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Metabolism of Creative Economy: Its Nexus with Energy Consumption Factors

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ABSTRACT

The purpose of this research work is to assess the impact of energy consumption factors on the creative economy. The creative economy is currently associated with green economy, innovation, knowledge, technology and digitalization. It is important to assess whether the creative economy is developing in line with sustainable development goals and with minimal environmental impact. In this context, the authors use the NARDL model to see if energy consumption volume have some impact on creative economy. West Texas Intermediate (WTI or NYMEX) crude oil prices per barrel, Renewable energy consumption (as a percentage of total final energy consumption), Electric net consumption (billion kWh), Refined petroleum product consumption (Mb/d), and Carbon dioxide (CO_2) emissions from the power industry (energy) (Mt CO2e) were all considered as independent variables. Total gross value added for creative industries, a dependent variable, was taken on a special request from the National Statistical Bureau. The results of the study show that energy consumption has a clear impact on the creative economy.

Keywords: Creative Economy, Energy Consumption, Oil Price, Electricity Consumption, CO_2 Emissions
JEL Classifications: P2, Q42, L8

1. INTRODUCTION

The creative economy is an economic sector associated with intellectual activities that combine knowledge, ideas, and technology. The creative economy as the economy of the 21st century began to gain momentum in the early 2000s. The first references to the creative economy are found in the works of Landry and Bianchin (1995), Howkins (2002), Florida (2003), Florida and Adler (2019). One of the economies with the quickest rates of growth at the moment is the creative economy (Lestariningsih et al., 2019). 2021 has been declared as the International Year of the Creative Economy for Sustainable Development by the United Nations (UNESCO, 2021). In this setting, several nations create new creative economic strategies, and in order to institutionalize these policies, they even set up ministries of creative economies. Countries must produce and allocate resources for macro-level graded policy documents, particularly in education, in order to develop their creative sectors and accomplish their desired goals, beginning with identifying the creative personality (Boğa and Topcu, 2020). For a country such as Kazakhstan, which is dominated by raw material exports, the creative economy can become one of the growth points. The Republic of Kazakhstan's primary responsibilities in the framework of establishing a knowledge-based economy are the formation of the national innovation system and the creation of creative policies and initiatives (Satpayeva, 2017). For this reason, in recent years, the creative sectors have received particular focus. In this regard, the Government of the Republic of Kazakhstan has developed the program "Concept for the Development of Creative Industries for 2021-2025" (UNCTAD, 2024). There are several challenges along the way, though. For instance, Temerbulatova et al. (2021) brought up the topic of regional development disparities, pointing out that the creative economy is concentrated only in large cities, while Bolatbek et al. (2024) emphasized the necessity of strategic collaborations. According to Argynbekov and Zeynelgabdin (2024), Kazakhstan does not have any cohesive clusters of creative economy industries.

Nonetheless, there is no denying that Kazakhstan's creative economy has grown considerably in the last several years. All facets of people's life have been impacted by global shocks like COVID-19 and lockdowns (Mukayev et al., 2023), therefore it's likely that sectors of the creative economy—some sectors unrelated to actual lockdowns—will eventually become major engines of economic expansion.

This article builds on following streams: to determine the relationship between the creative economy, which at first glance seems weakly related to the energy sector, and energy indicators, including such important indicators for Kazakhstan as CO_2 emissions from Power Industry, Renewable energy consumption, Electric net consumption, oil price and petroleum consumption. The reason why we want to determine the relationship between the creative economy and the energy sector is the close connection of the Kazakhstani economy to the oil and gas sector. Such dependence of the economy on oil prices, in turn, affects all sectors. The purpose of the research work is to evaluate the relationship between these energy indicators and the creative economy and make effective economic and social recommendations. There are several research questions that the authors are seeking answers to following research questions:

- RQ1: To what extent does the creative economy in Kazakhstan depend on energy consumption sources?
- RQ2: To what extent will changes in electricity consumption, oil prices, and CO_2 emissions due to global shocks, contribute to the creative economy?

Thus, this article is organized as follows: Introduction, Literature review, Methodology and Materials, Conclusion.

