X_1$  - FT, foreign trade turnover;  $X_2$  - FDI, foreign direct investment; and  $X_3$  - OGE, the volume of exports in the oil and gas sector. The descriptive statistics of the variables under investigation are first examined, with the aim of identifying the principal characteristics of the data - namely, trend, variation, distributional form, and inter-variable relationships. This analysis provides the foundational information required for subsequent econometric modeling and informs model specification decisions. In particular, the graphical analysis of time series allows for the visual identification of potential structural breaks and extreme values. The results presented in Table 1 and Figure 1 reflect the dynamics of Azerbaijan's current account balance ( $Y$ ), foreign trade turnover ( $X_1$ ), foreign direct investment ( $X_2$ ), and oil and gas exports ( $X_3$ ) over the period spanning 2001–2024.

Рис. 1. Динамика временных рядов  $Y$ ,  $X_1$ ,  $X_2$ ,  $X_3$ Fig. 1. Dynamics of the Time Series of  $Y$ ,  $X_1$ ,  $X_2$ ,  $X_3$ 

Источник: составлено авторами с использованием программного пакета EViews

Source: compiled by the authors using the EViews software package

From the analysis of the graphs presented in Figure 1, it can be observed that the time series under consideration are non-stationary. Fluctuations are evident across all time series, with the principal declines and rises occurring predominantly during the same periods. The graphical analysis of the time series indicates that the economic shocks of 2008, 2015, and 2020 exerted a discernible influence on all variables under investigation, giving rise to structural breaks in their dynamics. The fluctuations observed

are attributed to such processes as changes in world oil prices, the weakening of external trade relations and investment flows (2019–2020), the devaluation of the national currency in Azerbaijan (2015), and related developments.

A probability value exceeding 0.05 under the Jarque-Bera test indicates that the residuals of the corresponding time series are normally distributed, meaning that the distribution is considered standard according to the test. Upon examining the Jarque-Bera test results presented in Table 1, it can be observed that, since the aforementioned condition is satisfied for the independent variables, the residuals of those time series cannot be rejected as normally distributed at the 5% significance level. However, the same conclusion cannot be drawn for the dependent variable. Specifically, the test result for the current account time series was obtained with a value of  $JB_y=9.46$  at a probability of  $p=0.008<0.05$ .

Correlation analysis is employed to examine the direction and magnitude of pairwise associations among the study variables. In order to determine the correlation dependence, the values within the interval  $[-1; 1]$  obtained through the correlation coefficient are examined, and on the basis of the results, the strength of the relationship - whether weak, moderate, or strong - is determined using the Chaddock scale. If the value of the correlation coefficient is below 0.3, the relationship is

Таблица 1 / Table 1

**Descriptive statistics**  
**Описательная статистика**

| Descriptive Statistics | CA ( $Y$ ) | FT ( $X_1$ ) | FDI ( $X_2$ ) | OGE( $X_3$ ) |
|------------------------|------------|--------------|---------------|--------------|
| Mean                   | 1658.81    | 7064.849     | 1221.123      | 4219.782     |
| Median                 | 1393.5     | 7030.688     | 1168.5        | 4494.5       |
| Maximum                | 7379.7     | 15980.19     | 2523.639      | 11696.46     |
| Minimum                | -806.00    | 838.7        | 168.00        | 219.00       |
| Std. Dev.              | 1907.393   | 3681.708     | 469.001       | 2789.508     |
| Skewness               | 0.766172   | -0.087993    | 0.135771      | 0.112577     |
| Kurtosis               | 2.865653   | 2.282630     | 3.132688      | 2.305495     |
| Jarque-Bera            | 9.464509   | 2.182365     | 0.365366      | 2.132126     |
| Probability            | 0.008807   | 0.335819     | 0.833032      | 0.344362     |
| Sum                    | 159245.8   | 678225.5     | 117227.8      | 433899.1     |
| Sum Sq. Dev.           | 3.46E+08   | 1.29E+09     | 20896383      | 7.39E+08     |
| Observations           | 96         | 96           | 96            | 96           |

Table 2 / Таблица 2

**Correlation matrix**  
**Корреляционная матрица**

|       | $Y$   | $X_1$ | $X_2$ | $X_3$ |
|-------|-------|-------|-------|-------|
| $Y$   | 1     | 0.818 | 0.051 | 0.919 |
| $X_1$ | 0.818 | 1     | 0.475 | 0.969 |
| $X_2$ | 0.051 | 0.475 | 1     | 0.361 |
| $X_3$ | 0.919 | 0.969 | 0.361 | 1     |

considered weak; if it falls between 0.3 and 0.7, the relationship is moderate; and if it is 0.7 or above, the relationship is considered strong. The results of the correlation analysis are presented in Table 2. Based on the obtained results, it can be noted that a strong relationship exists between  $Y$  - that is, the dependent variable - and the independent variables  $X_1$  and  $X_3$ . However, the relationship between  $Y$  and  $X_2$  is assessed as weak, given that its value is close to zero. With regard to multicollinearity among the explanatory variables, the following results were obtained: since  $r = 0.475$  between  $X_1$  and  $X_2$ , and  $r = 0.361$  between  $X_2$  and  $X_3$ , multicollinearity is absent in these pairs; however,  $r = 0.969$  between  $X_1$  and  $X_3$  confirms the existence of a strong dependence, that is, multicollinearity.

