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Article

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Analysis of the Main Social Macroeconomic Indicators of the Population During The oil Boom in Azerbaijan

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ABSTRACT

Indicators directly related to the economies of oil-exporting countries, and especially the socio-economic well-being of the population, depend on the resource potential and prices for resources of these countries. The income of the population, their average monthly salary, the average amount of monthly pensions, the average amount of old-age pensions, the average amount of disability pensions, the amount of pensions for the loss of the head of the family form the basis of the state of financial well-being. Taking them as a basis, we completed the goal of our research by constructing models that determine the dependence of the main indicators of the socio-economic and, of course, material well-being of the population of Azerbaijan on world oil prices. The study covers the years 1997-2022. The *ARDL* and *ARDL_ECM* models are adapted to determine long-term and short-term levels of these indicators, taking into account world oil prices. According to the *ARDLBT* results, a high level of co-integration relationship with world oil prices and socio-economic indicators of the population is noted. This has also been proven in the short term. Thus, the alternative *CCR*, *DOLS*, *FMOLS*, and *VECM* models used to validate these results further demonstrated the importance of these interactions. Moreover, the study also conducted a combined Bayer-Hank co-integration test. But the results turned out to be somewhat different. The results of this study can be taken into account to 1° or another in the socio-economic policy of the state in Azerbaijan.

Keywords: Oil Boom, Social Economic Welfare, Socıal Macroeconomıc Indıcators ARDLBT, DOLS, FMOLS, CCR, VECM
JEL Classifications: E64, E24, H55, H60, I30, J30, Q41, Q48

1. INTRODUCTION

Every person in society is engaged in one or another economic activity. And in return they receive income, profits, salaries, dividends, etc. In addition, many members of the society cannot engage in economic activity for a plausible reason, so they receive aid in the form of pensions, allowances, etc. from the state and private institutions. As the economy develops, the growth of these funds is inevitable. This issue stands out for its relevance in the context of globalization and especially economic globalization. The new international division of labor, which emerged already in 1985-1995, requires a constant increase in indicators that directly affect the socio−economic situation of the population.

Since Azerbaijan also takes its own position in the international division of labor, such issues become more relevant for it. Thus, the country exports oil to the world market and develops its economy with the oil dollars received in return. Meanwhile it improves the socio-economic situation of the population. We tried to conduct our research in this direction. In other words, we examined the impact of world oil prices on the income of the population, their average monthly wages, the average amount of monthly pensions, the average size of old-age pensions, the average size of disability pensions, and the size of bereavement pensions. Based on the above, we put forward hypotheses for our study.

$H1_0$: There is an co-integration relationship between world oil prices and income of the population

$H2_0$: There is an co-integration relationship between world oil prices and average monthly salary

$H3_0$: There is an co-integration relationship between world oil prices and average amount of monthly pensions

$H4_0$: There is an co-integration relationship between world oil prices and average amount of old-age pensions

$H5_0$: There is an co-integration relationship between world oil prices and average amount of disability pensions

$H6_0$: There is an co-integration relationship between world oil prices and amount of pensions for the loss of the head of the family.

The results of this study can contribute to a more complete understanding of the indicators of socio-economic well-being of the population of Azerbaijan and the oil factor, which is the main determining factor influencing it, especially world oil prices. After determining the impact of global oil prices, policymakers can continue to look for other alternative ways to improve the socio-economic well-being of the population and economic diversification policies in this regard. Thus, the development of the non-oil sector can significantly reduce the dependence of these indicators on the oil factor. First of all, that is the share of the non-oil sector in the income of the population is increasing, the share of this sector in average monthly labor costs is increasing, as well as the contributions of the non-oil sector to the state budget, which constitutes an increasing source of funding for pensions. In other words, the negative impact of fluctuations in world oil prices on the material and social security of the population of the republic will be reduced.

The following parts of the article consist of a literature review, data analysis of variables, interpretation of the models used, results of econometric studies, general conclusions, discussion, policy recommendations and references.

2. LITERATURE REVIEW

2.1. On the Overall Impact of Oil on the Economy

In countries more dependent on oil production, one of the difficult issues is not the decline in population, much less its increase against the backdrop of falling world oil prices. Although there are no direct studies of the impact of world oil prices on the social welfare indicators considered in our study, there is a sufficient number of studies that address these issues in one way or another (Amuzegar, 1982; Harvie, 1990; Harvie and Maleka, 1992; Babuga and Naseem, 2022; Bolganbayev et al., 2021; Cohen, 2006; Aleksandrova, 2016; Bayramov and Orujova, 2017; Alekhina and Yoshino, 2018; Su et al., 2020; Michieka and Gearhart, 2022). Moreover, most studies have focused on the impact of oil prices on social welfare outcomes in net oil importing countries. Since the subject of our study is one of the net oil exporting countries, we had to touch on these exporting countries in the literature review. Thus, in a study by Sotoudeh and Worthington (2017), the impact of changes in world oil prices on the standard of living of the population in major oil consuming and producing countries was assessed using linear models and nonlinear parametric McKee-Glass models and nonparametric Hiemstra-Jones models and causality tests. The results obtained to current date indicate that world oil prices have a linear impact on the standard of living of the population in net oil consumers and nonlinearly in net oil producing countries.

Sabah et al. (2016) examined the impact of current changes in world oil prices on the living standards of the people of Kuwait, one of the largest oil exporters. At this time, they adopted real GDP as the dependent variable to measure living standards. Along with the percentage change in the world price of one barrel of oil, percentage changes in investment growth, inflation, unemployment and the number of prisoners were taken as independent variables. As a result, the increase in the standard of living of the population, along with other factors, primarily the rise in world oil prices, had a stronger impact.

In a report by Kitous et al. (2016) the GDP and government revenues of several major oil exporting countries in sub-Saharan Africa and North Africa were closely linked to oil prices, and their dependence on oil prices oil was investigated. According to the conclusion of this study, the fall in global oil prices has led to different results in different oil exporting countries. Of course, this is due to the fact that other factors influencing the economic situation of these countries are different.

Researchers (Vandyck, 2018), whose paper aimed to estimate the economic impact of falling oil prices, conducted a retrospective analysis based on data over the past 25 years. Based on the results of their analysis, the dependence of GDP and government revenues on the oil factor in many Gulf countries was determined.

Focusing his research on global oil prices and economic growth in oil-exporting countries, El Anshasy (2009) examined the impact of high volatility in global oil prices and associated government revenue fluctuations on economic growth in oil-exporting countries. He argued that global oil price volatility does not slow down long-term economic growth. Moreover, after controlling for fiscal policy, rising oil prices have little positive impact on economic growth in the long term. The researcher concluded that government fiscal policy is the main mechanism for the transmission of global oil price shocks to the economy, and this explains differences in growth rates among oil exporting countries. As I have mentioned above (Kitous et al., 2016) there are many non-oil factors, the diversity of which leads to different outcomes in individual oil exporting countries.

Manasseh et al. (2018) who examined the impact of fluctuations in global oil prices and oil revenues on socio-economic welfare in Nigeria, a major oil exporter, using multiple regression techniques based on annual time series from 1981 to 2014 concluded that fluctuations in oil prices affect the population, although they did not have a significant impact on socio-economic well-being, but the impact on oil revenues was significant and positive. In addition, the researchers further delved into the study using the Johanson co-integration test and concluded that there is co-integration, that is, a long-run relationship between the variables. That is, the influence of world oil prices and, accordingly, oil revenues on people's well-being is direct (directly proportional).

In many oil-dependent countries, the pursuit of oil revenues is in some way accompanied by underdevelopment. Actually, despite the fact that some success and growth have been achieved, as in any business, too much dependence leads to negative results. Thus, there is an inverse correlation between high dependence on natural resources and economic growth. It is true that oil-led development, as mentioned above, has the potential to benefit in accelerating economic growth and increasing government revenue for job creation, financing poverty alleviation, technology transfer, improving infrastructure and developing allied sectors. However, achieving all these benefits is difficult (Karl, 2007). In our opinion, the oil factor does not play a big role here. The key international division of labor is in a favorable position.

Public finances in oil-exporting countries are heavily dependent on oil revenues, and therefore fluctuations in world oil prices create a basis for instability. This of course manifests itself in production, terms of trade, government budgets, long-term growth rates and the resulting social costs. This leads to weakening human development indicators (Oduyemi and Owoeye, 2020). Based on time series data from 1980 to 2017 and using VAR, a researcher studying how human capital affects health in Nigeria, which ranks among the world's lowest in terms of development indicators despite being the largest producer oil in Africa, concluded that oil The negative impact of price shocks on people's well-being and health is not so great (Amuzegar, 1982).

We believe that this result was expected in the context of the overall economic development of Nigeria at the time of the study (Amuzegar, 1982). Modern research shows the opposite (Peterson, 2009).