2. LITERATURE REVIEW

Numerous Potts and Cunningham (2010) used four models—welfare, competition, growth, and innovation—to analyze the relationship between the creative economy and the rest of the economy. According to Levickaitė (2015), the creative economy is essential to sustainable development. The modern economy now heavily relies on the creative economy (Zavadenko, 2025). The rational person is the primary focus of economics, yet creativity is a perennially relevant and popular topic in human psychology (Amabile, 1983). According to statistics, there are more jobs in the creative industries than in other sectors, and those who work in these fields even have lower rates of depression (Boros, 2025). More people always mean more consumption. Scarcity and inappropriate use of resources may impede the expansion of creative businesses (Jan and Skikiewicz, 2019). An essential component of sustainable development has always been energy efficiency (Manioudis and Angelakis, 2023). Since resource scarcity, toxic substances released from energy source consumption, and energy source use themselves have become global issues and are contributing to climate change, the creative economy's positive effects on rational consumption are crucial today. Numerous researchers have focused on the direct or indirect relationship between energy factors and the creative economy, especially the creative industries. The creative economy has a wide range of actors. The cultural and creative industries, which sit at the intersection of the arts, culture, commerce, and technology, are at the core of this vibrant economy. Creative sectors are crucial to improving the standard of living for all citizens, particularly young people, by encouraging innovation, advancing cultural identity, and supporting the SDGs (UNDP Kazakhstan, 2023).

A close relationship exists between the creative economy and the Sustainable Development Goals (SDGs). The creative industries make numerous contributions to sustainability (Manioudis and Angelakis, 2023). As a result, the objectives of sustainable development and the growth of the creative economy ought to be tightly related. The growth of the nation's creative economy is influenced by a number of factors. Key macroeconomic indices like unemployment and economic growth are influenced by a significant component, such oil prices (Kakizhanova et al., 2026).

Many nations' economy is significantly impacted by oil prices (Speight, 2009; Wang et al., 2014; Tapia Carpio, 2019). He et al. (2022) claim that oil price has huge impact on corporate innovation. Using the induced-innovation theory, they looked into how the price of oil affected the development of new energy vehicle technology. Authors recommend that businesses establish long-term plans to support ongoing corporate innovation and that the central government offer pertinent regulations and incentives to address pricing shocks. It is not hard to notice that the oil and gas sector is more receptive to innovation and change now than it has ever been, and new technologies that are relevant are emerging at an astonishing rate (Aitimova et al., 2024; Alsuhaibany, 2025). Liang et al. (2025) contend that the connections between green innovation, technology adoption, and the digital economy are mediated and moderated by creative enterprises and financial capabilities. Determining which of the good and negative environmental effects in the context of climate change are more prevalent, as well as tracking the creative economy's development trajectory in order to ensure compliance with the 17 Sustainable Development Goals (United Nations, 2015) issued by the UN, are also significant topics.

Dulgheru (2024) believes that improving the functionality of products, immaterializing and miniaturizing them, creating products from biodegradable materials, humanizing the environment (natural and objective), and developing products with a high degree of creativity and significant scientific content are all important. Creative industries can be seen as one of the drivers of economic growth since they can be a desirable investment vehicle (Dzhakisheva et al., 2024). In order for the creative economy and its sectors to progress in producing both creative goods and creative services, authors consider that they should be connected to green technologies, innovations, and technology. In other words, there is a growing global urgency to reduce waste and consume more efficiently. For instance, 3D food printing technology, which reduces environmental damage and gets rid of food waste, is suggested by Alghamdy et al. (2025). In a similar vein, the creative economy needs to be as innovative as possible to live up to its moniker. Like all other industries, nearly every one of the creative economy classifications depends on energy sources. For instance, the creative industries provide 4% of the world's electricity consumption and a contribution of greenhouse gas emissions that is similar to that of other service industries (PEC, 2022). That is why it is important to use renewable energy sources in these industries as well. According to Ortiz-Ospino et al. (2025), the creative industries are benefiting from digital revolution, which raises energy consumption even further. Devices used in the creative sector (72%), data transmission (23%), and data centers (5%), consume the most electricity (UNCTAD, 2024). For instance, compared to art and history museums, science museums use more energy (19.8 kWh) per visitor. Compared to art/history museums, science museums use more water (53.5 L) per visitor. A museum visit results in 2.34 kg of CO_2 equivalent emissions (Farreny et al., 2012). The use of renewable energy consumption to lessen the environmental impact of the creative industries is a topic that is always relevant. However, the degree to which these issues are resolved depends not only on the creative industries themselves, but also on the policies and general capabilities of the countries in which they are located. Greening the creative economy is always a point of view when it comes to the topic of greening the economy (Gwak, 2013).

