INFORMATION ABOUT THE AUTHORS

Fedulova S. O. — D. Sc. in Economics, Professor, Head of the Global Economy Department, Alfred Nobel University, 18, Sicheslavska Naberezhna, Dnipro city, Ukraine, 49000; +38(067)775-76-89; sveta_fedulova@ukr.net; ORCID: 0000-0002-5163-3890

Reziapov K. I. — PhD in Economics, Doctoral Student at the Global Economy Department, Alfred Nobel University, 18, Sicheslavska Naberezhna, Dnipro city, Ukraine, 49000; E-mail: kirillreziapov@gmail.com; ORCID: 0009-0008-9770-3541

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E. I. ZIYALI, Senior Engineer

THE IMPACT OF INTERNATIONAL MOBILITY OF LABOR RESOURCES ON THE ECONOMY

Abstract. *This paper investigates the impact of international labor mobility on national economies. Understanding this impact becomes particularly important in the context of globalization, as labor migration takes on new scales and forms. The research examines the effect of international labor mobility on key macroeconomic indicators in Azerbaijan, including GDP, labor productivity, and employment. Using time-series data from 1995 to 2023, modern econometric approaches are employed to analyze the relationship between labor mobility indicators and economic development indicators. The results show a significant causal relationship between the migration of the working-age population and both real GDP and labor productivity. Finally, recommendations are provided for optimizing labor migration processes to enhance the efficiency of the national economy.*

Keywords: *labor force migration, working-age population, GDP, labor productivity.*

INTRODUCTION

The international mobility of the labor force is one of the key phenomena in the modern economic environment. In the context of globalization, with the decreasing significance of borders between countries for human movement, labor migration has a significant impact on the economies of both labor-exporting and labor-importing countries. The international mobility of labor is becoming an increasingly important factor in economic development, particularly in developing economies. Understanding its effect on key macroeconomic indicators is crucial for defining effective policies and economic planning. This research aims to quantify the relationship between international labor mobility and economic development indicators using econometric analysis methods. The goal of this paper is to assess the impact of international labor mobility on the national economy and identify the factors that facilitate or hinder this process.

LITERATURE REVIEW

Research on the economic impact of international migration is varied and multifaceted. In their works, Borjas and Dustmann et al. [2; 8] have noted that labor migration can lead to an increase in the host country's GDP by attracting skilled workers and reducing labor shortages. However, the authors also mention that these benefits may be offset by negative outcomes such as increased competition in the labor market and potential wage reductions for local workers. Further studies, such as those by Borjas [1], argue that migration may reduce local workers' wages in highly competitive environments. Meanwhile, research by Dustmann and Frattini [7] shows that migrants significantly

contribute to the host country's economy by boosting overall production levels and tax revenues.

Research by OECD (2013) [17] highlights that international migration also facilitates the transfer of knowledge and technology, which can, in turn, enhance innovation activities in host countries. On the other hand, studies by Czaika and de Haas [4] suggest that migration can lead to "brain drain" in exporting countries, negatively affecting their economic development. According to an OECD study (2017), labor migration can improve demographic conditions in countries like Japan and Germany, which have low birth rates. However, countries like Ukraine and Mexico experience "brain drain", which can adversely affect their economic development.

Further studies, such as those by Docquier and Rapoport [6], emphasize the socio-economic consequences of migration, particularly the changes in population structure that can lead to social conflicts and additional challenges for education and healthcare systems. Additionally, Dubrovina and Solovyov [25] discuss how migration can both enrich culture and create social tensions.

THEORETICAL FRAMEWORK

The international mobility of labor resources can impact the economy in two primary ways. First, the migration of workers and their mutual exchange of knowledge and technology can accelerate the spread of skills, which ultimately leads to increased labor productivity. The arrival of skilled labor can also enhance local workers' experiences and knowledge, contributing to productivity growth. Second, migration also affects the economy through remittances, which can increase the income levels of the population, thus stimulating production and improving the human development index.

METHODOLOGICAL FRAMEWORK

The econometric analysis of the impact of international labor mobility on the economy is based on empirical relationships between key macroeconomic indicators that characterize economic development. The methodology follows Gauss-Markov conditions to ensure unbiased and efficient estimators for regression analysis. This includes:

- Augmented Dickey-Fuller test for stationarity and integration testing;
- Multicollinearity analysis;
- Granger causality testing;
- Cointegration analysis using the Engle-Granger approach.

Given the non-stationarity of time series data, modern econometric methods are applied to avoid spurious regression results.

The analysis uses time-series data from official sources, creating an extensive database of economic and migration indicators. Key indicators analyzed include GDP, labor productivity, employment, and migration statistics. The time-series data allows the investigation of the relationships between these variables over time.

The econometric analysis involves various econometric tests to ensure the robustness of the model, including tests for autocorrelation, distribution of residuals, and heteroskedasticity.

Data Sources and Variables. The dataset used in this study includes key economic indicators, such as GDP, labor productivity, employment figures, migration data, and remittance flows. A summary of the indicators and their time coverage is provided in the tables, detailing the data sources and period covered.

The analysis of the impact of international mobility of labor resources on the economy is based on the empirical linear relationship between key macroeconomic indicators, such as GDP, labor productivity, and employment, which characterize the economic development of the country and indicators that characterize the international mobility of labor resources.