The descriptive statistics and graphical analyses obtained (see Table 1 and Figure 1) have established that the current account of Azerbaijan's balance of payments is significantly dependent on foreign trade turnover and oil and gas exports. The high correlation coefficient observed between foreign trade turnover and oil and gas exports ( $r = 0.969$ ) indicates the existence of a strong statistical relationship between these variables (see Table 2). This situation arises

from the fact that both variables reflect different aspects of the external trade sector of the Azerbaijani economy:  $X_1$  measures total trade turnover, while  $X_3$  captures its energy export component. Since both variables theoretically influence the current account through distinct economic channels, their joint inclusion within the ARDL model framework has been deemed appropriate.

Unit root tests for each time series were conducted using three methods. In the ADF test, the optimal lag length was determined automatically on the basis of the Schwarz Information Criterion (SIC). The PP test was applied to verify the ADF results, given its greater robustness against heteroskedasticity and autocorrelation. Taking into account the structural transformations to which the Azerbaijani economy was subjected during the period 2001Q1–2024Q4 - most notably the global financial crisis of 2008 and the sharp decline in oil prices in 2014–2015 - the Zivot-Andrews test, which endogenously identifies such breaks, was also employed. When structural breaks are not accounted for, conventional tests may lead to erroneous conclusions in rejecting the unit root.

As can be seen from Table 3, the results of the three tests across all variables mutually corroborate one another. At the level form, the ADF, PP, and Zivot-Andrews  $p$ -values for each variable exceeded the 0.05 threshold, and the null hypothesis - that is, the presence of a unit root - was not rejected. Upon taking first differences, however, the test statistics for  $Y$ ,  $X_1$ ,  $X_2$ , and  $X_3$  across all three tests surpassed the critical values at the 1% significance level, with  $p$ -values falling below 0.01. Accordingly, all variables included in the study are integrated of

Таблица 3 / Table 3

**Результаты тестов расширенного Дики-Фуллера, Филлипса-Перрона и Зивота-Эндрюса**  
**Results of the Augmented Dickey-Fuller, Phillips-Perron, and Zivot-Andrews Tests**

| Var.  | Form      | Augmented Dickey-Fuller |        | Phillips-Perron |        | Zivot-Andrews (Breakpoint) |        |           |           |         |
|-------|-----------|-------------------------|--------|-----------------|--------|----------------------------|--------|-----------|-----------|---------|
|       |           | $t$ -stat.              | $p$    | $t$ -stat.      | $p$    | $t$ -stat.                 | $p$    | crit.(1%) | crit.(5%) | Br.date |
| $Y$   | Level     | -2.2986                 | 0.4304 | -2.2986         | 0.4304 | -4.1063                    | 0.4522 | -5.7191   | -5.1757   | 2014Q2  |
|       | 1st diff. | -8.3189<br>***          | 0.0000 | -8.2161<br>***  | 0.0000 | -9.4662<br>***             | < 0.01 | -5.7191   | -5.1757   | 2008Q4  |
| $X_1$ | Level     | -2.2160                 | 0.4751 | -2.3726         | 0.3914 | -4.4910                    | 0.2408 | -5.7191   | -5.1757   | 2014Q3  |
|       | 1st diff. | -8.4918<br>***          | 0.0000 | -8.4182<br>***  | 0.0000 | -9.7453<br>***             | < 0.01 | -5.7191   | -5.1757   | 2008Q4  |
| $X_2$ | Level     | -2.2223                 | 0.2000 | -2.4418         | 0.1332 | -3.0670                    | 0.6469 | -4.9491   | -4.4436   | 2002Q3  |
|       | 1st diff. | -4.4494<br>***          | 0.0005 | -14.2111<br>*** | 0.0001 | -15.0864<br>***            | < 0.01 | -4.9491   | -4.4436   | 2024Q3  |
| $X_3$ | Level     | -2.7120                 | 0.2344 | -2.3363         | 0.4103 | -4.7610                    | 0.1363 | -5.7191   | -5.1757   | 2014Q3  |
|       | 1st diff. | -7.6065<br>***          | 0.0000 | -7.3862<br>***  | 0.0000 | -9.0919<br>***             | < 0.01 | -5.7191   | -5.1757   | 2008Q4  |

Note: \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.10$ . ADF and PP critical values are based on MacKinnon (1996). Zivot-Andrews critical values are based on Vogelsang (1993);  $p$ -values are asymptotic one-sided. Trend and Intercept specification applied for  $Y$ ,  $X_1$  and  $X_3$ ; Intercept only for  $X_2$ . Break type: Innovational Outlier; selection criterion: Dickey-Fuller minimum  $t$ -statistic (SIC).