3. METHODS

Taking into account the results of the literature review presented in the previous section, in this study the relationship between Total GVA for creative industry (GVACI) in the period 2004-2023 with energy consumption indicators of the Republic of Kazakhstan such as carbon dioxide (CO_2) emissions, Electric net consumption, Refined petroleum products consumption, Renewable energy consumption, WTI crude oil prices are being studied. GVACI is determined by the following equation:

GVACI = f (CO2_PI, REC, ENC, RPPC, CROIL_PR) (1)

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

The nonlinear NARDL model was estimated using the first difference, and long-run and short-run analyses of the relationship between variables were conducted. Using the first difference (Table 2), a logarithmic NARDL model was constructed based on the results of the Granger causality test, and long-run and short-run analyses of the relationship between variables were conducted. The coefficients in this model determine the elasticity. The bounds test tests the long-run relationships, and the results of the bounds test are presented in Table 3.

The main model was constructed. As in Model 1, the model specification was converted to a logarithmic one. In the nonlinear autoregressive model with distributed lags, the NARDL procedure is defined by equation 2:

$$\begin{aligned} &LOG(GVACI_t) \\ &= \beta_0 + \sum_{k=1}^{l} \beta_1 LOG(GVACI_{t-k}) \\ &+ \sum_{k=0}^{m} \beta_2 LOG(CO2\_PI_{t-k}) + \sum_{k=0}^{n} \beta_3 LOG(REC_{t-k}) \\ &+ \sum_{k=0}^{p} \beta_4 LOG(ENC_{t-k}) + \sum_{k=0}^{q} \beta_5 LOG(RPPC_{t-k}) \\ &+ \sum_{k=0}^{r} \beta_5 LOG(CROIL\_PR_{t-k}) + \gamma_1 CO2\_PI_{t-i} \\ &+ \gamma_2 REC_{t-i} + \gamma_3 ENC_{t-i} + \gamma_4 RPPC_{t-i} + \gamma_5 CROIL\_PR_{t-i} + \varepsilon_t \end{aligned} \tag{2}$$

Where, operator Δ represents the differencing operation.

4. DATA AND FINDINGS

4.1. Data

To apply the ARDL model, the research variables need to satisfy certain stationarity conditions. According to Alimi (2014), the variables should be I(0)/I(1), just I(0), or purely I(1). This was evaluated using the Dickey & Fuller (1979) test. The Akaike (1974) information criterion (AIC) was used to determine the optimal latency. The Jarque-Bera test (1980) is used to check for normality in the residuals. To look for serial correlation, the Breusch (1978) and Godfrey (1978) tests were used. Using the Breusch-Pagan-Godfrey (1979) test, the heteroscedasticity was investigated. The model's stability was assessed using the cumulative sum of recursive residuals (CUSUM) and cumulative sum of recursive residuals squares (CUSUMSQ) tests (Brown

Table 1: Model variables and sources

Variables	Definitions	Sources
GVACI	Total GVA for creative industry, million tenge	Bureau of National statistics of Kazakhstan (2025) https://stat.gov.kz/
CO2_PI	Carbon dioxide (CO_2) emissions from Power Industry (Energy) (Mt CO2e)	World Development Indicators (WDI) (2025)
REC	Renewable energy consumption (% of total final energy consumption)	World Development Indicators (WDI) (2025)
ENC	Electric net consumption (billion kWh)	U.S. Energy Information Administration (2025) https://www.eia.gov/international/data/country/KAZ
RPPC	Refined petroleum products consumption (Mb/d)	U.S. Energy Information Administration (2025) https://www.eia.gov/international/data/country/KAZ
CrOil_pr	West Texas Intermediate (WTI or NYMEX) crude oil prices per barrel	Macrotrends (2025) www.macrotrends.net