For this purpose, time-series data has been formed from official sources, creating an extensive database. It should be noted that by "time series", we refer to a sequence of observed values of a random variable measured at equal intervals of time. These observations are referred to as the levels of the series, denoted as yty_tyt, where t = 1,2, ..., nt = 1, 2, \dots, nt = 1,2, ..., n, and nnn represents the number of observations.

In modern econometric approaches, when empirical models are developed, the dependency of the dependent (endogenous) variable on explanatory (independent, exogenous) variables requires the examination of several characteristics–stationarity, cointegration, causality, and multicollinearity relationships, autocorrelation of the model's residuals, heteroskedasticity, distribution, and others. In this regard, the time series used in the study necessitate comprehensive econometric analysis.

The set of indicators included in the database used for econometric analysis is provided in **Table 1**.

The time series data included in the database are presented in **Table 2**.

The econometric analysis of the impact of international mobility of labor resources on the economy is based on the standard methodological approaches currently used in practice. Thus, the dependencies between indicators have been studied within the framework of regression analysis based on time series, and the adequacy of

Table 1

The set of indicators included in the database used for econometric analysis

Group	Name	Conditional indicator	Coverage period	Source
Economic Development Indicators	GDP at Current Prices	GDP	1995–2023	GSC
	Physical Volume Index of GDP Compared to the Previous Year (in percentage)	FHI	1995–2024	GSC
	Physical Volume Index of GDP by Sectors Compared to the Base Period. 2010 = 100	FHI_2010 = 100	1995–2025	GSC
	GDP Value for the Current Period at Base Period Prices. 2010 = 100	RGDP	1995–2026	GSC
	Labor Productivity	E_ Productivity	1995–2027	GSC
Indicators of Employment of the Population	Economically Active Population – Thousand People	I_FE	1995–2028	GSC
	Employed Population – Thousand People	I_ME	1995–2029	GSC
Indicators of Migration and Mobility of the Population	Immigrants for Permanent Residence – Thousand People	Y_GEL	1995–2030	GSC
	Emigrants for Permanent Residence – Thousand People	Y_GED	1995–2031	GSC
	Migration Increase (Decrease) – Thousand People	M_art	1995–2032	GSC
Indicators of Migration and Mobility of the Working-Age Population	Immigrants for Permanent Residence of Working-Age Population – Thousand People	YGEL_EQE	2010–2033	GSC
	Emigrants for Permanent Residence of Working-Age Population – Thousand People	YGED_EQE	2010–2034	GSC
	Migration Increase (Decrease) of the Working-Age Population – Thousand People	M_art_EQE	2010–2035	GSC
Indicators of the Income Subsection of the Current Account of the Balance of Payments (in thousand USD)	Remittances of Individuals	PB_FERQ	1995–2036	İB
	Inflows	PB_DAX	1995–2037	İB
	Payments	PB_XAR	1995–2038	İB

the constructed model has been analyzed based on various criteria. The residuals of the model–errors–were studied in terms of autocorrelation and distribution.

It is known that when the time series corresponding to economic variables are non-stationary, regression models built using traditional methods may have significant results in terms of the coefficient of determination, Fischer statistics, and t-Student criteria for the coefficients of the model, but the results could be considered as "incorrect regression" [9]. Therefore, non-stationary series should not be analyzed using traditional regression methods. In this case, the application of modern econometric analysis tools and approaches is necessary.

Taking into account these important issues during the analysis, the following requirements have been followed:

The regression model's parameters must meet the six conditions of Gauss-Markov in order to ensure the best possible outcomes of the least squares method. These conditions, as outlined by Stock J. and Watson M. W. [23], are:

For all observations, the expected value of random errors (ϵi) should be equal to zero: $M(\epsilon i) = 0$.

The variance of random errors must be constant for all observations: $D(\epsilon i) = \sigma^2$ = constant.