By examining the views of individual authors in a literature review, we found that Nugent and Switek (2013) put forward the following statement that "*despite general consensus regarding the importance and importance of oil prices for objectively measuring economic welfare across countries*" the influence of oil prices on the subjective well-being of the population at the international level can be agreed with the statement that practically no research has been conducted to analyze it.

The above-mentioned researchers concluded that oil prices have a very strong asymmetric effect on the life satisfaction of the population in oil-importing and exporting countries. One of the significant studies is the recently published paper by Imeokparia et al. (2023), in which the researchers set out to determine the impact of oil exports on poverty reduction in 10 major oil exporting countries in Africa. In this paper, covering the years 1991-2020, the ARDL panel method was used to analyze the variables. According to the results of the study, a decrease in poverty levels in these countries was noted, which has a beneficial and significant impact on the development of human capital indirectly through the oil factor, income from oil exports and oil production. In addition, it is emphasized that, in the long term, oil revenues have a positive impact on poverty reduction in African oil-exporting countries.

Other researchers (Babuga and Naseem, 2022) found that the long-term relationship between oil price changes and economic growth in six net oil exporting countries in sub-Saharan Africa, based on a dynamic heterogeneous panel PMG estimator, showed that economic growth was associated with rising oil prices in these countries. There is a threshold, a transitional level between them. Thus, a rise in world oil prices above a certain level leads to a decrease in real GDP. I think this is in accordance with natural laws and patterns. Thus, according to the law of saturation of products (events and processes, physical state), the transition of quantitative indicators into qualitative indicators and vice versa, as well as according to the law of their interaction, a rise in world oil prices above a certain limit leads to a decrease in real GDP. Of course, this is a relative decrease, or more precisely, a decrease in the growth rate of UDM.

In the period from January 2012 to December 2017, El-Chaarani (2019), who tried to determine the impact of changes in world oil prices on the financial performance of the banking sector in 8 oil-producing and exporting countries in the Middle East region, came to the conclusion that only in some countries this effect was significant and direct.

In a study that assessed the relationship between oil prices and wages in the 15 largest oil-producing regions of the United States using data from 2001 to 2018 and ARDL/NARDL models, over the long term, positive oil price shocks lead to higher wages across all industries: the greatest growth is observed in the manufacturing industry, the smallest in the services sector. At the same time, in the short term, oil price shocks have the greatest impact on wages in the commodity sector. In contrast, the NARDL models note that across the district level, across the economy as a whole, in the long and short run, global oil price shocks do not have a consistent effect on wages (Harvie and Maleka, 1992).

Back in the 1990s, Harvie and Maleka (1992), in a new paper they co-authored and followed up on a 1990 paper (Harvie, 1990), discussed possible macroeconomic adjustment processes occurring in an economy experiencing a temporary oil crisis production, that is, nominal and real, developed a simple model to try to identify alternative hypotheses about wage stickiness. The findings presented were that it is important to continually consider world oil prices and changes in that price to obtain a more accurate picture of the adjustment scale of macroeconomic variables associated with wage adjustments.

2.2. Studies Covering New oil States

In our opinion, new oil states can be included in the CIS. However, they participated in the overall export of oil to the world market centrally within the former USSR. Aleksandrova (2016), studying the oil factor in these countries. Examining the impact of falling world oil prices on economic growth, exchange rates and financial stability of oil exporting countries in the Caucasus and Central Asia, he concluded that uncertainty in oil revenues remains a challenge for the economies of oil exporting countries. Other researchers (Alekhina and Yoshino, 2018) used the VAR approach in their studies to study the interaction of the main macroeconomic indicators of non-OPEC oil exporting countries (Azerbaijan, Kazakhstan, Indonesia) and world oil prices. At this time, it was determined that a significant part of the countries' economies, their oil revenues, total exports, budget revenues and expenses depend on the oil factor. At the same time, based on the results obtained, it was determined that fluctuations in world oil prices have a significant impact on real GDP, consumer price index and inflation rate, interest rate and exchange rate. Moldabekova et al. (2022), one of the studies of the recent period, also analyzed the impact of fluctuations in world oil prices on the main macroeconomic indicators of Kazakhstan and social policy and concluded that these fluctuations are very effective.

In another study, the direct impact of world oil price shocks on economic growth in Russia in 1990-2015 subject to the economy's dependence on oil revenues, it was studied together with the indirect impact on migration trends based on the classical theory of migration in Russia, the Heckscher-Ohlin Paradigm. Using the VECM model to determine long-term relationships between variables and the Wald test to test short-term relationships, the researcher examined short-term structural and dynamic responses to shocks using variance decomposition and impulse response functions and concluded that there is a relationship between oil prices, economic growth and immigration established the existence of a long-term relationship, found a direct cause-and-effect relationship between oil prices and economic growth, economic growth and emigration in the short term (Burakov, 2017). Of course, this transmission effect was directly related to wages, although it was not mentioned in the study. Moreover, Nyangarika et al. (2018) also investigated in their articles the impact of global oil prices on the GDP of leading oil exporting countries such as Russia and Saudi Arabia and proved with empirical results that there is a strong relationship between them.

Both local and foreign authors devoted their research to the dependence of the Azerbaijani economy to one degree or another on the oil factor, in other words, on fluctuations in world oil prices (Rosenberg and Saavalainen, 1998; Cohen, 2006; Bayramov and Orujova, 2017; Dikkaya and Doyar, 2017; Shalbuzov et al., 2020; Czech and Niftiyev, 2021; Zulfigarov and Neuenkirch, 2020; Mukhtarov et al., 2021). However, neither among them, nor in studies devoted to the dependence of other oil exporters on the oil factor, have other authors examined separately in a scientific study the effect on more specific indicators. From this point of view, our article is somewhat new.

In another study, a panel analysis was conducted based on quarterly data from 2007 to 2020, and the impact and long-term relationship of changes in international Brent crude oil prices on the economic growth of Russia, Iran, Kazakhstan and Azerbaijan, which are around the Caspian Sea, were studied using Westerlund and Edgerton co-integration test (2007), and results were obtained on the impact of oil prices on economic growth (Bolganbayev et al., 2021).

Based on data from 1990 to 2016, Russian researchers used a VAR model to study the impact of global oil price shocks on labor market competition in Russia and hypothesized that inflation-adjusted wages would increase (slow down) given flexible wages. The result of their study was that a positive shock to world oil prices leads to an increase in aggregate wages and employment in the economy, while a negative shock leads to a slowdown in aggregate wage growth and an increase in the average unemployment rate (Kurnysheva and Burakov 2017). Ghalayini (2011) also examined the impact of price fluctuations on economic growth in oil exporting countries from Russia and mainly OPEC countries. After studying the impact of oil price fluctuations on wage arrears in Russia, he determined that falling prices lead to an increase in wage arrears.

3. DATA ANALYSIS AND METHODOLOGY

3.1. Data Analysis

The main information base of the study was the State Statistical Committee of the Republic Azerbaijan. Information about variables/time series was obtained from here. In it, he assessed the impact of world oil prices on the variables given in Table 1.

In this study, the data used to study the impact of world oil prices on the main socio-economic indicators of the population of Azerbaijan covers the years 1997-2022 (Table 1). Table 2 and, Figures 1 and 2 present descriptive statistics for the variables used

Table 1: Data and internet resource

Variables	Descriptions	Source
World oil prices (dollars)	*WOP*	www.cbar.az
Income of the population (dollars)	*IP*	www.stat.gov.az
Average monthly salary (dollars)	*MS*	www.stat.gov.az
Average amount of monthly pensions (dollars)	*MP*	www.stat.gov.az
Average amount of old-age pensions (dollars)	*OP*	www.stat.gov.az
Average amount of disability pensions (dollars)	*DP*	www.stat.gov.az
Amount of pensions for the loss of the head of the family (dollars)	*FP*	www.stat.gov.az

Table 2: Dynamics of variables

Years	*IP*	*MS*	*MP*	*OP*	*DP*	*FP*	*WOP*
2022/1997	13.11	13.96	30.62	28.79	33.39	35.67	5.29
2022/2000	9.11	10.14	13.66	13.23	11.53	20.02	3.59
2022/2005	4.63	3.68	7.48	7.81	5.94	7.46	1.90
2022/2010	0.91	0.97	1.05	1.03	1.06	1.31	0.96
2022/2015	1.51	1.65	1.76	1.72	1.79	2.03	2.00
2022/2020	1.24	1.19	1.26	1.24	1.27	1.37	2.46
2022/2021	1.20	1.15	1.10	1.09	1.11	1.10	1.47