Source: Compiled by authors

Table 2: Noncausality tests in the sense of Granger for the vector autoregressive (1) (2004-2023)

Direction of causality	F-statistic	Prob.
GVACI		
CO2_PI does not Granger Cause GVACI	0.86925	0.4423
REC does not Granger Cause GVACI	0.84535	0.4517
ENC does not Granger Cause GVACI	0.00513	0.9949
RPPC does not Granger Cause GVACI	3.38926	0.1054
CrOil_pr does not Granger Cause GVACI	1.11850	0.3563

Source: Author's calculation

Table 3: Results of cointegration test

Model	F statistics	Critical Bounds	Decision
NARDL (1,0,0,0,1,0)	40.30904	2.93-4.21	Cointegration

Critical bounds are reported at 1% (***) and 10% (**) level of significance.
Source: Authors' analysis results

et al., 1975). This study examines the impact of the main factors on the Total GVA for the creative industry in the Republic of Kazakhstan. The study uses data for the period from 2004 to 2023, which were obtained using the World Data Bank (WDI), U.S. Energy Information Administration, Macrotrends.net., Bureau of National statistics of Kazakhstan. The explanatory variables in this study are Carbon dioxide (CO_2) emissions from Power Industry (CO2_PI), Renewable energy consumption (% of total final energy consumption) (REC), Electric net consumption (ENC), Refined petroleum products consumption (RPPC), West Texas Intermediate crude oil prices per barrel.

All of indicator's definitions and measurements are given in the Table 1 below.

The dynamic change of all indicators presented in the table in the period 2004–2023 is depicted in the following graph:

It is clear from the analysis of the graph shown in Graph 1 that the study variables are suitable for analysis. The graph shows obvious, consistent and stable time patterns, indicating that changes in the variables are suitable for further study.

Graph 1 displays distinct, steady, and consistent time patterns that suggest the variable changes are appropriate for additional research. It is evident from the graph analysis that the variables being studied are appropriate for examination.

4.2. Descriptive Statistics

The study used time series variables as defined in Table 1. In the study, the median, mean, minimum, maximum, standard deviation, asymmetry, and Jarque-Bera statistics for each variable used in our model, and their respective characteristics are described in Table 4 below. The study validates the variables by mean, median, asymmetry, and minimum and maximum variables.

According to descriptive statistics, the median of GVACI is 383839.30 million tenge, and standard deviation is 326881.10 million tenge. The Jarque-Bera statistic is 3.13, the probability of the relationship is 0.21, which is >0.05, it can be concluded that the row is evenly distributed.

The CO2_PI median is 94.00Mt CO2e, and the standard deviation is 12.68 The standard deviation for all considered indicators does not exceed 0.05, which indicates the heterogeneity of the indicator in the period under consideration, while the standard deviation for all other indicators is exceeded. The results in Table 4 show that for all the considered indicators, except REC and ENC, the coefficient of asymmetry of time series is greater than zero, i.e. they have a right asymmetry. Kurtosis for all indicators indicates that the distribution is close to normal, without excessive excess.

4.3. Unit Root Test

Before studying long-term relationships between series, it is important to determine whether they are stationary. In this study, Augmented Dickey-Fuller (ADF) unit root tests were used to examine the levels or differences of the variables that are considered stationary. Some variables can be used at the I(0) level, while other variables are stationary at the first difference I(1). In addition, other cointegration methods are sensitive to sample periods. For the purposes of this study, the ARDL can be constructed. Table 5 presents the results of the Augmented Dickey-Fuller (ADF) lag unit root test for the level and first difference series, since the optimal lag is the first step in measuring ARDL models. ADF tests the non-stationary null hypothesis, which is rejected if the ADF is more negative or greater than the absolute critical values of 1%, 5% and 10%. The results indicate that all explanatory variables are stationary at first difference. GVACI is stationary only for the case with Trend and intercept, and GVACIGDP is stationary in the case with Intercept and without Trend and intercept.