Table 2

Time series used in the study

	GDP	FHI	FHI_2010=100	RGDP	E_Productivity	I_FE	I_ME	Y_EMGR	Y_İMGR	M_art	YEMGR_EQE	YİMGR_EQE	M_art_EQE	PB_Difference	PB_Internal	PB_External
1995	2133,80	88,20	17,66	7499,93	2,08	3641,30	3613,00	6,22	16,03	-9,81				23,00	35,00	–12,00
1996	2732,60	101,30	17,89	7597,43	2,06	3718,60	3686,70	5,78	13,15	-7,37				-20,53	19,86	–40,39
1997	3158,30	105,80	18,93	8038,08	2,18	3732,40	3694,10	7,53	15,70	-8,18				-16,17	30,01	–46,18
1998	3440,60	110,00	20,82	8841,89	2,39	3743,80	3701,50	5,40	10,50	-5,09				-1,10	74,74	–75,84
1999	3775,10	107,40	22,36	9496,19	2,51	4335,40	3782,80	4,81	9,14	-4,34				9,27	54,49	–45,23
2000	4718,10	111,10	24,84	10550,26	2,74	4370,20	3855,50	4,36	9,95	-5,59				3,56	57,13	–53,57
2001	5315,60	109,90	27,30	11594,74	2,98	4368,10	3891,40	2,57	7,29	-4,71				9,53	44,32	–34,79
2002	6062,50	110,60	30,20	12823,78	3,26	4369,70	3931,10	1,26	4,32	-3,06				14,24	162,73	–148,49
2003	7146,50	111,20	33,58	14260,05	3,59	4373,50	3972,60	2,50	3,75	-1,25				76,83	154,43	–77,59
2004	8530,20	110,20	37,01	15714,57	3,91	4365,60	4016,90	2,41	2,80	-0,39				126,62	191,48	–64,86
2005	12522,50	126,40	46,78	19863,22	4,89	4380,10	4062,30	2,01	2,91	-0,89				364,00	491,00	–127,00
2006	18746,20	134,50	62,91	26716,03	6,50	4402,00	4110,80	2,23	2,64	-0,41				513,00	663,00	–150,00
2007	28360,50	125,00	78,64	33395,04	8,02	4443,30	4162,20	1,95	3,08	-1,13				917,69	1191,33	–273,64
2008	40137,20	110,80	87,13	37001,70	8,78	4477,70	4215,50	3,60	2,53	1,07				1016,08	1415,55	–399,47
2009	35601,50	109,30	95,24	40442,86	9,47	4531,90	4271,70	2,29	1,37	0,92				660,00	1182,00	–522,00
2010	42465,00	105,00	100,00	42465,00	9,81	4587,40	4329,10	2,23	0,80	1,43	2,10	0,66	1,44	498,00	1338,00	–840,00
2011	52082,00	100,10	100,10	42507,47	9,72	4626,10	4375,20	2,18	0,48	1,70	2,02	0,41	1,61	632,82	1770,70	–1137,87
2012	54743,70	102,20	102,30	43442,63	9,77	4688,40	4445,30	2,17	0,23	1,95	1,98	0,17	1,81	-40,00	1852,00	–1892,00
2013	58182,00	105,80	108,25	45962,30	10,17	4757,80	4521,20	3,13	0,78	2,35	2,78	0,67	2,11	1,00	1580,00	–1579,00
2014	59014,10	102,80	111,24	47249,25	10,27	4840,70	4602,90	1,86	0,80	1,06	1,63	0,68	0,95	186,00	1708,00	–1522,00
2015	54380,00	101,10	112,46	47768,99	10,23	4915,30	4671,60	2,65	1,56	1,09	2,33	1,43	0,90	240,00	1182,00	–942,00
2016	60425,20	96,90	108,98	46288,15	9,72	5012,70	4759,90	3,23	1,71	1,52	2,83	1,58	1,25	74,00	564,00	–490,00
2017	70337,80	100,20	109,19	46334,44	9,61	5073,80	4822,10	3,07	1,90	1,17	2,69	1,75	0,94	677,00	1020,00	–343,00
2018	80092,00	101,50	110,83	47064,59	9,65	5133,10	4879,30	3,22	1,58	1,64	2,83	1,51	1,32	718,00	1079,00	–361,00
2019	81896,20	102,50	113,60	48241,20	10,08	5037,70	4785,60	2,04	1,65	0,39	1,74	1,58	0,16	503,00	934,00	–431,00
2020	72578,10	95,80	108,83	46215,07	9,79	5089,90	4721,20	1,67	0,57	1,10	1,42	0,56	0,86	537,48	1094,03	–556,55
2021	93203,20	105,60	114,93	48803,11	10,10	5141,60	4831,10	2,40	0,57	1,83	2,04	0,53	1,51	471,88	1133,39	–661,51
2022	133972,70	104,70	120,21	51048,06	10,42	5194,40	4901,10	2,87	1,07	1,80	2,44	1,04	1,40	2955,32	3620,12	–664,80
2023	123005,50	101,10	121,53	51609,59	10,40	5249,70	4963,30	3,64	2,48	1,16	3,08	2,41	0,67	1104,69	1654,82	–550,13

The source: Calculations based on official DSK data by the author.

Random errors for all observations (ϵi and ϵj) must be uncorrelated: ϵi and ϵj are independent for all $i \neq j$.

Random errors should not be dependent on the explanatory variable: $\sigma \epsilon i x i = 0$.

No multicollinearity should exist among the explanatory (independent) variables.

Random errors should follow a normal distribution.

Stationarity and Integrability of the time series: If the fundamental statistical properties such as expectation, variance, and autocovariance do not change over time, the series is considered stationary. To determine the stationarity, the Dickey-Fuller test was used [5].

Multicollinearity: In a multiple regression model, when two or more explanatory variables show a high correlation, it is known as multicollinearity. If the correlation coefficient between explanatory variables exceeds 0,7, it indicates strong multicollinearity.

Granger causality test: This test is used to check for causality between time series. The procedure aims to determine if changes in one time series (xt) cause changes in another series (yt). If both variables significantly contribute to each other's forecast, then other factors may be influencing both.

Cointegration relationship: Cointegration refers to a statistical relationship between two or more time series, where they share the same or opposite trends over time. If a linear combination of two non-stationary time series results in a stationary series, then they are considered cointegrated [20; 21].

The econometric evaluation of the impact of international mobility of labor resources on the economy has been performed using the Eviews software package, based on official data from the Azerbaijan State Statistical Committee and the Central Bank. The stages of the evaluation are as follows:

Descriptive statistics of the indicators.

Processing of empirical data, their systematization, visual presentation in graphs and tables, and calculation of descriptive statistics to quantify the data. Results of these calculations are presented in **Table 3**.

From the descriptive statistics in **Table 3**, it can be concluded that not all of the used series are normally distributed. The Jarque-Bera criteria highlighted in yellow indicate that these series do not follow a normal distribution.