Figure 1: Dynamics of variables

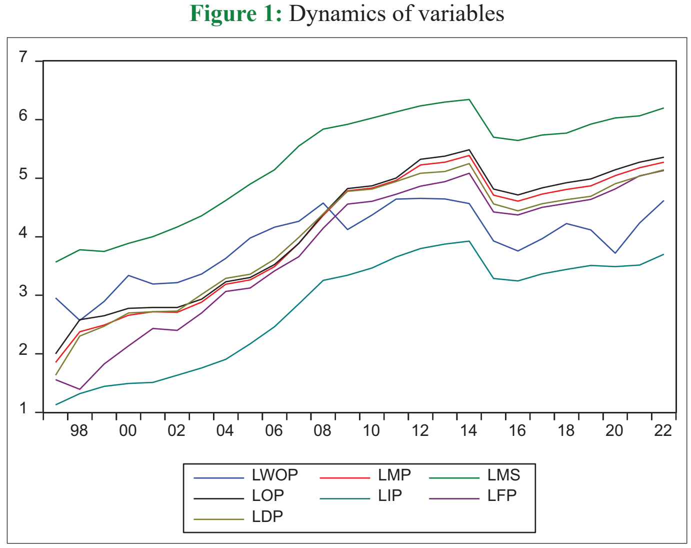
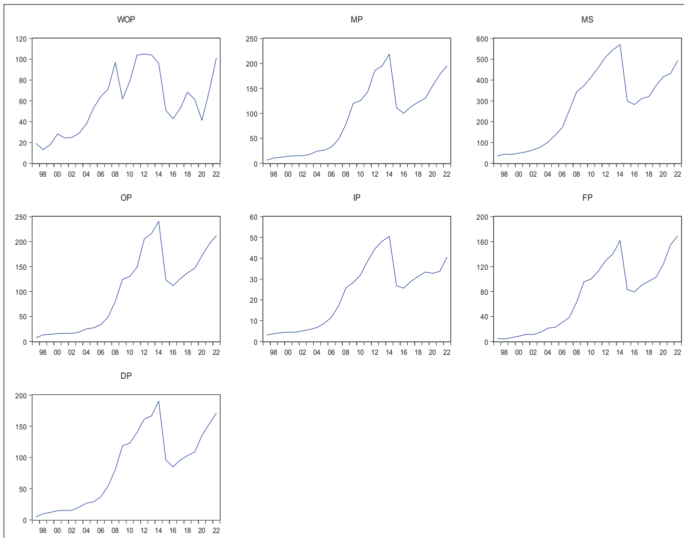
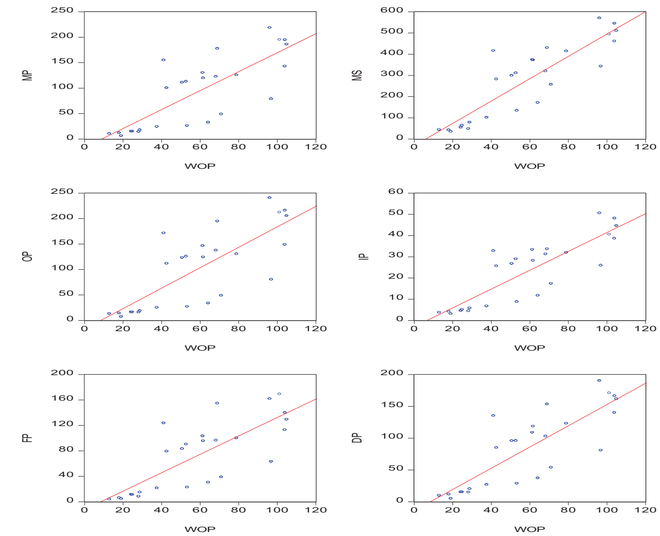


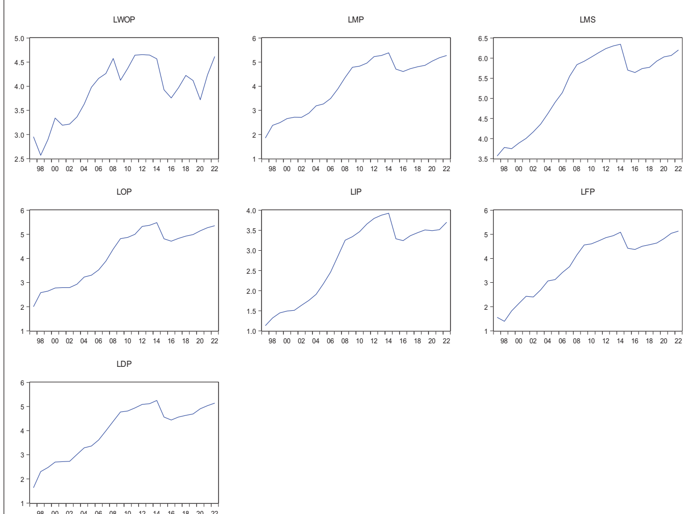
Figure 2: Dynamics of variables and regression



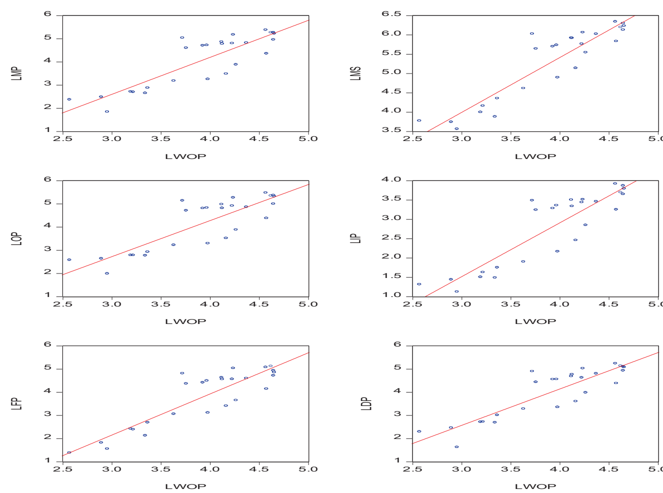
Dynamics of variables at their level.



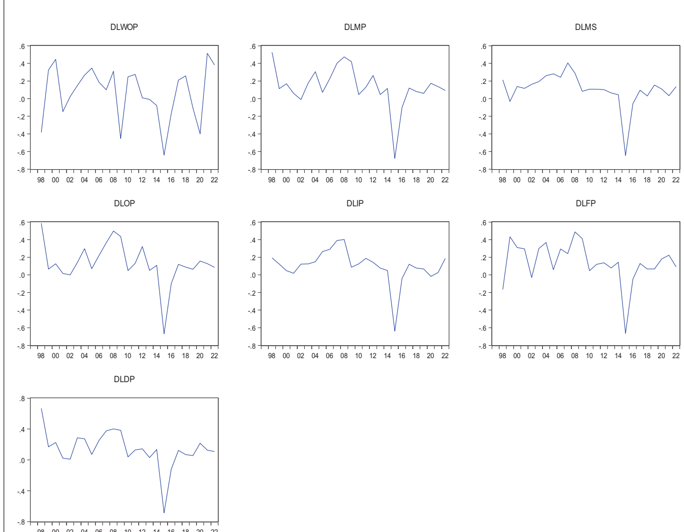
Regression of dependent and free variables at their level