## Модель ARDL (1, 3, 1, 2) – краткосрочная динамика

## ARDL(1, 3, 1, 2) Model – Short-Run Dynamics

| Dependent Variable: Y; Model Selection: AIC<br>Method: ARDL; Number of Observations: 93 (2001Q4 – 2024Q4) |             |            |                              |          |              |
|-----------------------------------------------------------------------------------------------------------|-------------|------------|------------------------------|----------|--------------|
| Variable                                                                                                  | Coefficient | Std. Error | t-Statistic                  | Prob.    | Significance |
| $Y(-1)$                                                                                                   | 0.604266    | 0.085825   | 7.040705                     | 0.0000   | ***          |
| $X_1$                                                                                                     | -0.476520   | 0.090060   | -5.291135                    | 0.0000   | ***          |
| $X_1(-1)$                                                                                                 | 0.260697    | 0.090266   | 2.888110                     | 0.0050   | ***          |
| $X_1(-2)$                                                                                                 | 0.147514    | 0.091001   | 1.621008                     | 0.1089   |              |
| $X_1(-3)$                                                                                                 | -0.050551   | 0.029830   | -1.694644                    | 0.0939   | *            |
| $X_2$                                                                                                     | -0.619518   | 0.135036   | -4.587810                    | 0.0000   | ***          |
| $X_2(-1)$                                                                                                 | 0.287829    | 0.145568   | 1.977284                     | 0.0514   | *            |
| $X_3$                                                                                                     | 1.271299    | 0.099990   | 12.71424                     | 0.0000   | ***          |
| $X_3(-1)$                                                                                                 | -0.683032   | 0.143882   | -4.747153                    | 0.0000   | ***          |
| $X_3(-2)$                                                                                                 | -0.175416   | 0.105925   | -1.656029                    | 0.1015   |              |
| c                                                                                                         | 30.41708    | 107.5527   | 0.282811                     | 0.7780   |              |
| Model Fit Statistics                                                                                      |             |            |                              |          |              |
| R-squared ( $R^2$ )                                                                                       | 0.977297    |            | F-statistic                  | 352.9880 |              |
| Adjusted $R^2$                                                                                            | 0.974528    |            | Prob(F-statistic)            | 0.000000 |              |
| S.E. of Regression                                                                                        | 305.5306    |            | Akaike Information Criterion | 14.39266 |              |
| Sum of Squared Residuals                                                                                  | 7654611     |            | Schwarz Criterion            | 14.69221 |              |
| Log Likelihood                                                                                            | -658.2585   |            | Hannan-Quinn Criterion       | 14.51361 |              |
| Mean Dependent Variable                                                                                   | 1712.116    |            | Durbin-Watson Statistic      | 2.222714 |              |

the first order, that is, they belong to the I(1) class.

The break dates identified by the Zivot-Andrews test correspond directly to the economic context of the present study. For variables  $Y$ ,  $X_1$ , and  $X_3$ , the period 2014Q2–2014Q3 was identified as the break point. This is explained by the structural impact exerted on Azerbaijan's current account, foreign trade turnover, and oil and gas exports by the approximately 50 percent decline in world oil prices during those years. The 2008Q4 break observed in the first differences reflects the sharp shock created in the dynamics by the global financial crisis. The 2002Q3 break in variable  $X_2$ , in turn, coincides with the period during which major oil contracts were being realized in Azerbaijan.

Accordingly, the results of the three unit root tests unanimously confirm that all variables are integrated of order I(1) and that none is integrated of order I(2). This finding fully satisfies the necessary methodological condition for the application of the ARDL method proposed by Pesaran, Shin, and Smith (2001). Specifically, the condition permits the joint modeling of variables integrated of order I(0) and I(1). However, the presence of an I(2) variable would undermine the validity of the Bounds test.

In the subsequent stage, an ARDL(1, 3, 1, 2) model was constructed and the existence of a long-run relationship among the variables was examined through the Bounds cointegration test. The ARDL model is a flexible methodological approach that allows for the simultaneous estimation of both short-run and long-run relationships within a unified structural framework. In this model, the current value of the dependent variable is explained not only

by its own past observations, but also by the current and lagged values of the independent variables. Within the scope of the study, the ARDL(1, 3, 1, 2) specification was identified as optimal through model selection based on the Akaike Information Criterion (AIC) (see Table 4).

The estimation of the coefficients yielded the following equation:

$$Y_t = 0.6043 Y_{t-1} - 0.4765 X_{1t} + 2.2607 X_{1t-1} + 0.1475 X_{1t-2} - 0.0506 X_{3t-3} - 0.6195 X_{2t} + 0.2878 X_{2t-1} + 1.2713 X_{3t} - 0.6830 X_{3t-1} - 0.1754 X_{3t-2} + 30.4171 \quad (5)$$

The estimation results indicate that the first lag of the dependent variable ( $Y_{t-1}$ ) was positive and highly statistically significant (0.6), confirming the persistence of the current account indicator. Although foreign trade turnover exerted a negative effect in the current period ( $X_{1t} = -0.4765$ ,  $p < 0.01$ ), positive and significant effects were observed in preceding periods ( $X_{1t-1} = 0.2607$ ,  $p < 0.01$ ). This finding suggests that trade turnover has both short-run negative and lagged positive effects on the current account. Foreign direct investment exerted a negative effect in the current period ( $X_{2t} = -0.6195$ ,  $p < 0.01$ ), but was positive and borderline statistically significant at the first lag ( $X_{2t-1} = 0.2878$ ,  $p \approx 0.05$ ). This indicates that, despite FDI weakening the balance in the short run, it may play a stabilizing role over the medium term.

Oil and gas exports exert a strong positive effect in the current period ( $X_{3t} = 1.2713$ ,  $p < 0.01$ ); however, negative effects were observed in preceding periods ( $X_{3t-1} = -0.6830$ ,  $p < 0.01$ ;  $X_{3t-2} = -0.1754$ ,  $p \approx 0.1$ ).