Stationarity and Integrability: The Augmented Dickey-Fuller test (ADF) was used to check the stationarity of the time series.

The results of this test, performed using the Eviews software, are presented in **Table 4**.

Table 3

Descriptive Statistics Calculated in Eviews Software

	GDP	I_FE	I_ME	RGDP	Y_İMGR	Y_EMGR	M_ART	YİMGR_EQE	YEMGR_EQE	M_ART_EQE	PB_İNT	PB_EXTR	PB_Difference
Mean	42026,16	4572,490	4295,759	31683,99	4,184483	3,147828	1,036655	0,516793	1,100483	0,583690	906,7973	-484,2035	422,5938
Median	40137,20	4531,900	4271,700	40442,86	2,483000	2,574000	0,919000	0,000000	0,000000	0,000000	1020,000	-361,0000	240,0000
Maximum	133972,7	5249,700	4963,300	51609,59	16,03300	7,528000	2,348000	2,413000	3,084000	2,111000	3620,117	-12,00000	2955,319
Minimum	2133,800	3641,300	3613,000	7499,930	0,226000	1,257000	-9,811000	0,000000	0,000000	0,000000	19,86200	-1892,000	-40,00000
Std, Dev,	37474,71	462,8201	433,8457	16973,13	4,678161	1,502303	3,443150	0,699238	1,210553	0,703710	816,0113	508,4068	597,3396
Skewness	0,736984	-0,451907	0,011124	-0,342381	1,431417	1,364562	-1,153172	1,158635	0,305553	0,650658	1,149821	-1,320952	2,739626
Kurtosis	2,787271	2,475468	1,628518	1,356561	3,762720	4,149748	3,112433	3,196075	1,353650	1,937090	5,123620	3,951359	12,18349
Jarque-Bera	2,679886	1,319517	2,273428	3,830164	10,60622	10,59713	6,442674	6,534888	3,726400	3,411368	11,83938	9,527401	138,1834
Probability	0,261861	0,516976	0,320872	0,147330	0,004976	0,004999	0,039902	0,038104	0,155175	0,181648	0,002686	0,008534	0,000000
Sum	1218759,	132602,2	124577,0	918835,6	121,3500	91,28700	-30,06300	14,98700	31,91400	16,92700	26297,12	-14041,90	12255,22
Sum Sq. Dev.	3,93E+10	5997669,0	5270218,0	8,07E+09	612,7854	63,19363	331,9478	13,69015	41,03231	13,86580	18644486	7237368,0	9990809,0
Observation	29	29	29	29	29	29	29	29	29	29	29	29	29

Table 4

The results of the unit root test for stationarity using the Augmented Dickey-Fuller test statistic in the Eviews software package

Indicator name	Level of the indicator	Specification of the tested equation	Augmented Dickey-Fuller test statistic	Test critical values:			prob
				1 % level	5 % level	10 % level	
RGDP	RGDP (-1),2	C	-5,335391	-3,711457	-2,981038	-2,629906	0,0002
E_ Productivity	E_ Productivity (-1),2	C	-5,044744	-3,711457	-2,981038	-2,629906	0,0004
I_FE	I_FE (-1)	C	-5,261643	-3,699871	-2,976263	-2,627420	0,0002
I_ME	I_ME (-1)	C	-3,791277	-3,699871	-2,976263	-2,627420	0,0081
Y_EMGR	Y_EMGR (-1)	C	-6,207815	-3,699871	-2,976263	-2,627420	0,0000
Y_İMGR	Y_İMGR	C	-3,152562	-3,689194	-2,971853	-2,625121	0,0340
M_art	M_art	C	-3,092899	-3,689194	-2,971853	-2,625121	0,0387
PB_İNTR	PB_İNTR (-1)	C	-7,654714	-3,699871	-2,976263	-2,627420	0,0000
PB_EXTR	PB_EXTR (-1)	C	-3,430647	-3,699871	-2,976263	-2,627420	0,0186
PB_Difference	PB_Difference	C	-3,106226	-3,689194	-2,971853	-2,625121	0,0376
YEMGR_EQE	YEMGR_EQE (-1),2	C	-3,811834	-4,121990	-3,144920	-2,713751	0,0167
YİMGR_EQE	YİMGR_EQE (-1),2	C	-4,361404	-4,200056	-3,175352	-2,728985	0,0078
M_art_EQE	M_art_EQE(-1)	C	-3,455802	-4,297073	-3,212696	-2,747676	0,0348

The source: The results of the Dickey-Fuller (ADF) test show that not all the indicators used in the model are stationary and integrable of the same order.

The results of the Dickey-Fuller (ADF) test show that not all the indicators used in the model are stationary and integrable of the same order.

Determining the initial specifications of the models selected for evaluation. The econometric analysis of the impact of international mobility of labor resources on the economy was conducted through three groups of evaluation models. The first group of models examines the direct impact of mobility on GDP, the second group explores the effect of mobility on labor productivity, and the third group investigates the impact of mobility on employment. Each model's specification was separately evaluated using the Eviews software package. Using this software, numerous different selection evaluations were made with both non-stationary and stationary series of the same order for the dependent and independent variables included in the models. The scope of the evaluations is presented in **Table 5** by groups.