Therefore, these variables are used to evaluate ARDL models. The unit root results are consistent with the initial assumptions, which requires the use of an ARDL model test to confirm the existence of long-term relationships between the Kazakh creative industry GVA and the explanatory economic factors proposed in the study.

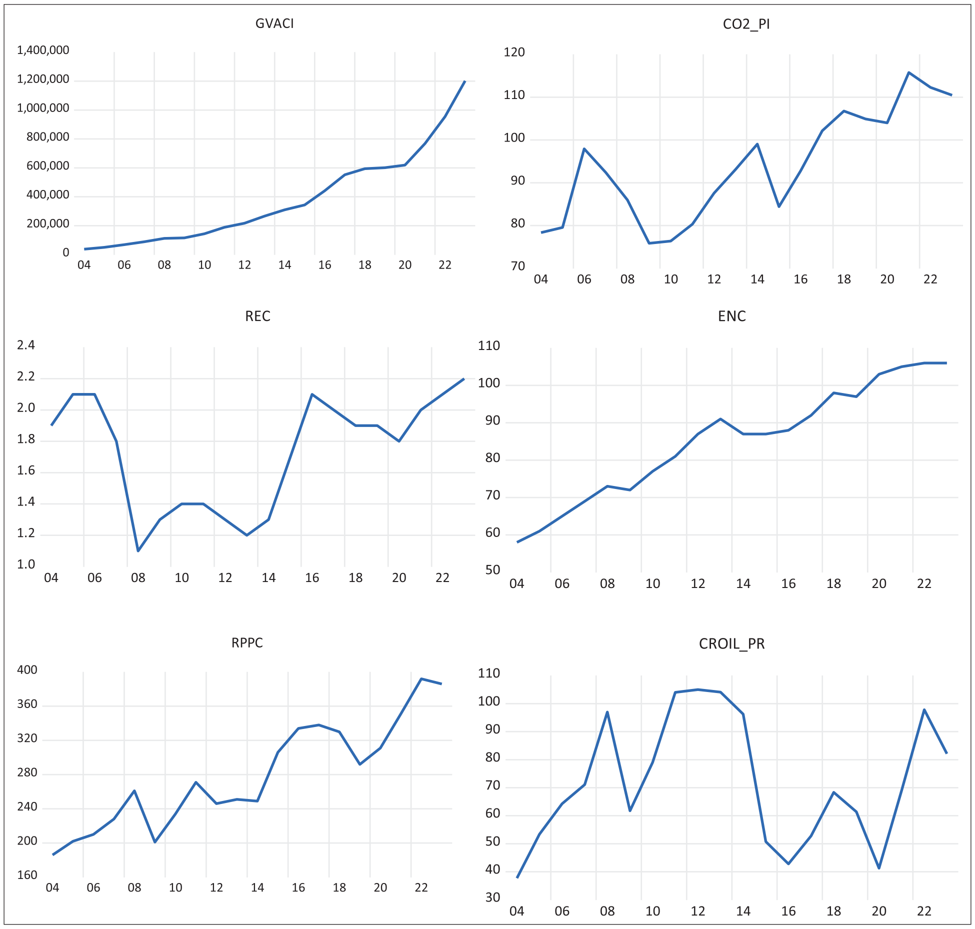
4.4. Granger Causality Test

To examine the causal relationship between the selected variables and GVA for the creative industry, a Granger test is performed, which tests the null hypothesis that changes in the dependent variable are Noncausality. The acceptance criterion is called the P-value. If $P < 0.05$ then the null hypothesis is rejected. According to Table 2, the null hypothesis is accepted for all variables.