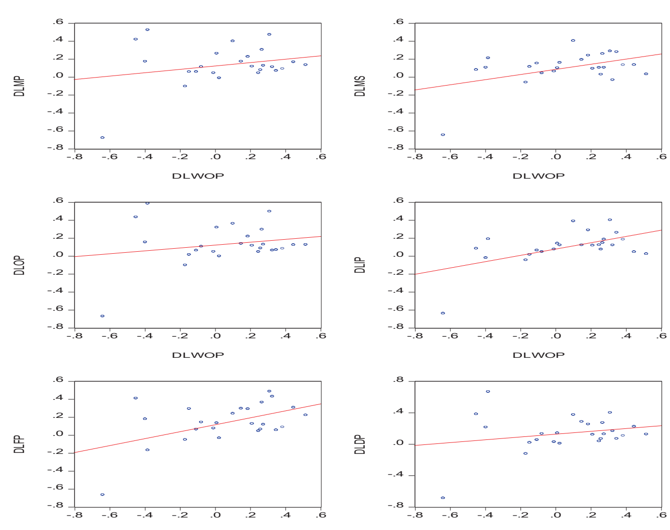
Dynamics of variables in logarithm



Regression of dependent and free variables in a logarithmized manner



Dynamics of variables in the form of logarithmic first difference change



Regression of dependent and free variables in the form of a logarithmic first difference change in this article. Economic growth in Azerbaijan was characterized by high rates between 2005 and 2015 due to oil production as well as the favorable situation in the global oil market. However, fluctuations in oil prices have recently caused some changes in this trend. This led to fluctuations in oil revenues, and then in household incomes, wages, pensions and other sources of income. We can tell this visually by looking at tables and graphs. As we know, oil prices have reached their lowest prices twice in the last 20 years. The first of them was in December 2008-45.59 (the minimum price in this month was 36.2). This is the lowest price since January 2016, following a high of 139.83 in June 2008 (the highest price in the same month was 143.95). Oil prices did not fall below $100 from January 2011 to September 2014, following upheavals in the Middle East and North Africa. But later, in just 5 months, the price of oil fell twice-from $103.87 in August 2014 to $53.95 in January 2015. That month the minimum price was $46.50. It was after this price that the Central Bank of Azerbaijan carried out the first devaluation of the manat. The rate dropped from 0.80 to 1.05. However, prices remained relatively stable over the next 9 months, but due to Russian-Syrian military cooperation in the Middle East, prices dropped again to $37.67 and $35.99 in December 2015 and January 2016, respectively. It was the 30% drop in oil prices from August to December that prompted the Central Bank of Azerbaijan to decide on a second devaluation of the manat. This was a necessary and correct step. Thus, one of the lowest prices-$26.5-was observed during the period of our research in the next month. The next oil price shock may be related to the COVID-19 pandemic. Thus, the sudden stops have led to stagnation and suffering in many areas of the economy. This, of course, reduced the demand for oil. So, in March and April 2020, prices fell to $26. This was the lowest monthly price during our study period. In April, $19/day is generally considered the lowest price in 20 years. It was in the context of such fluctuations in oil prices that income indicators characterizing the socio-economic situation underwent certain changes. In fact, these indicators were not subject to fluctuations due to the double devaluation of the manat in terms of manat. But to make the situation more realistic, we conducted a study converting these figures into dollars. In this case, you may observe graphs with fluctuations. It should be noted that the oil factor continues to act not only as an economic influence, but also as a political force. A clear proof of this is the psychological threshold exceeding $100 in March-July 2022 due to the beginning of the Russian-Ukrainian conflict. Let us remember that the last time the price of oil exceeded $100 was in August 2014 at 103.77$. Now, in March-July 2022, the highest price averaged $115.6 in May, and the highest price averaged $135 in March. All this is reflected in the indicators we studied, which were discussed above. Thus, although household income in millions of dollars from 2007 to 2008 increased from $17.35 billion to $26 billion, in 2009 this growth rate began to slow down and amounted to $29 billion. However, in 2014-2016 this decrease was more noticeable. Thus, in 2014 it decreased from $49.49 billion to $26 billion in 2015 and 2016. At the same time, in 2009, compared to 2008, the growth rate of average monthly nominal wages, average monthly pensions-total, pensions for old age, disability and loss of the head of the family decreased. However, in the period from 2014 to 2016, the growth rate not only did not decrease, but even took the opposite sign. Thus, if in 2014 the average monthly nominal salary was $569.87, then in 2015 it decreased to $299.29 and in 2016-$282.37. The average size of assigned pensions is $218.58, $111.15 and $100.39, respectively, the age pension is $240.76, $123.37 and $111.63, and the pension for disability-190.25$, 95.75$ and 84.92$, the amount of pensions due for the loss of the head of the family was 161.79$, 83.38$ and 79.36$.

3.2. Methodology

Several estimation methods (*OLS*, Engle and Granger, Johansen test, *ECM*, *ARDL*, etc.) are used in economic research, especially when studying the interaction of time series. As we know, most time series studied in economics are not stationary. For this reason, the traditional or classical *OLS* method leads to errors and proves that the results that can be obtained from established models are false. The Engle and Granger (1987) and Johansen and Juselius (1990) tests were developed to address this problem or the problem of spurious regression. This made it possible to determine the interaction between non-stationary variables. *ECM* can be applied when the variables are I(1) and there is a cointegration relationship between them. However, this test cannot be used in cases where the variables are mixed integration and non-stationary. This limitation can be overcome by applying the *ARDL* model (Pesaran and Shin, 1999).

The *ARDL* model is of great help to researchers in economics, sociology and many other fields in general due to its simplicity. Thus, it has become a popular and widely used method in various fields. In other words, this model is a non-stationary mixed Order Least Squares (*OLS*) method of integrated time series analysis. In addition, the dynamic *ECM* is generated from the *ARDL* through a simple linear transformation. Similarly, *ECM* integrates short-term dynamics with long-term equilibrium while preserving long-term data as well, avoiding the problems of spurious or spurious miscorrelation due to non-stationary time series. The advantages of the *ARDL* approach over other commonly used co-integration methods also include the following:

- It does not require the same integration/stationarity (level of stationarity) of the time series data.
- It can also be applied to short-term variables (small sample sizes). Allows different/different lag lengths for each time series (variables) respectively.
- It can work with both long-term and short-term models.
- This can ensure objective assessment results in the long term.
- It is not a pair that is being built, but an equation.

In this study, the income of the population in Azerbaijan, etc. simple equations (models) were created after studying the dependence on world oil prices. That is, this study examines the one-dimensional structure expressed by the following equations (1).

$$Y = f(X) \tag{1a}$$

$$Y = LnIP, LnFP, LnMS, LnDP, LnMP, LnOP \tag{1b}$$

$$X = LnWOP \tag{1c}$$

Here *Ln*– represents the natural logarithm of the dependent variable (*MP*, *MS*, *IP*, *DP*, *OP*, *FP*) and the independent variable (*WOP*).

Linear functions of dependent variables on world oil prices based on equation (1a, 1b and 1c) can be written as equation (2).

$$LnIP_t = \theta_0 + \theta_1\, LnWOP + \varepsilon_t \quad (2)$$

$$LnMS_t = \theta_0 + \theta_1\, LnWOP + \varepsilon_t \quad (3)$$

$$LnMP_t = \theta_0 + \theta_1\, LnWOP + \varepsilon_t \quad (4)$$

$$LnDP_t = \theta_0 + \theta_1\, LnWOP + \varepsilon_t \quad (5)$$

$$LnOP_t = \theta_0 + \theta_1\, LnWOP + \varepsilon_t \quad (6)$$

$$LnFP_t = \theta_0 + \theta_1\, LnWOP + \varepsilon_t \quad (7)$$

The first step in a study involving time series analysis of variables is to perform unit root tests to determine the order of integration of the stationarity of the variables. Performing stationarity tests allows us to determine whether the variables used in the ARDL model are not integrated into the second difference (I[2]). So, the fact that any of the variables is equal to I(2) makes the application of this model irrelevant and meaningless. To check and confirm the level of integration/stationarity of variables/time series, the basic version of the Augmented Dickey-Fuller (*ADF*) test proposed by Dickey and Fuller (1979, 1981), the Phillips-Perron (*PP*) test developed by Phillips and Perron (1988) are used and the Kwiatkowski-Phillips-Schmidt-Shin (*KPSS*) test developed by Kwiatkowski et al. (1992) were used. Single root the analysis was accepted.

As mentioned earlier in the study, the *ARDLBT* procedure developed by Pesaran et al. (2001) examines the co-integration relationship between variables. That is, the *ARDLBT* method was chosen instead of the approaches of Engle and Granger (1987), Johansen and Juselius (1990). Thus, variables/time series can be used in different orders of integration/stationarity. In addition, the *ARDLBT* procedure performs simultaneous estimation of long-term and short-term model parameters. An *ARDL* model with constant and trend typically looks like this (Davudova, 2022):

$$\Delta y_t = \mathrm{a}_0 + \mathrm{a}_1 t + \lambda \cdot \left(y_{t-1} - \sum_{i-1}^{n} c_i x_{i,t-1} + c^{Coint} \right) + \sum_{k=1}^{N_y} d_k \Delta \mathrm{y}_{t-i} + \sum_{l_j=1}^{N_y} \sum_{j=1}^{n} b_{l_j,j} \Delta x_{j,t-l_j} + \varepsilon_t$$

Here, y_t– is explainable (dependent) endogenous variable, n– is a number of explanatory (free) exogenous variables. N_Y– is a number of lags of the endogenous variable, N_X– is a number of lags of the exogenous variable, $\mathrm{a}_0, \mathrm{a}_1, b_{l_j,j} (\mathrm{j} = \overline{1,n}, l_\mathrm{j} = \overline{1,N_X}), c_i \left(\mathrm{i} = \overline{1,\mathrm{n}},\right),\ d_k \left(k = \overline{1,N_X}\right)$– is estimated coefficients of the ARDL model, c^{Coint}– is constant value of the co-integration equation, ε_t– this is a model error.