In order to prevent the regression from being spurious in models built based on non-stationary series, the series of the same level or differenced were first identified, and the causality relationships between the series to be included in the models were checked. As a result, the causality test results for the group of models presented in **Table 6** are as follows.

Only the time series with causality relationships were used to build practical models, and the residuals of the built models were checked for normal distribution, stationarity, and cointegration relationships among the variables. The results are provided in **Table 6**.

The results of the Granger causality test. To check if the selected independent variables can act as causes for the dependent variable, the Granger causality test was performed. The results of the Granger causality test indicate that the labor force migration in and out of the country can be causes for real GDP and labor productivity. This is because the results of the Granger causality test, shown in the last probability column of **Tables 7** and **8**, indicate a probability smaller than 0,05 %, thus the null hypothesis (H0: causality exists, H1: causality does not exist) is accepted.

This translation reflects the content and purpose of the analysis and confirms that the variables were evaluated through the Granger causality test to determine the causal relationships.

Investigation of cointegration relationships. If a linear combination of non-stationary time series results in a stationary series, it is said that "there is a cointegration relationship between these series". In econometrics, cointegration relationships are interpreted as the existence of long-term mutual relationships between series. One of the commonly used methods for determining cointegration is the Engle-Granger test. This test not only evaluates the cointegration relationship but also

Table 5

Specification of the models included in the evaluation by groups

Group of Evaluation Models	Dependent Variable	Independent Variables	Time Series of Variables
GDP impact	RGDP	Y_EMGR and Y_İMGR	2010–2023
	RGDP	M_art	2010–2023
	RGDP	YEMGR_EQE və Y_İMGR	2010–2023
	RGDP	M_art_EQE	2010–2023
	RGDP	PB_İNTR and PB_EXTR	2010–2023
	RGDP	PB_Difference	2010–2023
Impact on labor productivity	E_ Productivity	Y_EMGR and Y_İMGR	2010–2023
	E_ Productivity	M_art	2010–2023
	E_ Productivity	YEMGR_EQE and Y_İMGR	2010–2023
	E_ Productivity	M_art_EQE	2010–2023
Impact on employment of the population	I_FE	Y_EMGR and Y_İMGR	2010–2023
	I_FE	M_art	2010–2023
	I_ME	Y_EMGR və Y_İMGR	2010–2023
	I_ME	M_art	2010–2023

Table 6

Causality relationships between the series intended to be included in the estimated models

Group of evaluation models	Dependent variable	Independent variables	Time series of variables	Granger causality test
GDP impact	RGDP	Y_EMG and Y_İMG	2010–2023	The results of the Granger causality test are not adequate.
	RGDP	M_art	2010–2023	The results of the Granger causality test are not adequate.
	RGDP	Y_EMG_EQE və Y_İMG	2010–2023	The results of the Granger causality test are not adequate.
	RGDP	M_art_EQE	2010–2023	The results of the Granger causality test are not adequate.
	RGDP	PB_İNTR and PB_ EXTR	2010–2023	The results of the Granger causality test are not adequate.
	RGDP	PB_Difference	2010–2023	The results of the Granger causality test are not adequate.
Impact on labor productivity	E_ Productivity	Y_EMGR və Y_İMGR	2010–2023	The results of the Granger causality test are not adequate.
	E_ Productivity	M_art	2010–2023	The results of the Granger causality test are not adequate.
	E_ Productivity	YEMGR_EQE and Y_İMGR	2010–2023	The results of the Granger causality test are not adequate.
	E_ Productivity	M_art_EQE	2010–2023	The results of the Granger causality test are not adequate.
Impact on employment of the population	I_FE	Y_EMGR və Y_İMGR	2010–2023	The results of the Granger causality test are not adequate.
	I_FE	M_art	2010–2023	The results of the Granger causality test are not adequate.
	I_ME	Y_EMGR and Y_ İMGR	2010–2023	The results of the Granger causality test are not adequate.
	I_ME	M_art	2010–2023	The results of the Granger causality test are not adequate.

Table 7

The results of the Granger causality test

Dependent variable: DRGDP			
Excluded	Chi-sq	df	Prob.
DYGED_EQE	11,93377	2	0,0026
DYGEL_EQE	4,649038	2	0,0978
All	12,60630	4	0,0134

Table 8

The results of the Granger causality test

Dependent variable: DE_Productivity			
Excluded	Chi-sq	df	Prob.
DY_İMGR_eqe	36,60184	2	0,0000
DY_EMGR_eqe	15,74350	2	0,0004
All	37,32747	4	0,0000

allows determining the stationarity of the residuals from the cointegration regression of the series. The empirical evaluation of the cointegration relationships between the series of values of the indicators using the Engle-Granger test was implemented in the Eviews software. The results are provided in **Tables 9** and **10**.

