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Assessment of How Oil Factors and Economic Development Impact on Industrial Employment of the Country: Symmetric Analysis

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ABSTRACT

Employment is influenced by elements specific to each sector of the labor market. The authors' goal was to investigate how employment in the industrial sector—which includes the oil and gas sector—is affected by oil factors. Kazakhstan is particularly vulnerable to global shocks, such as shifts in energy policies, because it is a nation that exports raw materials. This study looks at how important factors affect the Republic of Kazakhstan's Employment in Industry (EMP). The World Data Bank (WDI) provided the data used in the study, which spans the years 1991-2023. GDP per capita, average annual Brent crude oil price, and crude oil production are the study's explanatory variables. All statistical validation tests were passed by the study, which employed the autoregressive distributed lag (ARDL) approach. According to the estimation results, the lag variables of oil production volume and GDP per capita have a negative short-term impact on employment growth in the sector, whereas the lag variables of oil price and GDP per capita have a positive one. Long-term employment growth in the sector is positively impacted by the lag variables of oil price and GDP per capita, but negatively by the lag variable of oil volume.

Keywords: Oil Price, Industrial Employment, Oil Production, Autoregressive Distributed Lag
JEL Classifications: E24, L16, B22

1. INTRODUCTION

In a market economy, all people of working age are united by the labor market. The labor market creates all the necessary conditions for workers to reach their full potential. On the other hand, labor potential characteristics are negatively impacted by the quality of life, low living standards, household financial circumstances, and reliance on imports for food production (Yergasheva et al., 2020). The coronavirus pandemic, the subsequent accelerated digitalization (Kabylkairatkyzy and Kondybayeva, 2024; Kaliyeva et al., 2025; Kakizhanova et al., 2025), the development of various technologies (Sansyzbayeva et al., 2022; Eder et al., 2025), and other geopolitical events that have transpired over the past 5 years have also affected the evolution of employment.

Furthermore, the structural characteristics of employment are deeply ingrained, and it is possible that a change in one aspect of one sector will have a detrimental effect on that sector while having the opposite effect on another. Because of this, it is crucial to take into account the sectoral distinctiveness of this labor market category while thinking about employment. Oil output, oil pricing, and the policies of large nations regarding oil are still very relevant for a state like Kazakhstan, whose economy is centered on the export of raw materials (Panzabekova et al., 2019).

Oil is said to as the world's most valuable "black gold" for a reason. Numerous nations' economy is directly impacted by oil prices, particularly important labor market segments like underemployment and unemployment (Turkeeva and

Suleimenova, 2021; Kraim et al., 2025). With jobs for 12.5% of all employed persons, industry sector comes in third in terms of employment (BNS, 2025). Given that Kazakhstan's industry generates resources for export, it is critical to carefully examine employment in this sector and the variables affecting it. In this study authors aim to assess impact of oil price, oil production and GDP per capita on industrial employment vulnerability. Thus, this paper organized as follows: Introduction, Literature review, Methodology and materials, Conclusion.

2. LITERATURE REVIEW

Using to sector economy, Hoel (1982) studied effects of increased oil price on employment. In studies of Mork (1989) and Papapetrou (2001) nonlinear impact of oil shock on employment was verified. From a geopolitical perspective as well as an economic one, oil has always been significant in the global arena (Hassani, 2006; Berument et al., 2010; Jaffe and Elass, 2015; Grand and Wolff, 2020). Oil and gas extraction is a major source of export revenue and, to a lesser extent, employment in many developing countries (Sunley et al., 2011; Parra-Cely and Zanoni, 2022).

Keane and Prasad (1996) analyzed effects of oil price changes on employment and real wage at whole economy and industrial sector. They employed OLS method and results demonstrated variations in oil prices cause shifts in employment shares and relative earnings between industries. Davis and Haltiwanger (2001) examined the effects of oil price shocks on employment growth and destruction in the US manufacturing sector from 1972 to 1988. Oil price shocks explain 20-25% of the variation in employment growth. Employment growth responds asymmetrically to oil price increases and decreases, and oil shocks cause major job reallocation activity. In oil-rich countries, oil production is one of the macro-determinants of employment and labor force (Kakizhanova et al., 2026). Therefore, it's critical to determine if oil or non-oil income have a bigger influence on economic growth (Huseynli, 2022; Kreishan et al., 2023). Ordóñez et al. (2010) analyzed impact of oil shocks on job creation and job destruction. His work added a number of significant and novel findings to the body of literature. First, one significant factor influencing changes in the labor market is shocks to real oil prices. Second, the job seeking rate is basically the method by which such shocks are transmitted.