The *ARDL* boundary criteria for our study can be expressed by the following equations.

$$\Delta LnIP_t = \theta_{10} + \sum_{i=1}^{p} \theta_{11} \Delta LnWOP_{t-1} + \sum_{i=1}^{q} \theta_{12} \Delta LnIP_{t-1} + \theta_{13} LnWOP_{t-1} + \theta_{14} LnIP_{t-1} + \varepsilon_{1t} \quad (8)$$

$$\Delta LnMS_t = \theta_{20} + \sum_{i=1}^{p} \theta_{21} \Delta LnWOP_{t-1} + \sum_{i=1}^{q} \theta_{22} \Delta LnMS_{t-1} + \theta_{23} LnWOP_{t-1} + \theta_{24} LnMS_{t-1} + \varepsilon_{2t} \quad (9)$$

$$\Delta LnMP_t = \theta_{30} + \sum_{i=1}^{p} \theta_{31} \Delta LnWOP_{t-1} + \sum_{i=1}^{q} \theta_{32} \Delta LnMP_{t-1} + \theta_{33} LnWOP_{t-1} + \theta_{34} LnMP_{t-1} + \varepsilon_{3t} \quad (10)$$

$$\Delta LnDP_t = \theta_{40} + \sum_{i=1}^{p} \theta_{41} \Delta LnWOP_{t-1} + \sum_{i=1}^{q} \theta_{42} \Delta LnDP_{t-1} + \theta_{43} LnWOP_{t-1} + \theta_{44} LnDP_{t-1} + \varepsilon_{4t} \quad (11)$$

$$\Delta LnOP_t = \theta_{50} + \sum_{i=1}^{p} \theta_{51} \Delta LnWOP_{t-1} + \sum_{i=1}^{q} \theta_{52} \Delta LnOP_{t-1} + \theta_{53} LnWOP_{t-1} + \theta_{54} LnOP_{t-1} + \varepsilon_{5t} \quad (12)$$

$$\Delta LnFP_t = \theta_{60} + \sum_{i=1}^{p} \theta_{61} \Delta LnWOP_{t-1} + \sum_{i=1}^{q} \theta_{62} \Delta LnFP_{t-1} + \theta_{63} LnWOP_{t-1} + \theta_{64} LnFP_{t-1} + \varepsilon_{6t} \quad (13)$$

Here θ_{10}–θ_{60} — is a constant coefficient, θ_{11}–θ_{61} and θ_{12}–θ_{62} — are short–term coefficients, θ_{13}–θ_{63} and θ_{14}–θ_{64} are long-term coefficients, ε_t — is a model error, (*p, q*) — is a number of lags for each of the variables included in the model and *t* — is time.

The test hypotheses regarding co-integration are listed in Table 3. Two critical values were proposed in Pesaran et al.'s (2001) tests and Narayan's (2005) co-integration tests. If the *F*– statistic exceeds the critical upper limit value defined by both authors, in other words, if it is higher than it, the null hypothesis H_0 is rejected and the alternative hypothesis is accepted (Table 4). This case shows that the variables in the model are co-integrated. If the *F*–statistic is less than the critical value of the lower bound, then the null hypothesis H_0 is not rejected. This shows that there is no co-integration relationship between the variables. In the third case, the results will be assessed as indeterminate if the calculated *F*– statistic is between the critical value of the lower and upper bounds. Please note that the calculation is made using the Wald test, but the latest versions 9-13 of the econometric software package *Eviews* calculate this automatically.

In our study, we used *ECM* to calculate the rate at which variables reach long-run equilibrium. Note that the *ECMs* are lagged *OLS* residuals resulting from the long model period. So we can construct the following equations of the *ARDL* version of the *ECM* models

Table 3: Descriptive statistics for the variables

Variables	*LnFP*	*LnIP*	*LnMS*	*LnDP*	*LnWOP*	*LnMP*	*LnOP*
Mean	3.774257	2.790204	5.291981	4.006398	3.911927	4.060566	4.145655
Median	4.398182	3.270938	5.720422	4.501798	4.047598	4.659735	4.765078
Maximum	5.132332	3.924058	6.345411	5.248373	4.654056	5.387196	5.483839
Minimum	1.392767	1.128737	3.566005	1.634131	2.569554	1.852384	1.998096
SD	1.213867	0.948813	0.941898	1.076773	0.607009	1.124152	1.114838
Skewness	−0.646055	−0.505344	−0.643896	−0.633584	−0.563261	−0.485676	−0.432291
Kurtosis	1.976759	1.623020	1.840693	2.050870	2.287502	1.709060	1.632457
Jarque-Bera	2.942954	3.160693	3.252601	2.715444	1.924763	2.827553	2.835817
Probability	0.229586	0.205904	0.196656	0.257246	0.381982	0.243223	0.242220
Sum	98.13068	72.54531	137.5915	104.1663	101.7101	105.5747	107.7870
Sum square deviation	36.83683	22.50616	22.17931	28.98599	9.211492	31.59296	31.07160
Observations	26	26	26	26	26	26	26

SD: Standard deviation

Table 4: Hypothesis for the bound test

Model	Null hypothesis (H_0)	Alternative hypothesis (H_1)
Equation 8	$\theta_{13}=\theta_{14}$	$\theta_{13}\neq\theta_{14}$
Equation 9	$\theta_{23}=\theta_{24}$	$\theta_{23}\neq\theta_{24}$
Equation 10	$\theta_{33}=\theta_{34}$	$\theta_{33}\neq\theta_{34}$
Equation 11	$\theta_{43}=\theta_{44}$	$\theta_{43}\neq\theta_{44}$
Equation 12	$\theta_{53}=\theta_{54}$	$\theta_{53}\neq\theta_{54}$
Equation 13	$\theta_{63}=\theta_{64}$	$\theta_{63}\neq\theta_{64}$

dealing with the income of the population, etc. and expressing the dependence on world oil prices.

$$\Delta LnIP_t = \theta_{10} + \sum_{i=1}^{p}\theta_{11}\Delta LnWOP_{t-1} + \sum_{i=1}^{q}\theta_{12}\Delta LnIP_{t-1} + \lambda_1 ECT_{1t-1} + \varepsilon_{1t} \quad (14)$$

$$\Delta LnMS_t = \theta_{20} + \sum\theta_{21}\Delta LnWOP_{t\ 1} + \sum\theta_{22}\Delta LnMS_{t-1} + \lambda_2 ECT_{2t-1} + \varepsilon_{2t} \quad (15)$$

$$\Delta LnMP_t = \theta_{30} + \sum_{i=1}^{p}\theta_{31}\Delta LnWOP_{t-1} + \sum_{i=1}^{q}\theta_{32}\Delta LnMP_{t-1} + \lambda_3 ECT_{3t-1} + \varepsilon_{3t} \quad (16)$$

$$\Delta LnDP_t = \theta_{40} + \sum_{i=1}^{p}\theta_{41}\Delta LnWOP_{t-1} + \sum_{i=1}^{q}\theta_{42}\Delta LnDP_{t-1} + \lambda_4 ECT_{4t-1} + \varepsilon_{4t} \quad (17)$$

$$\Delta LnOP_t = \theta_{50} + \sum_{i=1}^{p}\theta_{51}\Delta LnWOP_{t-1} + \sum_{i=1}^{q}\theta_{52}\Delta LnOP_{t-1} + \lambda_5 ECT_{5t-1} + \varepsilon_{5t} \quad (18)$$

$$\Delta LnFP_t = \theta_{60} + \sum_{i=1}^{p}\theta_{61}\Delta LnWOP_{t-1} + \sum_{i=1}^{q}\theta_{62}\Delta LnFP_{t-1} + \lambda_5 ECT_{5t-1} + \varepsilon_{6t} \quad (19)$$

Here λ– explains the rate of change.

$$ECT_{1t-1} = \theta_{13} LnWOP_{t-1} + \theta_{14} LnIP_{t-1} \quad (20a)$$

$$ECT_{2t-1} = \theta_{23} LnWOP_{t-1} + \theta_{24} LnMS_{t-1} \quad (20b)$$

$$ECT_{3t-1} = \theta_{33} LnWOP_{t-1} + \theta_{34} LnMP_{t-1} \quad (20c)$$

$$ECT_{4t-1} = \theta_{43} LnWOP_{t-1} + \theta_{44} LnDP_{t-1} \quad (20d)$$

$$ECT_{5t-1} = \theta_{53} LnWOP_{t-1} + \theta_{54} LnOP_{t-1} \quad (20e)$$

$$ECT_{6t-1} = \theta_{63} LnWOP_{t-1} + \theta_{64} LnFP_{t-1} \quad (20f)$$

Usually built models, of course, always try to eliminate possible errors. Currently, diagnostics of model residuals is one of the most important components of diagnostic tests in modern economic and econometric modeling. For this reason, we tested for serial correlation (Breusch, 1978), natural distribution of residuals (Jarque and Bera, 1980; 1981; 1987), and heteroscedasticity issues using (Breusch and Pagan, 1979; Bollerslev, 1986; Engle, 1982) diagnostic tests of residuals. The linearity of the model was tested using the Ramsey RESET test (Ramsey, 1969; Ramsey, 1974). Model stability was determined using the cumulative sum (*CUSUM*) and cumulative sum squared (*CUSUMQ*) tests (Brown et al., 1975; Pesaran and Pesaran, 1997; Muhammad Meo et al., 2018).