The results show that, in the long term, there is a cointegration relationship between the mobility of the working-age population leaving the

Table 9

Results of empirical assessment of cointegration relationships between series of indicator values using the Engle-Granger test, implemented in the Eviews software

Null Hypothesis: RESID01 has a unit root				
Exogenous: Constant				
Lag Length: 1 (Automatic – based on SIC, maxlag = 2)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3,377261	0,0391
Test critical values:	1 % level		-4,297073	
	5 % level		-3,212696	
	10 % level		-2,747676	
*MacKinnon (1996) one-sided p-values,				
Warning: Probabilities and critical values calculated for 20 observations				
and may not be accurate for a sample size of 10				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(RESID01)				
Method: Least Squares				
Date: 12/20/24 Time: 12:37				
Sample (adjusted): 2014 2023				
Included observations: 10 after adjustments				
Variable	Coefficient	Std, Error	t-Statistic	Prob.
RESID01(-1)	-1,904046	0,563784	-3,377261	0,0118
D(RESID01(-1))	0,792884	0,374298	2,118322	0,0719
C	191,5651	540,1047	0,354681	0,7333
R-squared	0,633005	Mean dependent var		-358,7565
Adjusted R-squared	0,528149	S,D, dependent var		2338,136
S,E, of regression	1606,098	Akaike info criterion		17,84433
Sum squared resid	18056865	Schwarz criterion		17,93510
Log likelihood	-86,22164	Hannan-Quinn criter,		17,74475
F-statistic	6,036908	Durbin-Watson stat		1,876198
Prob(F-statistic)	0,029944			

Table 10

Results of empirical assessment of cointegration relationships between series of indicator values using the Engle-Granger test, implemented in the Eviews software

Null Hypothesis: RESID01 has a unit root				
Exogenous: Constant				
Lag Length: 1 (Automatic - based on SIC, maxlag = 2)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-1,737904	0,3878
Test critical values:	1 % level		-4,200056	
	5 % level		-3,175352	
	10 % level		-2,728985	
*MacKinnon (1996) one-sided p-values,				
Warning: Probabilities and critical values calculated for 20 observations				
and may not be accurate for a sample size of 11				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(RESID01)				
Method: Least Squares				
Date: 01/16/25 Time: 12:15				
Sample (adjusted): 2013 2023				
Included observations: 11 after adjustments				
Variable	Coefficient	Std, Error	t-Statistic	Prob.
RESID01(-1)	-0,698334	0,401825	-1,737904	0,1162
C	-0,034557	0,101943	-0,338983	0,7424
R-squared	0,251267	540,1047	0,354681	0,7333
Adjusted R-squared	0,168075	Mean dependent var		-0,073403
S,E, of regression	0,329878	S,D, dependent var		0,361669
Sum squared resid	0,979377	Akaike info criterion		0,782779
Log likelihood	-2,305287	Schwarz criterion		0,855124
F-statistic	3,020309	Hannan-Quinn criter,		0,737176
Prob(F-statistic)	0,116233	Durbin-Watson stat		1,596214
Prob(F-statistic)	0,029944			

country and entering the country for permanent residence, and the real GDP. However, there is no cointegration relationship between the mobility of the working-age population and labor productivity.

The results of the Normal distribution test of the model's residuals. Based on the results of the causality and cointegration tests, the following two models have been established (**Table 11, 12; Figure 1, 2**).

CONCLUSION

The results of the econometric analysis of the two key models are as follows:

1. The relationship between the mobility of the working-age population leaving and arriving in the country and real GDP. The empirical formula obtained is:

$$D(RGDP,2) = 1836,69 * D(YİMGRQE,2) - 152,63 * D(YEMGRQE,2) - 195,50D(RGDP,2) = 1836,69 * D(YİMGR\_EQE,2) - 152,63 * D(YEMGR\_EQE,2) - 95.50D(RGDP,2) = 1836.69 * D(YİMGRQE,2) - 152,63 * D(YEMGRQE,2) - 195,50$$

In this model, the time series used were non-stationary, and thus, the second-order differences of these time series were used in the model construction. There is a cointegration relationship between the variables in the model. The independent variables can be considered the causes of the dependent variable. The residuals of the model

Table 11

Specification of the first model

Dependent Variable: D(RGDP,2)				
Method: Least Squares				
Date: 12/20/24 Time: 12:20				
Sample (adjusted): 2012 2023				
Included observations: 12 after adjustments				
Variable	Coefficient	Std, Error	t-Statistic	Prob.
D(YİMGR_EQE,2)	1836,697	894,6203	2,053047	0,0703
D(YEMGR_EQE,2)	-152,6363	587,4885	-0,259811	0,8009
C	-195,5025	551,1140	-0,354741	0,7310
R-squared	0,330240	Mean dependent var		43,25530
Adjusted R-squared	0,181405	S,D, dependent var		2064,738
S,E, of regression	1868,097	Akaike info criterion		18,11555
Sum squared resid	31408085	Schwarz criterion		18,23677
Log likelihood	-105,6933	Hannan-Quinn criter,		18,07066
F-statistic	2,218828	Durbin-Watson stat		1,616633
Prob(F-statistic)	0,164678			