Third, in the framework of the Pissarides model, shocks to the price of oil offer a novel amplification mechanism of business cycle variations and are complementary to the typical technology shocks. Hore and William (2011) examined the effect of one of the largest oil spillovers in US history and found out that employment and average earnings grew in that year, when the cleanup effort was at its peak, and there appears to have been little, if any, negative impact on average labor market opportunities in subsequent years. Michieka and Gearhart (2019) investigated the long- and short-run correlations between oil prices and employment in four sectors of the top oil-producing states in the United States. In the long term, results from a Panel auto regressive distributed lag (ARDL) model show a causal relationship between oil prices and employment in all sectors of the county panel. The state panel findings show that there is long- and short-run causality between oil prices and mining and trade employment, but no effect on service employment. Employment in natural resources and mining returns to equilibrium the fastest after oil price shocks. Palaios and Papapetrou (2022) examined the spillover effects transmission mechanism between oil prices, oil price uncertainty, and oil price volatility on the labor market in Greece, utilizing static and dynamic quantile connectedness approach.

The authors' findings indicate that the COVID-19 pandemic and state assistance to perpetuate it had a significant impact on the labor market. Overall, the study demonstrates a significantly higher time-varying connectivity of the system at the tails of the distribution, demonstrating that changes in energy markets effect the Greek labor market asymmetrically in recessionary and flourishing conditions of the economy, as opposed to normal periods. Kuldasheva et al. (2024) analyzed interrelationship between oil prices, technological advances, and labor market dynamics on inflation in south Asian countries. Authors used Panel ARDL for 1995-2022 years' coverage, and demonstrated that oil price fluctuations have effect on inflation. Also, the overall state of the labor market is reflected in indicators such as employment rates, which have a significant impact on inflation. Olarte et al. (2025) investigated Ecuadorian labor market into an economic catastrophe caused by an exogenous reduction in crude oil prices. The data suggest that social security affiliation affects the probability of being employed by 3% during crises, with disemployment impacts disproportionately affecting women (10 times more than men). By investigating the relationship between oil income shocks and labor market regulation in 83 countries from 1970 to 2014, Brueckner et al. (2025) demonstrate that growing oil revenues cause labor market deregulation in autocracies but have no effect in democracies.

The degree of employment in various economic sectors is impacted by factors such as rapid urbanization, the expansion of urban agglomeration (Tleuberdinova et al., 2024; Kuzembekova and Zhanbyrbayeva, 2022), and the underdevelopment of industrial integration in regions (Tleuberdinova et al., 2024). For instance, even a slight shift in oil prices or production volumes has a significant effect on employment in other parts of Kazakhstan since workers from all over the nation migrate to the western region, where the industrial sector is well developed (Alibekova et al., 2023, Kaliyeva and et al., 2025; Satybaldin and et al., 2023). Kazakhstan's inclusive growth is slowed down by the effects of employment in one sector on all areas and reliance on fluctuations in raw material prices (Nurlanova et al., 2023).

3. METHODS

We employed a regression model to investigate the relationship between Employment in Industry (EMP) in the Republic of Kazakhstan for the period 1991-2023 and the explanatory variables influencing it, based on the findings of the reviews in the article's previous part. Consequently, the following econometric model was employed in order to accomplish the study's goals:

$$EMP_t = f\,(COP_t,\ BCOP_t,\ GDPPC_t) \quad (1)$$

Where all of their definitions and measurements are given in the Table 1 below.

All of the indicators under investigation were found to be stationary at the level of I(0) or first differences I(1), based on the findings of the ADF test (Table 2). As a result, the ARDL approach is applied, a particular test is utilized to pick no more than two lags, and the order of variable integration is established to ascertain whether the ARDL model is appropriate for the study (Table 3).