**Модель ARDL (1, 3, 1, 2) - Долгосрочная динамика и тест границ**  
**ARDL(1, 3, 1, 2) Model – Long-Run Dynamics and Bounds Test**

| Dependent variable: $D(Y)$ ; Restricted constant, no trend;<br>Model: ARDL(1, 3, 1, 2); Number of observations: 93 |             |                  |             |        |
|--------------------------------------------------------------------------------------------------------------------|-------------|------------------|-------------|--------|
| Conditional Error Correction Regression                                                                            |             |                  |             |        |
| Variable                                                                                                           | Coefficient | Std. Error       | t-Statistic | Prob.  |
| $Y(-1)^*$                                                                                                          | -0.395734   | 0.085825         | -4.610961   | 0.0000 |
| $X_1(-1)$                                                                                                          | -0.118860   | 0.056052         | -2.120517   | 0.0370 |
| $X_2(-1)$                                                                                                          | -0.331689   | 0.124912         | -2.655379   | 0.0095 |
| $X_3(-1)$                                                                                                          | 0.412852    | 0.113923         | 3.623942    | 0.0005 |
| $D(X_1)$                                                                                                           | -0.476520   | 0.090060         | -5.291135   | 0.0000 |
| $D(X_1(-1))$                                                                                                       | -0.096963   | 0.088422         | -1.096591   | 0.2760 |
| $D(X_1(-2))$                                                                                                       | 0.050551    | 0.029830         | 1.694644    | 0.0939 |
| $D(X_2)$                                                                                                           | -0.619518   | 0.135036         | -4.587810   | 0.0000 |
| $D(X_3)$                                                                                                           | 1.271299    | 0.099990         | 12.71424    | 0.0000 |
| $D(X_3(-1))$                                                                                                       | 0.175416    | 0.105925         | 1.656029    | 0.1015 |
| $X_3$                                                                                                              | 1.043255    | 0.149402         | 6.982867    | 0.0000 |
| $c$                                                                                                                | 76.86242    | 269.9700         | 0.284707    | 0.7766 |
| F-Bounds Test                                                                                                      |             |                  |             |        |
| F-statistic                                                                                                        | 4.416413    |                  |             |        |
| k                                                                                                                  | 3           |                  |             |        |
|                                                                                                                    |             | 10%              | 2.37        | 3.20   |
|                                                                                                                    |             | 5%               | 2.79        | 3.67   |
|                                                                                                                    |             | 2.5%             | 3.15        | 4.08   |
|                                                                                                                    |             | 1%               | 3.65        | 4.66   |
| Actual Sample size                                                                                                 | 93          |                  |             |        |
|                                                                                                                    |             | 10% ( $n = 80$ ) | 2.474       | 3.312  |
|                                                                                                                    |             | 5% ( $n = 80$ )  | 2.920       | 3.838  |
|                                                                                                                    |             | 1% ( $n = 80$ )  | 3.908       | 5.044  |

This finding indicates that the oil and gas sector strengthens the current account in the short run, but generates volatility across consecutive periods.

The estimation results of the model demonstrate a high explanatory power ( $R^2 = 0.9773$ , Adj.  $R^2 = 0.9745$ ), the F-statistic is significant ( $p < 0.01$ ), and the Durbin-Watson statistic ( $DW = 2.22$ ) indicates no evidence of residual autocorrelation. These indicators confirm the reliability of the model and the accurate estimation of the short-run dynamics.

The cointegration equation reflecting the long-run equilibrium relationships was constructed on the basis of the results presented in Table 5 using the Engle–Granger methodology, and is specified as follows:

$$\Delta Y_t = -0.3957(Y_{t-1} - (-0.3004X_{1t-1} - 0.8383X_{2t-1} + 1.0433X_{3t-1} + 76.8624)) \quad (6)$$

The error correction term (ECT) coefficient, which characterizes the speed of adjustment toward long-run equilibrium, is -0.3957, statistically highly significant ( $p < 0.01$ ), and carries a negative sign. This result confirms the tendency of short-run deviations occurring in the model to be corrected toward long-run equilibrium. The calculations indicate that approximately 39.6% of the disequilibrium arising

each quarter is eliminated; this suggests that the speed of adjustment to equilibrium is satisfactory, and that the full restoration of equilibrium requires approximately 2.5 quarters (roughly 7 - 8 months).

The results of the Bounds Test reported in Table 5 provide significant evidence indicating the existence of long-run relationships among the statistical indicators of Azerbaijan's balance of payments. The results of the tests conducted demonstrate that the calculated test statistic exceeds the critical bounds required to confirm the existence of long-run relationships. In particular, at the 10% and 5% significance levels, this statistic lies above the upper bound, thereby confirming the formation of cointegration relationships.