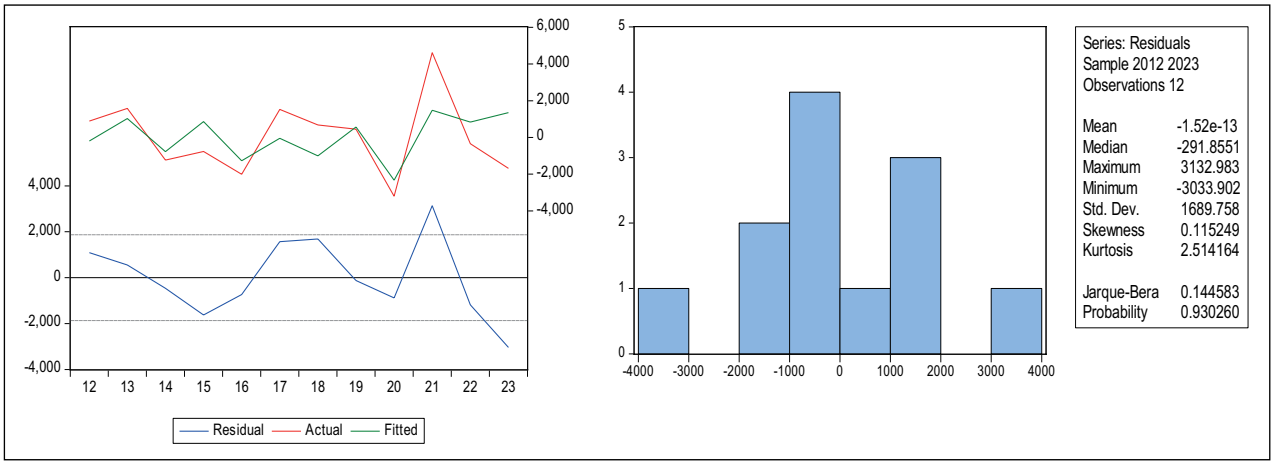

Figure 1. Results of the normal distribution test of the residuals of model 1

are normally distributed and stationary. According to the model, a one-unit increase in the number of people leaving the country for permanent residence leads to an increase of 1836,69 units in real GDP. This variable is statistically significant according to the parameters. However, the parameter for the number of working-age people coming to the country for permanent residence has no statistically significant impact on real GDP.

2. The relationship between the mobility of the working-age population leaving and arriving in the country and labor productivity. The empirical formula obtained is:

$$D(E\_PRODUCTİVİTY,2) = 0,40 * D(YİMGRQE,2) - 0,09 * D(YEMGRQE,2) - 0,042D(E\_PRODUCTİVİTY,2) =$$
$$= 0,40*D(YİMGR\_EQE,2) - 0.09*D(YEMGR\_EQE,2) - 0,042D(E\_PRODUCTİVİTYI,2) = 0,40 *$$
$$* D(YİMGRQE,2) - 0,09 * D(YEMGRQE,2) - 0,042$$

The time series used in this model were also non-stationary, and second-order differences of these time series were used to construct the model. There is no cointegration relationship between the variables in this model. The independent variables can be considered the causes of the dependent variable. The residuals are normally distributed, but non-stationary. According to the

Table 12

Specification of the second model

Dependent Variable: D(E_MEHSULDARLIQ,2)				
Method: Least Squares				
Date: 12/20/24 Time: 12:20				
Sample (adjusted): 2012 2023				
Included observations: 12 after adjustments				
Variable	Coefficient	Std, Error	t-Statistic	Prob.
D(Y_İMGR_EQE,2)	0,401665	0,166079	2,418511	0,0387
D(Y_EMGR_EQE,2)	-0,095921	0,109063	-0,879501	0,4020
C	-0,042091	0,102310	-0,411403	0,6904
R-squared	0,394028	Mean dependent var		0,006355
Adjusted R-squared	0,259367	S,D, dependent var		0,402972
S,E, of regression	0,346798	Akaike info criterion		0,932168
Sum squared resid	1,082419	Schwarz criterion		1,053395
Log likelihood	-2,593010	Hannan-Quinn criter,		0,887286
F-statistic	2,926083	Durbin-Watson stat		1,263203
Prob(F-statistic)	0,104963			

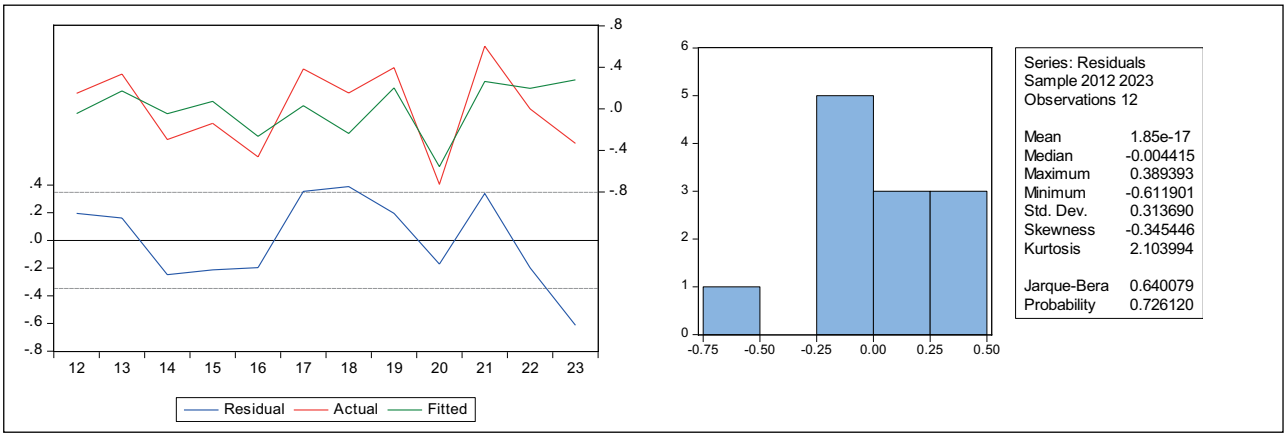

Figure 2. Results of the normal distribution test for the residuals of the second model

Table 13

The results of the tests for both models

Granger causality test results*	Engle Granger cointegration test results**	Results of the Normal distribution test of the model residuals***
dy_imgr_eqe və dy_emgr_eqe are the reason for rgdp	t-Statistic -3,37 Prob.* 0,0391	Jarque bera 0,14; Probability 0,93
dy_imgr_eqe və dy_emgr_ eqe de_ is the reason for productivity	t-Statistic -1,73 Prob.* 0,3878	Jarque bera 0,64; Probability 0,72

Note: * see Tables 7 and 8, ** see Tables 9 and 10,*** see Tables 11 and 13.

model, a one-unit increase in the number of people leaving the country for permanent residence leads to a 0,4-unit increase in labor productivity. This variable is statistically significant according to the parameters. However, the parameter for the number of working-age people coming to the country for permanent residence does not have a statistically significant effect on labor productivity.