The linear ARDL model was estimated using the initial difference in order to do both short-term and long-term studies of the relationship between variables. All of the chosen independent factors were found to be causally related to the changes in the dependent variable EMP, as per the linear ARDL model. The linear ARDL model was calculated and the long-term and short-term evaluations of the relationship between variables were carried out based on the Granger causality test results (Table 4).

$$EMP_t = \beta_0 + \sum_{k=1}^{m}\beta_1 EMP_{t-k} + \sum_{k=0}^{n}\beta_1 COP_{t-k} + \sum_{k=0}^{p}\beta_1 BCOP_{t-k} + \sum_{k=0}^{q}\beta_1 GDPPC_{t-k} + \gamma_1 COP_{t-i} + \gamma_2 BCOP_{t-i} + \gamma_3 GDPPC_{t-i} + \varepsilon_t \quad (2)$$

Where, operator Δ represents the differencing operation.

Table 1: Model variables and sources

Variables	Definitions	Sources
EMP	Employment in industry (% of total employment)	World Development Indicators (WDI)
COP	Cude oil production (Mln t) Kazakhstan	World Development Indicators (WDI)
BCOP	Average annual Brent crude oil price, U.S. dollars per barrel	World Development Indicators (WDI)
GDPPC	GDP per capita (current US$)	World Development Indicators (WDI)

Source: Compiled by authors

The presence of cointegration between the sample variables is likewise ascertained by the ARDL approach in the linear autoregressive model with distributed lag. Long-term associations are examined using the limits test, and Table 5 displays the findings of the boundedness test. The CUSUM and CUSUMSQ (Graph 1) tests are used to determine the ARDL model coefficients.

4. DATA AND FINDINGS

4.1. Data

This study looks at how important factors affect the Republic of Kazakhstan's Employment in Industry (EMP). The World Data Bank (WDI) provided the data used in the study, which spans the years 1991-2023. GDP per capita, average annual Brent crude oil price, and crude oil production are the study's explanatory variables. Table 1 below provides definitions and measurements for each indicator.

The dynamic change of all indicators presented in the table in the period 1991-2023 is depicted in the following Graph 2:

The figure's graphs demonstrate distinct, steady, and consistent temporal patterns, suggesting that the variable changes are appropriate for additional research. It is evident from the analysis in Graph 2 that the variables being examined are appropriate for analysis.

4.2. Descriptive Statistics

Descriptive statistics, which shed light on many facets of the data set and the ARDL model, were employed in this study to evaluate the hypothesis. Table 6 displays the descriptive statistics results for each variable utilized in our model, including the pooled averages (mean and median) and measures of dispersion and variation (skewness, minimum, maximum, Jarque-Bera statistic, and standard deviation).

Descriptive statistics show that the EMP indicator's mean, median, and standard deviation are all comparatively constant at 18.71436,

Table 2: ADF unit root tests

Variables	Intercept			Trend and intercept			None		
	Level	First difference	Order of integration	Level	First difference	Order of integration	Level	First difference	Order of integration
EMP	−0.433 (0.891)	−2.599* (0.094)	I (1)	−3.231* (0.098)	−2.683 (0.250)	I (0)	1.080 (0.923)	−0.020** (0.020)	I (1)
COP	−0.369 (0.903)	−3.76*** (0.008)	I (1)	−1.231 (0.887)	−3.340* (0.080)	I (1)	1.698 (0.976)	−2.758*** (0.007)	I (1)
BCOP	−1.544 (0.499)	−5.14*** (0.000)	I (1)	−2.202 (0.473)	−5.119*** (0.001)	I (1)	−0.244 (0.590)	−5.162*** (0.000)	I (1)
GDPPC	−0.217 (0.926)	−3.718* (0.009)	I (1)	−2.401 (0.372)	−3.692** (0.038)	I (1)	1.273 (0.945)	−3.468*** (0.001)	I (1)

1) *, **, *** denote statistically significant at the 10%, 5% and 1% levels, respectively. P-value is inside brackets. Source: Compiled by authors

Table 3: Selection order criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	−86.05061	NA	22.18688	5.936708	6.076827	5.981533
1	2.212053	152.9886	0.066067	0.119196	0.306023	0.178964
2	4.914174	4.503535*	0.059071*	0.005722*	0.239255*	0.080431*
3	4.917872	0.005917	0.063275	0.072142	0.352381	0.161793

Source: Compiled by authors

18.63881, and 1.801121, respectively. The series is uniformly distributed, as indicated by the Jarque-Bera statistic value of 2.476334 and the chance of a tie of 0.289915, both of which are >0.05. Every other indicator's standard deviation is likewise higher than 0.05. Table 6 shows that all indicators have a right skewness, meaning that their skewness coefficient is >0, with the exception of COP. The distribution is nearly normal, with no extreme kurtosis, according to the kurtosis value for each indicator.