First and foremost, it should be noted that the calculated F-statistic (4.416) exceeds the corresponding critical values at the 10% and 5% significance levels (2.37, 2.79, 3.15, and 3.67), thereby confirming the existence of cointegrating relationships among the variables in the model. This result indicates that the variables considered in the model - foreign trade turnover ( $X_1$ ), foreign direct investment ( $X_2$ ), and oil and gas exports ( $X_3$ ) - possess the potential to form long-run relationships. Additionally, the low  $p$ -values of variables  $X_1$  and  $X_2$  (0.037 and 0.0095, respectively)

confirm their statistical significance within the long-run relationship and their relevance as strategically significant variables for economic policy design. From the perspective of economic interpretation, the long-run coefficient of foreign trade turnover ( $X_1$ ) is  $-0.3004$ , indicating a negative direction. This result suggests that trade expansion accompanied by an increase in imports generates a long-run deficit in the current account. Conversely, the long-run coefficient of oil and gas exports ( $X_3$ ) was found to be  $1.0433$ , indicating a positive effect on the balance of payments. Accordingly, the obtained results are considered statistically reliable and confirm that foreign trade and investment flows are significant determinants of the long-run equilibrium relationships of Azerbaijan's balance of payments. These findings provide an important empirical basis for the optimization of economic policy and the formulation and strengthening of investment and trade strategies.

The results of the ARDL model indicate that the first lagged value of the current account ( $Y(-1) = -0.3957$ ) is statistically significant ( $p < 0.05$ ), confirming the influence of preceding periods on the current period. The current period coefficient of foreign trade turnover is  $-0.4765$  and is highly significant ( $p < 0.001$ ). This negative effect is explained by short-run import growth. However, the first lagged values of foreign trade turnover and foreign direct investment are positive ( $X_1(-1) = 0.2607$ ,  $X_1(-2) = 0.1475$ ), indicating a positive contribution of foreign trade to the current account in the long-run perspective. The current period coefficient of foreign direct investment is  $-0.6195$  and is statistically significant ( $p < 0.001$ ). This negative effect is associated with repatriation and import demand in the short run. The first lagged value of this indicator is positive, reflecting the long-run production and export effect of investments ( $X_2(-1) = 0.2878$ ). The current period coefficient of oil and gas exports is  $1.2713$  and carries the highest degree of statistical significance ( $p < 0.001$ ). This strong positive effect once again confirms the dominant role of oil and gas exports in the balance of payments.

The CUSUM test is employed to assess the stability of a model in economic and statistical frameworks. This test evaluates parameter stability by examining whether the cumulative sum of recursive residuals remains within critical bounds over the sample period. In the presence of structural instability, the cumulative sum crosses the critical bounds, indicating a rejection of parameter constancy.

According to the results of the CUSUM test, the parameters of the model remained broadly stable throughout the period under investigation. As can be seen from Figure 2, the blue line does not approach the upper and lower bounds (at the 5% significance level) and exhibits no signs of systematic departure

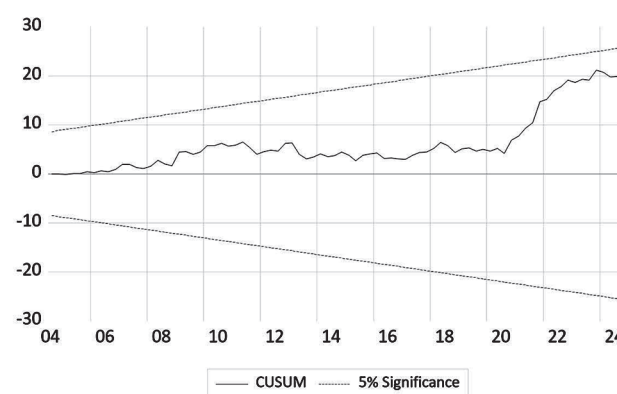


Рис. 2. Тест контрольной карты кумулятивных сумм

Fig. 2. CUSUM Test

Источник: составленный авторами с использованием программного пакета EViews

Source: compiled by the authors using the EViews software package

or abrupt shift. This indicates that no statistically significant structural breaks or deviations contrary to stability are present in the model, meaning that the results are stable and reliable. From an economic perspective, this finding suggests that changes in the indicators affecting the balance of payments in Azerbaijan have been stable and persistent, without the occurrence of long-run or short-run structural breaks. This implies that no sudden or transitory effects associated with general economic conditions or policy changes are observed, and that the results obtained from the model demonstrate stability.

Diagnostic tests conducted on the residuals of the constructed economic models for autocorrelation and heteroskedasticity indicate that the residuals of the model must be free from serial correlation and must exhibit constant variance. When these conditions are satisfied, the model's estimates are considered reliable and the inference drawn from them is statistically valid. Conversely, when autocorrelation or heteroskedasticity is detected in the residuals, the results of the model may become distorted and the reliability of future forecasts may be undermined. For this reason, the regular conduct

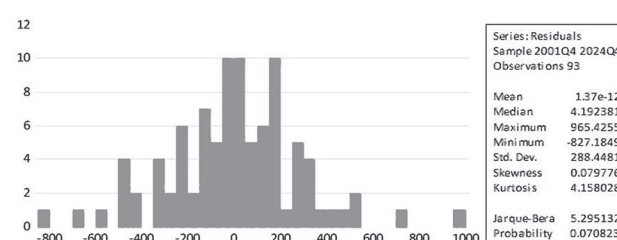


Рисунок 3. Гистограмма остатков с нормальным распределением (тест Харке-Бера)

Figure 3. Histogram of Residuals with Normal Distribution (Jarque-Bera Test)

Источник: составленный авторами с использованием программного пакета EViews

Source: compiled by the authors using the EViews software package

of diagnostic tests in empirical studies is regarded as methodologically indispensable.