In addition to the *ARDLBT* procedure, our study also used the *FMOLS* (Phillips and Hansen, 1990), *DOLS* (Stock and Watson, 1993), and *CCR* (Park, 1992) methods. These methods are chosen because of their importance in testing the consistency and robustness of the long-term elasticity of the *ARDL* model. Moreover, the *FOOLS*, *DOLS*, and *CCR* procedures eliminate problems of endogeneity and serial correlation. We then compared the coefficients of long-term and short-term ties with those obtained using *VECM*. To further analyze the co-integration relationships, the combined Bayer and Hank (2013) co-integration calculation was also performed. Thus, this test combines the different results of individual integration tests.

This test uses Fisher's formula to combine the results:

$$EG-JOH=-2[ln(P_{EG})+ln(P_{JOH})]$$

$$EG-JOH-BO-BDM$$
$$=-2[ln(P_{EG})+ln(P_{JOH})+ln(P_{BO})+ln(P_{BDM})]$$

Here P_{EG}, P_{JOH}, P_{BO} are the P-values of the Engel-Granger (*EG*), Johansen (*JOH*), Boswijk (*BO*) (Boswijk, 1994) and Baneerjee-Doladoe-Mestre (*BDM*) (Banerjee et al.,1998) cointegration tests, respectively. If the critical value given by Bayer and Hank is less than the calculated Fisher statistic, the co-integration hypothesis will be accepted.

4. RESULTS AND DISCUSSION

4.1. Modular Root Test

To determine the stationarity or order of integration of the variables used in the study, a single root test was performed for both initial/eigenlevels and first differences. The results of the three conventional and classical unit root tests (*ADF*, *PP* and *KPSS*) are given in Table 5. As usual, the *ADF* and *PP* unit root tests give the same results. The results of the stationarity test completely indicate that none of the variables is I(2). Thus, all variables are fixed at their level or first difference.

4.2. Evaluation of the ARDL Model

Stationarity based on the levels of integration of the variables I(0) and I(1) provides a good basis for the suitability of the *ARDL* method for analysis. *ALC* and *SIB* information criteria were used to select the best or optimal model based on the maximum model building delays. All models used in this study were *ARDL*(1,0). That is, the dependent variables (*IP*, *MS*, *MP*, *OP*, *DP*, *FP*) have a lag. The independent variable, world oil price in our study, has a corresponding zero lag.

Table 6 shows the evaluation results of the *ARDL* model. All *ARDL* models are important here. (*F*– statistics = 591.0354; 499.6097; 357.8607; 304.1223; 319.9558 and 442.1717) and no autocorrelation problems do exist (*DW* = 1.637909; 1.744215; 1.576324; 1.562410; 1.528559 and 1.972918). In *ARDL* models R^2 = 0.981729; 0.978457; 0.970178; 0.965093; 0.966763 and 0.975727 which has high explanatory power, which indicates the income of the population of Azerbaijan, etc. states that on average 96-98% of the variation in the amount can be explained by the chosen independent variable, that is, world oil prices. Also, the dependence of the dependent variables on world oil prices is positive and statistically significant at the level of 10%, 5% and 1%, respectively. This data is presented in either tabular or graphical form and is fully compatible with the original visual analysis.

Table 5: The results of the root test

Unit root test	Level			First differencing		
	Intercept	Intercept and trend	No intercept and no trend	Intercept	Intercept and trend	No intercept and no trend
Augmented Dickey-Fuller						
LnWOP	−1.515076	−1.753704	0.858891	−4.599385***	−4.644736***	−4.363989***
LnMP	−2.035042	−1.215161	1.172960	−3.699188**	−3.655156**	−3.276314**
LnMS	−1.866641	−0.866605	1.185211	−3.216005**	−3.316390*	−2.782706***
LnIP	−1.685521	−0.799268	0.909927	−3.109740**	−3.151726**	−2.693741***
LnDP	−2.620478	−1.629613	2.100202	−4.087618***	−4.061861***	−3.646357***
LnOP	−1.895978	−1.233779	1.207021	−3.890720***	−3.790343**	−3.496949**
LnFP	−1.697818	−1.040826	2.281483	−4.135567***	−4.711651***	−3.082079***
Phillips-Perron						
LnWOP	−1.379356	−1.701844	1.008717	−4.600752***	−4.721830***	−4.363989***
LnMP	−1.871382	−1.437463	1.723868	−3.699188**	−3.655156**	−3.276314**
LnMS	−1.711740	−1.093438	1.769217	−3.216005**	−3.316390*	−2.782706
LnIP	−1.566012	−1.082462	1.377667	−3.109740**	−3.169816**	−2.693741
LnDP	−2.458152	−1.738093	1.633973	−4.067618*	−4.020861***	−3.646357***
LnOP	−1.764996	−1.482770	1.723474	−3.907179***	−3.821060***	−3.501668***
LnFP	−1.697818	−1.040826	1.833127	−4.180068***	−4.711651***	−3.075890***
Kwiatkowski-Phillips-Schmidt-Shin						
LnWOP	0.485550**	0.169837**	N/A	0.127127***	0.113841***	N/A
LnMP	0.672367**	0.158251**	N/A	0.258848***	0.079607***	N/A
LnMS	0.620409**	0.172237**	N/A	0.282779***	0.094940***	N/A
LnIP	0.639498**	0.163889**	N/A	0.639498**	0.163889**	N/A
LnDP	0.660528**	0.170689*	N/A	0.399747**	0.078142***	N/A
LnOP	0.676877**	0.150788**	N/A	0.230827***	0.077725***	N/A
LnFP	0.674560**	0.175484*	N/A	0.288678**	0.094749***	N/A

*, **and *** denote rejection of the null hypotheses at the 10%, 5% and 1% significance levels, respectively. *ADF*, *PP* and *KPSS* denote the Augmented Dickey-Fuller, Phillips-Perron tests and Kwiatkowski-Phillips-Schmidt-Shin respectively. Maximum lag order is set to two and optimal lag order (k) is selected based on Schwarz criterion in the tests; The critical values for the tests are taken from MacKinnon (1996). Estimation period: 1997-2022. N/A: Not available

Table 6: Estimated primary ARDL model

Variable	Coefficient					
	Model 1	Model 2	Model 3	Model 3.A	Model 4	Model 5
$LnIP_{(-1)}$	0.743814***					
$LnMS_{(-1)}$		0.724600***				
$LnMP_{(-1)}$			0.794028***			
$LnDP_{(-1)}$				0.752054***		
$LnOP_{(-1)}$					0.804168***	
$LnFP_{(-1)}$						0.782972***
$LnWOP_{(-1)}$	0.380129***	0.381982***	0.301136**	0.309395*	0.286379*	0.380008**
C	−0.693206**	0.043898	−0.226342	−0.099760	−0.194527	−0.550836
R^2	0.981729	0.978457	0.970178	0.965093	0.966763	0.975727
Adjusted−R^2	0.980068	0.976499	0.967467	0.961920	0.963741	0.973520
F–statistic	591.0354	499.6097	357.8607	304.1223	319.9558	442.1717
Prob (F–st)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
D–W Durbin and Watson, 1971	1.637909	1.744215	1.576324	1.562410	1.528559	1.972918

***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively

4.3. ARDL Cointegration Test

As mentioned, a bounds test based on the *ARDLBT* procedure was used to test for the presence of co-integration indicating long-run relationships in the models. Table 7 shows the results of the bound test. Since each of the models has one regressor, that is, $K = 1$. In addition, the *F*– statistic is found at 95% confidence interval based on the Wald test (15.81362 and 15.59783 in model 1, 12.76243 and 11.70570 in model 2, 8.608100 and 6.399513 in model 3, 9.415206 and 7.416610 in model 4, 7.499819 and 5.562088 in model 5, 9.812969 and 7.421217 in model 6) exceed the critical value of the upper bound defined by Pesaran et al. (2001) and Narayan (Table 7). Thus, the null hypothesis in the models is rejected in favor of the alternative hypothesis. Thus, it can be concluded that the variables in the established models are co-integrated or there is a long-term relationship between them.

4.4. Conditional Error Correction Regression and ARDL_ECM in the Short-run

After confirming the presence of co-integration between variables in the established ARDL models, the next step is to estimate the long-term and short-run models. The results of the estimation of short-term models are presented in Table 8.

It can be noted that the short-run coefficients of the variables in the models meet the criteria and values in terms of statistical significance.