Table 4: Noncausality tests in the sense of Granger for the vector autoregressive (1) (1991-2023)

Direction of causality	F-statistic	Probability
EMP		
COP does not granger cause EMP	7.74270	0.1023
BCOP does not granger cause EMP	0.94226	0.4027
GDPPC does not granger cause EMP	1.53105	0.2352

Source: Compiled by authors

Table 5: Bounds of cointegration test

Model	F Statistics	Critical Bounds			Decision
		Significance (%)	I (0)	I (1)	
ARDL (2, 1, 0, 1)	6.931470***	10	2.37	3.2	Cointegration
		5	2.79	3.67	
		2.5	3.15	4.08	
		1	3.65	4.66	

Critical bounds are reported at 1% (***) and 10% (**) level of significance.
Source: Compiled by authors

4.3. Unit Root Test

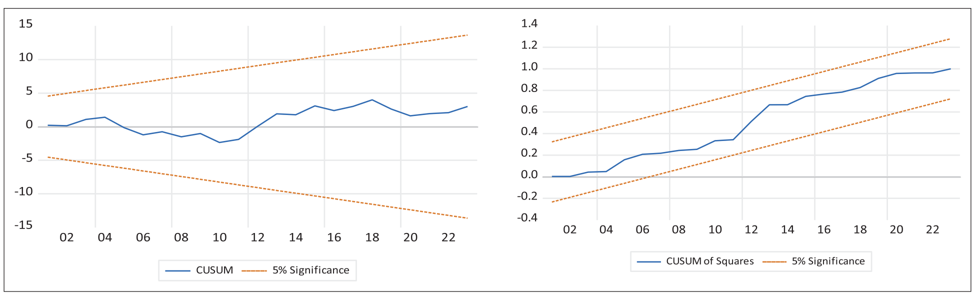
The stationarity of the series must be established before evaluating their long-term relationship. The augmented Dickey-Fuller (ADF) unit root tests were employed to determine whether the levels or differences of the time series variables were stationar. At Level I(0) or the first difference I(1), all variables are stationary. Consequently, the most effective strategy for evaluating or testing the long-term relationship between the research variables is the ARDL cointegration methodology.

The unit root results support the key hypotheses that necessitate the application of the ARDL model test in order to verify the presence of long-term correlations between Kazakhstan's GDPPC and the explanatory factors suggested in the research.

4.4. Granger Causality Test

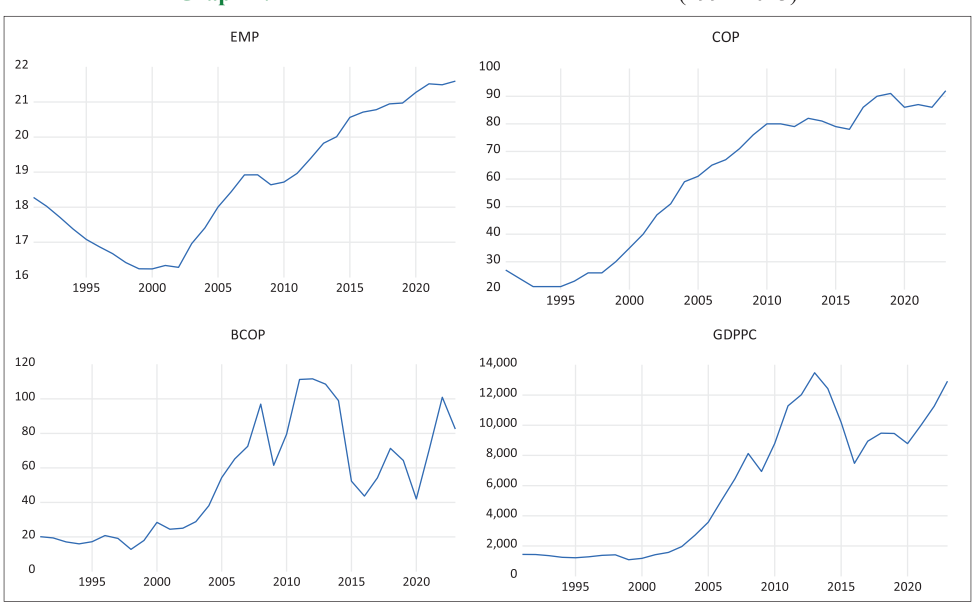
As indicated in Table 4, the study employed paired Granger causality analysis to ascertain the causal linkages between