Analysis results indicate that the number of people leaving the country for permanent residence is an important factor in real GDP.

- The first model shows good statistical properties and can be used for future policy analysis. These results suggest that policymakers should carefully consider the economic impacts of the mobility of people leaving the country for permanent residence when preparing migration and economic policies.
- To optimize international labor migration processes, comprehensive strategies that consider the interests of both exporting and importing countries need to be developed. These strategies may include the preparation of vocational training programs for migrants, creating conditions for their integration into receiving societies, and establishing cooperation mechanisms between states.

In conclusion, future research in this field should focus on a deeper evaluation of the impact of the mobility of the international labor force on the various aspects of national economies, as well as the development of effective policies for managing migration flows.

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Е. І. ЗІЯЛІ, викладач, ст. інженер

ВПЛИВ МІЖНАРОДНОЇ МОБІЛЬНОСТІ ТРУДОВИХ РЕСУРСІВ НА ЕКОНОМІКУ

Резюме. *У статті досліджено вплив міжнародної мобільності робочої сили на національні економіки. Розуміння цього впливу стає особливо важливим у контексті глобалізації, оскільки трудова міграція набуває нових масштабів і форм. Автор вивчає вплив міжнародної мобільності робочої сили на ключові макроекономічні показники в Азербайджані, включаючи ВВП, продуктивність праці та зайнятість. У статті проаналізовано часові ряди даних за 1995–2023 роки. Сучасні економетричні підходи було застосовано для аналізу зв'язку між показниками мобільності робочої сили та рівнем економічного розвитку. Результати показують значний причиново-наслідковий зв'язок між міграцією населення працездатного віку та як реальним ВВП, так і продуктивністю праці. Надано рекомендації щодо оптимізації процесів трудової міграції для підвищення ефективності національної економіки.*

Ключові слова: *міграція робочої сили, населення працездатного віку, ВВП, продуктивність праці.*

INFORMATION ABOUT THE AUTHOR

Ziyali Elnura Ilgar — Senior Engineer, SOCAR Gas Export Department, Marketing, logistics and business development department, 19, Rovshan Aliev Str., Baku, Azerbaijan, AZ1025; Finance teacher, Azerbaijan University, Faculty of Business and Economics, 22a, A. Maharramov, Baku, Azerbaijan; elnura.huseynova@socar.az, elnuraziyali@gmail.com. elnura.ziyaly@au.edu.az; ORCID: 0009-0009-2938-1154

ІНФОРМАЦІЯ ПРО АВТОРА

Зіялі Ельнура Ільгар — старший інженер, Департамент експорту газу SOCAR, відділ маркетингу, логістики та розвитку бізнесу, вул. Ровшана Алієва 19, Баку, Азербайджан, AZ1025; викладач, Азербайджанський університет, факультет бізнесу та економіки, вул. А. Махарамова 22а, Баку, Азербайджан, AZ1025; elnura.huseynova@socar.az, elnura.ziyaly@au.edu.az; ORCID: 0009-0009-2938-1154

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N. A. GULIYEVA

THE ROLE, EVOLUTION AND DEVELOPMENT OF CLUSTERS IN MODERN ECONOMIES

Abstract. *Clusters are formed by firms in related industrial sectors concentrated in a certain geographical area, gaining competitive advantage through proximity, having specialized supplier and buyer (marketing) advantages due to their location, and supported by physical facilities, education and research opportunities. With the transition from mass production systems to flexible production systems, clusters have become the most important research area in regional development theories. Clusters mostly; includes end product or service companies, specialized input, intermediate machinery suppliers, and service and financial institutions and firms in related industries. However, it also includes units that provide specialized education, conduct knowledge and research, provide technical support (such as universities, think tanks, vocational training providers) and set standards. In the modern world where global competition is intensifying, clusters are emerging as an attractive element of competition. This article attempts to clarify the characteristics of successful cluster examples, taking into account the historical development of clustering. It also seeks to answer the question of whether clusters can be evaluated as an economic and regional development strategy in the long term.*

The main purpose of the article is to provide detailed information about the role and benefits of clusters in the economy and industry, to explain the development stages and economic impacts of clusters. There are various theoretical approaches to studying clusters, and some of these approaches are analyzed and reviewed in this article. The creation and development of clusters supports the growth of the economy and industry. In general, the development of clusters has a positive impact not only on direct economic outcomes, but also on areas such as education, innovation and social well-being. This makes the future economy more competitive, innovative and sustainable, while at the same time creating a more stable social and economic environment.

Keywords: *cluster, economy, innovation, industry, infrastructure.*