The histogram (see Figure 3) indicates that the distribution of residuals is largely symmetric, with no pronounced right or left skewness observed. This suggests the absence of significant outliers or heavy tails in the residual distribution. The Jarque-Bera test statistic is 5.295, with a probability of 0.0708. Since the  $p$ -value exceeds the 0.05 threshold, there is no basis for rejecting the hypothesis of normal distribution of the residuals. Accordingly, the null hypothesis of normally distributed residuals cannot be rejected at the 5% significance level, which confirms the model's compliance with the OLS assumptions.

Таблица 6 / Table 6

**LM тест последовательной корреляции  
Бреуша-Годфри**

**Breusch-Godfrey Serial Correlation LM Test**

| Null Hypothesis: No serial correlation at up to 2 lags;<br>Included observations: 93 |          |               |           |
|--------------------------------------------------------------------------------------|----------|---------------|-----------|
| Test Statistic                                                                       |          |               | Prob. (p) |
| F-statistic                                                                          | 1.589531 | F(2, 80)      | 0.2104    |
| Obs*R-squared                                                                        | 3.554414 | Chi-Square(2) | 0.1691    |

The results of the Breusch-Godfrey test (see Table 6) indicate that no autocorrelation exists in the residuals up to 2 lags. Since the  $p$ -values for the F-statistic (1.589531,  $p = 0.2104$ ) and Obs\*R-squared (3.554414,  $p = 0.1691$ ) both exceed the 0.05 threshold, the null hypothesis of no autocorrelation is not rejected; in other words, confirming that the residuals exhibit no serial correlation up to the second lag.

Таблица 7 / Table 7

**White / Heteroskedasticity test**

**Тест Уайта на гетероскедастичность**

| Null hypothesis: Homoskedasticity<br>Sample: (2001Q4-2024Q4) |          |                        |           |
|--------------------------------------------------------------|----------|------------------------|-----------|
| Test Statistic                                               |          |                        | Prob. (p) |
| F-statistic                                                  | 1.752463 | Prob. F(65,27) =       | 0.0542    |
| Obs*R-squared                                                | 75.18013 | Prob. Chi-Square(65) = | 0.1820    |
| Scaled explained SS                                          | 92.28919 | Prob. Chi-Square(65) = | 0.0147    |

The White heteroskedasticity test conducted in Table 7 assesses the constancy of the variance of the residuals. In terms of the hypotheses,  $H_0$  represents the assumption of homoskedasticity, while the alternative hypothesis  $H_1$  expresses the assumption of heteroskedasticity. Based on the test results, the  $p$ -value for the F-statistic was 0.0542, for ObsR<sup>2</sup> it was 0.1820, and for Scaled Explained SS it was 0.0147. As the primary decision criteria, the F-statistic and ObsR<sup>2</sup> indicators are generally taken into consideration. Since  $p > 0.05$  for both of these indicators, the null hypothesis  $H_0$  is not rejected, confirming that the residuals are homoskedastic.

Accordingly, no statistically significant heteroskedasticity problem is observed in the model. This finding confirms that the standard errors are correctly estimated, satisfying a key assumption underlying the validity of  $t$  and  $F$  tests, and supporting the overall reliability of the empirical results. The presence of homoskedastic residuals supports the reliability of the model's parameter estimates and any forecasts derived therefrom.

## Conclusion

The empirical analysis conducted has established that all variables are integrated of order  $I(1)$  and that the ARDL(1, 3, 1, 2) model reliably estimates both short-run and long-run relationships:

- The first lag coefficient of the current account is 0.6043, highly significant ( $p < 0.001$ ), confirming the persistence of the indicator;

- Foreign trade turnover exerted an effect with a coefficient of  $-0.4765$  ( $p < 0.001$ ) in the current period, while the coefficients at the first and second lags were positive (0.2607,  $p = 0.005$ ; 0.1475,  $p \approx 0.11$ ), indicating a short-run negative but medium-term positive effect of imports.

- The current period coefficient of foreign direct investment is  $-0.6195$  ( $p < 0.001$ ), while the first lag yields a positive coefficient of 0.2878 ( $p \approx 0.05$ ). This suggests that although FDI weakens the balance in the short run, it plays a stabilizing role over the medium term.

- Oil and gas exports exert a strong positive effect in the current period (1.2713,  $p < 0.001$ ); however, negative coefficients were observed in preceding periods ( $-0.6830$ ,  $p < 0.001$ ;  $-0.1754$ ,  $p \approx 0.10$ ), confirming that the energy sector strengthens the current account contemporaneously but introduces volatility across successive periods.

- The Bounds test yielded  $F = 4.4164$ , exceeding the 5% critical bound and confirming the existence of cointegration relationships.

- The long-run coefficient of foreign trade turnover is  $-0.3004$ , that of foreign direct investment is  $-0.8382$ , and that of oil and gas exports is 1.0433.

- The Error Correction Term (ECT) =  $-0.3957$  ( $p < 0.001$ ), indicating that approximately 40% of the disequilibrium arising each quarter is eliminated, confirming that the full restoration of equilibrium requires approximately 2.5 quarters (7–8 months).

- The reliability of the model is confirmed by its high explanatory power ( $R^2 = 0.9773$ ), the absence of autocorrelation in the residuals (DW = 2.22), homoskedasticity and freedom from serial correlation (White test:  $p = 0.1820$ ; Breusch–Godfrey test:  $p = 0.2104$ ), and the stability of parameters as confirmed by the CUSUM test.