Graph 1: CUSUM and CUSUM squares tests



Source: Compiled by authors

Graph 2: Evolution of all variables for Kazakhstan (1991-2023)



Source: Compiled by authors

variables in order to improve the stability test's reliability. The Granger test, which tests the null hypothesis that changes in the dependent variable are not causal (noncausality), is used to investigate the causal relationship between the chosen factors and the level of EMP.

A study reveals a causal relationship between EMP and COP, BCOP, and GDPPC.

4.5. Selection Order Criteria

The long-term link between COP, BCOP, GDPPC, and EMP in the Republic of Kazakhstan is investigated in this paper using the ARDL bounds testing approach. With a small sample size (1991-2023), the ARDL approach was selected to investigate the variables' long-term connection. The lag length condition must be established before the cointegration test can be conducted.

LR, FPE, AIC, SC, and HQ are used to determine the lag duration criterion. The results of the chosen lag are shown in Table 3. Table 3 shows that because it has more stars and was utilized throughout the study, the chosen lag duration is 2.

4.6. Results of Long- and Short Run Relationship

In order to do both short-term and long-term analysis of the relationship between the variables, the linear ARDL (2, 1, 0, 1) (Equation 2) was estimated using the findings throughout the investigation. The results are shown in Table 5 below.

According to the model's cointegration F-test results (Table 5), the generated F-statistic of 6.931470 is statistically significant at the 1-10% significance level and surpasses the upper limit of 4.66. The findings indicate a long-term association between the variables in the instance of Kazakhstan and the cointegration of the chosen variables.

We can move on to the following phase, which entails estimating the long-run and short-run coefficients, since the chosen variables are cointegrated over the long term. The first difference was used to estimate linear ARDL, which allows us to estimate the short- and long-term effects of a 1-unit change in the explanatory factors on the dependent variable.

Long-term employment in industry (EMP) growth in Kazakhstan has a negative correlation with the average annual Brent crude oil price (BCOP), with a coefficient of −0.050689, ceteris paribus. The results show that, assuming other equal conditions, the remaining explanatory variables, GDP per capita (GDPPC) and crude oil production (COP), have a positive correlation with *Δ*EMP (coefficients of 0.061769 and 0.000339, respectively).

With a coefficient of −0.011813, the empirical data (Table 7) show that BCOP and EMP have a short-term negative and significant correlation in Kazakhstan. Notably, the increase of GDPPC (Δ [GDPPC]) has a positive correlation with a coefficient of 0.000188, whereas the growth of COP (Δ [COP]) has a short-term negative correlation with Δ (EMP) with a corresponding value of −0.028412. With a coefficient of 0.571709, the growth of the lagged variable EMP (Δ [EMP(−1)]) has a positive short-term impact on the growth of EMP.

Furthermore, it was demonstrated that the lag variable EMP(−1) in period t had a short-term negative impact on the EMP growth rate in period t-1 (−0.233056), whereas the EMP growth rate was positively dependent on the COP(−1) and GDPPC(−1) indicators (coefficients 0.014396 and 7.89E−05, respectively).