As expected in the short-term models, it was found that global oil prices had little impact on indicators of socio-economic well-being. However, according to the fixed (1,1) *ARDL* models, the change in world oil prices per 1 unit in the first difference is 0.45-0.48 for *LnFP*, 0.39-0.41 for *LnIP*, 0.38-0.40 for *LnMS*, 0.25-0.30 for *LnDP*, will lead to a change in *LnMP* by 0.23-0.26 and *LnOP* by 0.22-0.23. Moreover, these measures are close to the coefficients included in the *ARDL_ECM* models for each dependent variable (Table 9).

Finally, negative model terms and statistically significant model errors (−0.256186; −0.275400; −0.205972; −0.248946; −0.195839 and −0.217028) report that the long-term equilibrium recovery rate will be 25.61%; 27.54%; 20.59%; 24.89%; 19.58% and 21.70%/year, respectively.

For regression analysis based on ordinary *OLS* to produce the best results, the random error of the model must satisfy certain conditions, known as Gaussian-Markov conditions. From this perspective, we can say that our *ARDL* models meet the assumptions of linear regression to a certain extent, although not completely. That is, the residual passed tests of normality, serial correlation, heteroscedasticity, and linearity. This is given in Panel C. Specifically, the Breusch-Godfrey serial correlation *LM* test was performed for all models. The *ARCH* heteroscedasticity test was performed in all models. Ramsey *RESET* test passed on all models. The Jarque-Bera test only passes in Models 4, 5, and 6. The heteroscedasticity of the Breusch-Pagan-Godfrey test means that it passes in Models 3, 5, and 6 and partially in others. The structural stability of the model was tested using *CUSUM* and *CUSUMSQ*. All models had a *CUSUM* significance level of 5%. However, in Models 2 and 3, *CUSUMSQ* did not reach the 5% level of significance.

4.5. Results of Long-term ARDL Models and Alternative Assessment Methods

The results of the *FOOLS*, *DOLS* and *CCR* models were similar to those of the *ARDL* long-term model. So, they demonstrated the validity of the *ARDL* model. According to these three methods, an increase in world oil prices by 1% increases the average income of the population by 1.52%, the average monthly nominal wage by 1.55%, the average fixed monthly pension by 1.72%, the average pension age by 1.65%, the average size of a disability pension by 1.65%, 1.65% increases the average size of pensions due to the loss of the head of the family by 1.88%. They are also at the 1% significance level. Besides, the coefficients obtained from the traditional regression equation and the *VECM* model are also consistent with *ARDL* and the alternative estimation methods listed and the results of which are shown in the table (Table 10).

Table 7: Conditional error correction regression and short - run coefficients

Variable	Coefficient					
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Panel A conditional error correction regression						
$LnIP_{(-1)}$	−0.256186***					
$LnMS_{(-1)}$		−0.275400***				
$LnMP_{(-1)}$			−0.205972***			
$LnDP_{(-1)}$				−0.247946***		
$LnOP_{(-1)}$					−0.195832**	
$LnFP_{(-1)}$						−0.217028***
$LnWOP_{(-1)}$	0.380129***	0.381982***	0.301136**	0.309395*	0.286379*	0.380008**
C	−0.693206**	0.043898	−0.226342	−0.099760	−0.194527	−0.550836
R2	0.586432	0.525540	0.367798	0.402713	0.305833	0.382862
Adj−R2	0.598835	0.471498	0.300326	0.398414	0.255454	0.358577
F–statistic	15.59783	11.70570	6.399513	7.416610	5.562088	7.421217
Prob (F–st)	0.000061	0.000345	0.006448	0.003452	0.011093	0.003442
D–W	1.637909	1.744215	1.576324	1.562410	1.528559	1.972925
Panel B: Short-run estimation						
C	−0.693206***[B]	0.043898B	−0.226342*[B]	−0.099760[B]	−0.194527[B]	−0.550836**[,B]
$CointEq_{(-1)}$	−0.256186***[,A,B]	−0.275400***[,A,B]	−0.205972***[,A,B]	−0.248946***[,A,B]	−0.195839***[,A,B]	−0.217028***[,A,B]
R2	0.586432[A,B]	0.515540[A, B]	0.367798[A,B]	0.402713[A,B]	0.335833[A,B]	0.402862[A,B]
Adj−R²	0.586432[A]	0.515540[A]	0.367798[A]	0.402713[A]	0.335833[A]	0.402862[A]
	0.568451[B]	0.494477[B]	0.340311[B]	0.376744[B]	0.306956[B]	0.376900[B]
F–statistic	32.61365[B]	24.47556[B]	13.38080[B]	15.50746[B]	11.62982[B]	15.51709[B]
Prob (F–st)	0.000008[B]	0.000053[B]	0.001310[B]	0.000656[B]	0.002398[B]	0.000654[B]
D–W	1.637909[A,B]	1.744215[A,B]	1.576324[A,B]	1.562410[A,B]	1.528559[A,B]	1.972925[A,B]
Panel C: Diagnostics						
Residual diagnostics						
Breusch-Godfrey serial correlation LM test						
χ^2 serial	1.118312	0.423420	0.608508	0.532324	0.590192	0.240201
Probability	0.5717	0.8092	0.7377	0.7663	0.7445	0.8868
F−statistic	0.468272	0.172286	0.249476	0.217562	0.241785	0.097012
Probability	0.6328	0.8430	0.7816	0.8064	0.7875	0.9080
Heteroskedasticity test: Breusch-Pagan-Godfrey						
χ^2	6.210226	9.011753	5.514050	7.651627	5.146441	7.642687
P	0.0448	0.0110	0.0635	0.0218	0.0763	0.0219
F−statistic	3.635621	6.200135	3.112732	4.851630	2.851421	4.843466
P	0.0482	0.0073	0.0645	0.0180	0.0792	0.0181
Heteroskedasticity test: ARCH						
χ^2 *ARCH*	0.205465	0.226064	0.821663	0.767315	0.886876	0.691647
P	0.6503	0.6345	0.3647	0.3810	0.3463	0.4056
F−statistic	0.189969	0.209195	0.779891	0.726603	0.844165	0.652823
P	0.6672	0.6519	0.3867	0.4039	0.3682	0.4278
Jarque-Bera						
χ^2 *NORMAL*	36.65009	20.41495	3.282062	1.876119	2.084927	2.468251
P	0.000000	0.000000	0.193780	0.391387	0.352585	0.291089
Stability diagnostics						
Ramsey RESET test						
χ^2 *RESET* t−statistic	0.224390	1.144606	0.490076	1.008706	0.663960	0.754564
Probability	0.8246	0.2653	0.6292	0.3947	0.5139	0.4589
F−statistic	0.050351	1.310122	0.240174	1.017487	0.440843	0.569367
Probability	0.8246	0.2653	0.6292	0.3947	0.5139	0.4589
CUSUM and CUSUM of squares tests						
CUSUM	Stable	Stable	Stable	Stable	Stable	Stable
CUSUMSQ	No-Stable	No-Stable	Stable	Stable	Stable	Stable

***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively

Thus, the *FOOLS*, *DOLS* and *CCR* models support the long-term *ARDL* model.

Since all variables were integrated to 1, we also used combined Bayer and Hank co-integration tests (*EG–JOH and EG–JOH–BO–BDM* tests). However, the results of the co-integration test were different (Table 11).

We can say that based on the table below (Table 12). All models have short-term dependence, long-term dependence and strong dependence.

Table 8: Results of from bound tests

Estimated model	Bound test			Result
	F–statistic	*t*–statistic		
Model 1	15.81362***^{,A}–15.59783***^{,B}	−5.493493***^{B}–−5.710836***^{C}		Co-integration
Model 2	12.76243***^{,A}–11.70570***^{,B}	−4.837805***^{B}–−4.947278***^{C}		Co-integration
Model 3	8.608100***^{,A}–6.399513**^{,B}	−3.571818**^{B}–−3.657978**^{C}		Co-integration
Model 4	9.415206***$^{, A}$–7.416610**^{,B}	−3.699562**^{B}–−3.937951***^{C}		Co-integration
Model 5	7.499819***^{,A}–5.562088*^{B}	−3.335007**^{B}–−3.410252**^{C}		Co-integration
Model 6	9.812969***^{A}–7.421217**^{B}	−3.849088***^{B}–−3.939174***^{,C}		Co-integration
Critical values	**10%**	**5%**	**2.5%**	**1%**
Bounds				
Lower I (0)				
n=1000[1]	3.02	3.62	4.18	4.94
n=30[2]	3.303	4.09		6.027
Upper I (1)				
n=1000[1]	3.51	4.16	4.89	5.58
n=30[2]	3.797	4.663		6.76
Lower I (0)	−2.57	−2.86	−3.13	−3.43
Upper I (1)	−2.91	−3.22	−3.5	−3.82