- The empirical findings highlight three principal mechanisms in Azerbaijan's balance of payments. While foreign trade turnover exerts a negative short-run effect by increasing imports and weakening the

balance, its stabilizing role becomes apparent over the medium and long run. Although foreign direct investment weakens the balance in the short run due to repatriation and import demand, it generates long-run stability by enhancing production and export potential. Oil and gas exports represent the dominant component of the current account, exerting a positive effect in both the short and long run; however, the volatility of the sector necessitates a diversification policy for economic stability.

Accordingly, the results of the model indicate that policies such as import management, the channeling of investments toward production and exports, energy sector diversification, and the strengthening of non-oil exports should be prioritized for the stability of Azerbaijan's balance of payments. Such an approach would contribute to macroeconomic stability, improve the effectiveness of economic policy, and enhance the reliability of empirical forecasts.

## Литература

1. Krugman P. R., Obstfeld M. International Economics: Theory and Policy. London: Pearson Education, 2009.
2. Hamilton J.D. What Is an Oil Shock? // Journal of Econometrics. 2003. № 113. С. 363–398. DOI: 10.1016/S0304-4076(02)00207-5.
3. Ayyubova N.S., & Aghayeva N. R. Statistical analysis of oil prices on the current account of the balance of payments of the Azerbaijan Republic // Scientific Collection «InterConf+». Brighton, Great Britain: 2024. № 45(201). С. 114–133. DOI: 10.51582/interconf.19-20.05.2024.010.
4. Айюбова Н.С. Анализ коинтеграционных связей между платежным балансом Азербайджана и мировыми ценами на нефть // Финансы: теория и практика / Finance: Theory and Practice. 2025. № 29(1). С. 68–79. DOI: 10.26794/2587-5671-2025-29-1-68-79.
5. Айюбова Н.С. Анализ динамики платежного баланса Азербайджана с использованием модели коррекции ошибок // Статистика и Экономика. 2025. № 22(5). С. 4–18. DOI: 10.21686/2500-3925-2025-5-4-18.
6. Mushendami P., Manuel V. Empirical Analysis of the Monetary Approach to the Balance of Payment in Namibia // International Research Journal. 2017. № 3(1). С. 1088–1104.
7. Eita J. H., Gaomab M. H. Macroeconomic Determinants of Balance of Payments in Namibia // International Journal of Business and Management. 2012. № 7(3). DOI: 10.5539/ijbm.v7n3p173.
8. Смирнов В.В., Мулендеева А.В. Анализ динамики российского платежного баланса // Финансы и кредит. 2019. Т. 25. № 9. С. 2006–2021. DOI: 10.24891/fc.25.9.2006.
9. Ghilous Azeddine & Ziat Adel "Balance of Payments as a Monetary Phenomenon: An ARDL Bounds Test Method for Algeria" // Folia Oeconomica Stetinensia, Sciendo. 2023. № 23(1). С. 64–86. DOI: 10.2478/fofi-2023-0004.
10. Kamara Abu Kai., Bendu Dante Alie., Jalloh Mohamed Sajor, & N'Jai Abdulrahman. Determinants of Balance of Payments in Sierra Leone: An ARDL Model Approach (September 24, 2025). DOI: 10.2139/ssrn.5523260.
11. Rexford Abaidoo Balance of Payment Constrained Growth: Johansen versus Autoregressive Distributed Lag Model (ARDL) Test for Co-integration // Journal of Applied Business and Economics. 2011. № 12(2). С. 49–60.
12. Insel A., Kayikçi F. Determinants of the Current Account Balance in Turkey: an ARDL Approach // Economic Research-Ekonomska Istraživanja. 2013. № 26(1). С. 1–16. DOI: 10.1080/1331677X.2013.11517587.
13. Macroeconomic statistics [Электрон. ресурс]. Central Bank of Azerbaijan. Режим доступа: <https://www.cbar.az/page-41/macroeconomic-indicators>.
14. Патель Р., Мохapatра Д.Р., Ядав С.К. Анализ детерминант ПИИ с помощью модели авторегрессии с распределенным лагом: данные по Индии // Финансы: теория и практика / Finance: Theory and Practice. 2024. № 28(3). С. 144–156. DOI: 10.26794/2587-5671-2024-28-3-144-156.
15. Конторович Г.Г. Лекции: Анализ временных рядов // Экономический журнал Высшей школы экономики, НИУ ВШЭ. 2003. Т. 7. № 1. С. 79–103.
16. Айюбова Н.С. Анализ влияния мировых цен на нефть на ВВП (на примере Азербайджанской Республики) // Статистика и Экономика. 2023. № 20(2). С. 22–41. DOI: 10.21686/2500-3925-2023-2-21-40.
17. Dickey D.A., Fuller W.A. Distribution of Estimators for Autoregressive Time Series with a Unit Root // Journal of the American Statistical Association. 1979. № 74. С. 427–431. DOI: 10.2307/2286348.
18. Johansen S. Statistical Analysis of Cointegration Vector // Journal of Economic Dynamics and Control. 1988. №12. С. 231–254. DOI: 10.1016/0165-1889(88)90041-3.