4.7. Diagnostic Tests

To make sure the nonlinear ARDL model is stable, diagnostic tests are run. These consist of tests for heteroskedasticity, serial correlation, and normality. There is no serial correlation in this ARDL model, as indicated by the LM statistic in Table 8 of 1.480954 and the probability value of 0.2502. The model is homoskedastic, according to the results of the heteroskedasticity tests, which showed an F-statistic of 1.660179 and a probability of 0.1689 that are above the 5% significance threshold. The F-statistic of 0.520294 and the probability of 0.7709 for Jarque-Bera demonstrate that the probabilities of all tests are above the significance level, indicating that the model accepts the null

Table 6: Values of descriptive statistics of the displayed series

Values	EMP	COP	BCOP	GDPPC
Mean	18.71436	59.63636	52.96182	5979.779
Median	18.63881	67.00000	52.31991	6449.439
Maximum	21.59418	92.00000	111.6300	13478.46
Minimum	16.23960	21.00000	12.80000	1091.547
Standard deviation	1.801121	26.02021	32.41627	4406.533
Skewness	0.176133	−0.353789	0.426503	0.196808
Kurtosis	1.705056	1.499385	1.876042	1.471269
Jarque-Bera	2.476334	3.784704	2.737487	3.426435
Probability	0.289915	0.150717	0.254426	0.180285
Sum	617.5740	1968.000	1747.740	197332.7
Sum Sq. Dev.	103.8091	21665.64	33626.07	6.21E+08
Obs	33	33	33	33

Source: Compiled by authors

Table 7: Results of ARDL (2, 1, 0, 1) Estimation (1991-2023)

Estimation Δ (EMP)				
Variable	Coefficient	Standard error	t-statistic	Probability
Short run				
EMP(−1)*	−0.233056***	0.044660	−5.218450	0.0000
COP(−1)	0.014396***	0.003843	3.746155	0.0011
BCOP**	−0.011813***	0.003637	−3.248359	0.0035
GDPPC(−1)	7.89E−05**	3.51E−05	2.246028	0.0346
Δ (EMP[−1])	0.571709***	0.143833	3.974820	0.0006
Δ (COP)	−0.028412**	0.011307	−2.512784	0.0194
Δ (GDPPC)	0.000188***	6.19E−05	3.035504	0.0059
Long run				
COP	0.061769***	0.016346	3.778881	0.0010
BCOP	−0.050689***	0.012934	−3.918951	0.0007
GDPPC	0.000339**	0.000126	2.682273	0.0133

1) Coefficients are statistically significant at ***1%, **5%, *10% level of significance.
2) Compiled by the authors

Table 8: Short-run diagnostics

Test	F-statistics	P-value
Serial correlation LM	1.480954	0.2502
Heteroskedasticity	1.660179	0.1689
Jarque-Bera	0.520294	0.7709

Source: Compiled by authors

hypothesis of the normality test and comes to the conclusion that the residuals are normally distributed. Consequently, the diagnostic test findings show that there is no serial correlation or heteroscedasticity in the calculated model. Lastly, the model's stability was demonstrated by the successful completion of all diagnostic tests, including the Jarque-Bera normalcy test, the heteroscedasticity test, and the Langrauge multiplier serial correlation test.

4.8. Stability Tests

The CUSUM and CUSUM squares tests are used to test whether the estimated model coefficients remain constant over time, which is an indicator of model stability.

Graph 1 displays the outcomes of the CUSUM and CUSUMSQ stability tests. Since staying below the critical thresholds is important, the model is stable, according to the plot of the tests at the 5% significance level. The long-term dynamics of the regression are also examined using this test.

5. CONCLUSION

One of the most crucial measures of the labor market and the overall state of the economy is still employment. It has an impact on society's social and economic well-being. However, a thorough examination of the economy's structure reveals that certain factors influence employment in particular labor market sectors. The aim of this study is to evaluate the degree to which employment in industry is impacted by significant issues in this field. In order to accomplish this, the authors used the ARDL model to estimate the dynamics of indicators using statistics for the years 1991-2023. Employment in the industrial sector is the dependent variable, whereas GDP per capita, average annual Brent crude oil prices, and crude oil output are the independent variables. In the short term, industrial employment growth is positively impacted by the lag variables for oil prices and GDP per capita, but negatively by the lag variable for oil production volume. Long-term industrial employment growth is positively impacted by the lag variable for oil prices and GDP per capita, but negatively by oil volume. Even little changes have an impact on the price and volume of oil since it is still a political and economic tool on the global arena. And a chain reaction follows from this. Therefore, mobilizing all efforts to make Kazakhstan's economy independent of raw materials is still relevant.

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