***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively. [1]Pesaran, M.H.; Shin, Y.; Smith, R.J. Bounds testing approaches to the analysis of level relationships. J. Appl. Econom. 2001, 16, 289-326, [2]Narayan, P.K. The saving and investment nexus for China: Evidence from cointegration tests. Appl. Econ. 2005, 37, 1979-1990 A - Case 2: Restricted constant and no trend levels equation, B - Case 3: Unrestricted constant and no trend levels equation C - Case 3: Unrestricted constant and no trend ECM regression

Table 9: Results of ARDL_ECM

Variable	Models	*LnIP*	*LnFP*	*LnMS*	*LnDP*	*LnMP*	*LnOP*
D (LnWOP)	ARDL (1,1) fixed	0.39−0.41***	0.45−0.48***	0.38−0.40***	0.25−0.30*	0.23−0.26*	0.22−0.23
	ARDL_ECM	0.438185***	0.441087	0.415806***	0.388259**	0.362415*	0.319150*
-	CointEq (−1)	−0.256186***	−0.275400***	−0.205972***	−0.248946***	−0.195839***	−0.217028***
-	ARDL_ECM	−0.205000**	−0.196627*	−0.255217**	−0.209277*	−0.183918*	−0.176916*

***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively

Table 10: Coefficients of long-range models

Variable	OLS	ARDL	FMOLS	DOLS	CCR	VECM
LnMP						
LnWOP	1.595579***	1.462025***	1.725458***	1.682024***	1.725528***	1.644038***
C	−2.181222**	−1.098898	−2.574954*	−2.408957*	−2.569983*	−2.372873
R2	0.742294		0.691195	0.855371	0.690248	
Adjusted R^2	0.731557		0.677769	0.823231	0.676781	
LnMS						
LnWOP	1.420493***	1.387006***	1.544206***	1.577361***	1.536854***	1.488273***
C	−0.264886	0.159397	−0.678458	−0.821286	−0.645147	−0.524387
R^2	0.838032		0.802832	0.937068	0.803174	
Adjusted R^2	0.831283		0.794260	0.923083	0.794617	
LnIP						
LnWOP	1.393038***	1.483800***	1.515909***	1.512977***	1.510133***	1.533943
C	−2.659257***	−2.705870***	−3.052027***	−3.044699***	−3.024608***	−3.203611***
R^2	0.794245		0.751319	0.901961	0.751133	
Adjusted R^2	0.785672		0.740506	0.880174	0.740313	
LnDP						
LnWOP	1.569201***	1.247831***	1.664106***	1.625938***	1.666683***	1.456983***
C	−2.132201**	−0.402347	−2.399679**	−2.252460*	−2.406383**	−1.697486
R^2	0.782526		0.745354	0.885288	0.744425	
Adjusted R^2	0.773465		0.734282	0.859797	0.733313	
LnOP						
LnWOP	1.554220***	1.462376***	1.686814***	1.647317***	1.687475***	1.656192***
C	−1.934341*	−0.993337*	−2.334064*	−2.186320	−2.331128*	−2.334943
R^2	0.716129		0.660198	0.837904	0.659049	
Adjusted R^2	0.704301		0.645424	0.801883	0.644225	
LnFP						
LnWOP	1.774581***	1.750962***	1.930592***	1.811008***	1.927192***	1.931652***
C	−3.167774***	−2.538086*	−3.684676**	−3.197143**	−3.664394**	−3.781971
R^2	0.787480		0.745691	0.865515	0.745187	
Adjusted R^2	0.778625		0.734634	0.835629	0.734108	

***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively

Table 11: Results of Bayer and Hank co-integration tests

Cointegration test	*LnFP*	*LnIP*	*LnMS*	*LnDP*	*LnMP*	*LnOP*	Critical value (10%)
F–st							
EG–JOH	3.57283	8.26069*	9.43016*	5.05053	4.84863	5.13972	8.678
EG–JOH–BO–BDM	9.38505	21.5008*	16.6758	9.72156	10.1683	11.2411	16.964
EG							
P	0.4878	0.5203	0.2538	0.4376	0.5848	0.6264	
Test statistics	−2.0686	−2.0081	−2.5507	−2.1640	−1.8841	−1.8002	
JOH							
P	0.3435	0.0309	0.0353	0.1829	0.1514	0.1222	
Test statistics	9.0148	16.2652	15.8981	11.1514	11.7243	12.3636	
BO							
P	0.2546	0.0341	0.1364	0.2643	0.2328	0.2094	
Test statistics	−2.3832	−3.3599	−2.7479	−2.3579	−2.4407	−2.5056	
BDM							
P	0.2148	0.0391	0.1958	0.3661	0.3005	0.2260	
Test statistics	7.2777	12.0147	7.5652	5.5596	6.2277	7.1197	

***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively

Table 12: Granger cause-and-effect analysis evaluation results

Models	Short-term period			Long-term period			Strong impact	
	$\Delta LnWOP$			ECT_{-1}			ECT_{-1} and $\Delta LnWOP$	
	χ^2	F–statistic	t–statistic	χ^2	F–statistic	t–statistic	F–statistic	χ^2
Model 1	23.35818***	23.35818***	4.833039***	8.252187***	8.252187***	−2.872662**	13.56067***	27.12135***
Model 2	10.24893***	10.24893***	3.201394**	6.883830*	6.883830*	3.201394*	6.800686**	13.60137***
Model 3	15.85765***	15.85765***	3.982170***	8.650713**	8.650713**	−2.941209**	9.357222***	18.71444***
Model 4	8.587967***	8.587967***	2.930523**	6.933172**	6.933172*	−2.633092*	6.030343***	12.06069***
Model 5	6.874151**	6.874151*	2.621860*	7.143660**	7.143660*	−2.672763*	5.743651*	11.48730**
Model 6	5.930490*	5.930490*	2.435260*	7.246719**	7.246719*	−2.691970*	5.594574*	11.18915**

ECT_{-1} ADF unit root test

Variants	Model 1	Model 2	Model 3; 3A	Model 4	Model 5; 5A	Model 6	Model 7	Model 8
t_m	−2.191451	−2.271892	−2.858642*	−2.421205	−3.031879**	−2.397299		
t_T	−3.518116*	−2.894232	−5.049207***	−2.372318	−3.582960*	−2.785843		
t_0	−2.236070**	−2.319178**	−2.916065**	−2.474378**	−3.085910***	−2.445030**		

Wald test. ***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively. t_m–with intercept only, t_T–with intercept and trend and t_0–no intercept and no trend. ADF denotes the Augmented Dickey-Fuller single root system respectively. The optimum lag order is selected based on the Shwarz criterion automatically; The critical values are taken from MacKinnon (1996). Assessment period: 1997-2022

5. CONCLUSION AND POLICY IMPLICATIONS

The results obtained in the article, the purpose of which is to analyze the impact of fluctuations in world oil prices on the main indicators of the socio-economic well-being of the population of Azerbaijan, are not much different from those whose economies depend on the export of natural resources, mainly energy resources. Thus, the results of the *ARDLBT* procedure suggest a high level of co-integration links with world oil prices and basic indicators of the socio-economic well-being of the population. The existence and significance of these long-term interactions are also supported by alternative estimates and results from the *CCR*, *DOLS*, *FMOLS* and *VECM* models, which confirm the consistency and robustness of the *ARDL* method. *ARDL_ECM* models also proved that the short-term relationships of these indicators with world oil prices are statistically significant. However, the results of the combined Bayer-Hank co-integration test, which we additionally used in the study, were slightly different. Nevertheless, the hypotheses we put forward were completely justified. At least this proves the importance of our research.

The results of this study can contribute to a more complete understanding of the indicators of socio-economic well-being of the population of Azerbaijan and the oil factor, which acts as the main determining factor influencing it, especially world oil prices. After determining the impact of global oil prices, policymakers can continue to look for other alternative ways to improve the socio-economic well-being of the population and economic diversification policies in this regard. Thus, the development of the non-oil sector in modern times can significantly reduce the dependence of these indicators on fluctuations in world oil prices. In other words, the share of the non-oil sector in the income of the population of the republic will increase, the share of this sector in the average monthly salary will increase, and pensions will increase revenues from the non–oil sector to the state budget are increasing, which are a source of financing for many state socio-economic activities associated with an increase in other benefits, social assistance and payments, indicators of the socio-economic well-being of the population. In other words, the negative impact of fluctuations in world oil prices on the material and social security of the population of the republic will be reduced. As with any study, our study had some challenges. These were mainly the selection of the optimal population as socio-economic indicators, as well as some difficulties in calculation based on indicators expressed in manats. Thus, fluctuations in world oil prices led to a reduction in oil revenues, as a result of which volumes were devalued twice in February and December 2015. For this reason, we first had to express all figures in dollars. This greatly facilitated our research and made the results more significant.

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