## References

1. Krugman P. R., Obstfeld M. International Economics: Theory and Policy. London: Pearson Education; 2009.
2. Hamilton J.D. What Is an Oil Shock? Journal of Econometrics. 2003; 113: 363-398. DOI: 10.1016/S0304-4076(02)00207-5.
3. Ayyubova N.S., & Aghayeva N. R. Statistical analysis of oil prices on the current account of the balance of payments of the Azerbaijan Republic. Scientific Collection «InterConf+». Brighton, Great Britain: 2024; 45(201): 114-133. DOI: 10.51582/interconf.19-20.05.2024.010.
4. Ayyubova N.S. Analysis of cointegration relationships between the balance of payments of Azerbaijan and world oil prices. Finansy: teoriya i praktika / Finance: Theory and Practice = Finance: Theory and Practice. 2025; 29(1): 68-79. DOI: 10.26794/2587-5671-2025-29-1-68-79. (In Russ.)
5. Ayyubova N.S. Analysis of the dynamics of the balance of payments of Azerbaijan using the error correction model. Statistika i Ekonomika = Statistics and Economics. 2025; 22(5): 4-18. DOI: 10.21686/2500-3925-2025-5-4-18. (In Russ.)
6. Mushendami P., Manuel V. Empirical Analysis of the Monetary Approach to the Balance of Payment in Namibia. International Research Journal. 2017; 3(1): 1088-1104.
7. Eita J. H., Gaomab M. H. Macroeconomic Determinants of Balance of Payments in Namibia. International Journal of Business and Management. 2012; 7(3). DOI: 10.5539/ijbm.v7n3p173.
8. Smirnov V.V., Mulendeyeva A.V. Analysis of the Dynamics of the Russian Balance of Payments. Finansy i kredit = Finance and Credit. 2019; 25; 9: 2006-2021. DOI: 10.24891/fc.25.9.2006. (In Russ.)
9. Ghilous Azeddine & Ziat Adel "Balance of Payments as a Monetary Phenomenon: An ARDL Bounds Test Method for Algeria". Folia Oeconomica Stetinensia, Sciendo. 2023; 23(1): 64-86. DOI: 10.2478/fofi-2023-0004.
10. Kamara Abu Kai., Bendu Dante Alie., Jalloh Mohamed Sajor, & N'Jai Abdulrahman. Determinants of Balance of Payments in Sierra Leone: An ARDL Model Approach (September 24, 2025). DOI: 10.2139/ssrn.5523260.
11. Rexford Abaidoo Balance of Payment Constrained Growth: Johansen versus Autoregressive Distributed Lag Model (ARDL) Test for Co-integration. Journal of Applied Business and Economics. 2011. 12(2): 49-60.
12. Insel A., Kayikçi F. Determinants of the Current Account Balance in Turkey: an ARDL Approach. Economic Research-Ekonomika Istraživanja. 2013; 26(1): 1-16. DOI: 10.1080/1331677X.2013.11517587.
13. Macroeconomic statistics [Internet]. Central Bank of Azerbaijan. Available from: <https://www.cbar.az/page-41/macroeconomic-indicators>.
14. Patel' R., Mokhapatra D.R., Yadav S.K. Analysis of FDI Determinants Using a Distributed Lagged Autoregressive Model: Evidence from India. Finansy: teoriya i praktika / Finance: Theory and Practice = Finance: Theory and Practice. 2024; 28(3): 144-156. DOI: 10.26794/2587-5671-2024-28-3-144-156. (In Russ.)
15. Kontorovich G.G. Lectures: Time Series Analysis. Ekonomicheskij zhurnal Vysshey shkoly ekonomiki, NIU VSHE = Economic Journal of the Higher School of Economics, National Research University Higher School of Economics. 2003; 7; 1: 79-103. (In Russ.)
16. Ayyubova N.S. Analysis of the Impact of World Oil Prices on GDP (on the Example of the Republic of Azerbaijan). Statistika i Ekonomika = Statistics and Economics. 2023; 20(2): 22-41. DOI: 10.21686/2500-3925-2023-2-21-40. (In Russ.)
17. Dickey D.A., Fuller W.A. Distribution of Estimators for Autoregressive Time Series with a Unit Root. Journal of the American Statistical Association. 1979; 74: 427-431. DOI: 10.2307/2286348.
18. Johansen S. Statistical Analysis of Cointegration Vector. Journal of Economic Dynamics and Control. 1988; 12: 231-254. DOI: 10.1016/0165-1889(88)90041-3.

## Сведения об авторах

**Натаван Солтан Аюбова**

К.э.н., доцент, кафедра Математическая экономика  
Бакинский государственный университет,  
Баку, Азербайджан  
Эл. почта: [nayyubova50@gmail.com](mailto:nayyubova50@gmail.com)

**Раван Тархан Гафарли**

Магистр кафедры "Математическая экономика"  
Бакинский государственный университет,  
Баку, Азербайджан  
Эл. почта: [revanqafarli77@gmail.com](mailto:revanqafarli77@gmail.com)

## Information about the authors

**Natavan S. Ayubova**

Cand. Sci. (Economics), Associate Professor,  
Department of Mathematical Economics  
Baku State University,  
Baku, Azerbaijan  
E-mail: [nayyubova50@gmail.com](mailto:nayyubova50@gmail.com)

**Ravan T. Gafarli**

Master's student, Department of Mathematical Economics  
Baku State University, Baku, Azerbaijan  
Email: [revanqafarli77@gmail.com](mailto:revanqafarli77@gmail.com)