4.5. Co-integration Test

The ARDL approach was used with a small sample size in order to investigate the long-term association between the variables. This study examines the long-term relationship between the chosen variables and GVA for the Republic of Kazakhstan's creative industry using the NARDL bounds testing approach. Determining the lag duration requirement is crucial before doing the cointegration test. LR, FPE, AIC, SC, and HQ are used to determine the lag duration criterion. The results of the chosen lag are shown in Table 6. Table 3 shows that because it contains more stars and was utilized throughout the study, the chosen lag duration is 1.

Graph 1: Evolution of all variables for Kazakhstan (2004–2023)



Source: Compiled by authors

Table 4: Values of descriptive statistics of the displayed series

Values	GVACI	CO2_PI	REC	ENC	RPPC	CROIL_PR
Mean	383839.30	94.00	1.73	85.15	278.95	72.00
Median	287932.20	92.97	1.85	87.00	266.00	68.71
Maximum	1202175.00	115.76	2.20	106.00	392.00	105.01
Minimum	37568.86	75.86	1.10	58.00	186.00	37.73
Std. Dev.	326881.10	12.68	0.36	15.18	62.26	22.49
Skewness	0.97	0.09	−0.40	−0.23	0.28	0.14
Kurtosis	3.13	1.77	1.65	1.94	1.97	1.73
Jarque-Bera	3.13	1.29	2.06	1.12	1.14	1.42
Probability	0.21	0.52	0.36	0.57	0.57	0.49
Sum	7676785.00	1880.10	34.60	1703.00	5579.00	1440.06
Sum Sq. Dev.	2.03E+12	3053.22	2.46	4378.55	73640.95	9610.87

Source: Author's calculation

4.6. Results of Long- and Short Run Relationship

In the study, the NARDL power model (Equation 2) was estimated using the logarithms and first difference from the ADF test, and to conduct the long-run and short-run analysis of the relationship between the variables, the results obtained are presented in the following table. The results of the cointegration F test show that the selected variables are cointegrated, and in the case of Kazakhstan, there is a long-run relationship between them, since for NARDL (Table 3), the obtained F statistic (40.30904) exceeds the upper limit of 4.21 and is statistically significant at the 10 and 5% significance levels. The results show that the selected variables are cointegrated and in the Kazakhstan case, there is a long-term relationship between them.

Given that the selected variables are cointegrated in the long run, the next step involves estimating the long-run and short-run coefficients. Based on the results of NARDL(1,0,0,0,1,0), the authors can estimate how a 1% increase in the explanatory variables affects the dependent variable in both the long and short run.

Table 5: ADF unit root tests

Variables	Intercept			Trend and intercept			None		
	Level	First different	Order of integration	Level	First different	Order of integration	Level	First different	Order of integration
GVACI	3.694 (0.07)	−2.393 (0.159)	>I (1)	−0.567 (0.965)	−4.231** (0.025)	I (1)	4.457 (0.999)	0.765 (0.867)	>I (1)
LOG (GVACI)	−2.88** (0.071)	−2.97** (0.057)	I (0)	−2.626 (0.274)	−4.447 (0.016)	I (1)	7.807 (1.000)	−1.291* (0.074)	I (1)
CO2_PI	−1.363 (0.578)	−4.26*** (0.004)	I (1)	−2.628 (0.273)	−4.120** (0.023)	I (1)	0.739 (0.866)	−4.186*** (0.000)	I (1)
REC	−1.238 (0.635)	−3.15** (0.040)	I (1)	−1.625 (0.744)	−0.94* (0.078)	I (1)	−0.032 (0.681)	−3.257** (0.003)	I (1)
ENC	−1.340 (0.589)	−3.99*** (0.008)	I (1)	−2.256 (0.435)	−4.068** (0.025)	I (1)	3.464 (0.999)	−2.607** (0.012)	I (1)
RPPC	−0.857 (0.779)	−4.26*** (0.006)	I (1)	−3.657* (0.053)	−4.131** (0.027)	I (0)	1.329 (0.948)	−4.06*** (0.000)	I (1)
CrOil_pr	−0.857 (0.779)	−4.26*** (0.006)	I (1)	−3.657* (0.053)	−4.131** (0.027)	I (0)	1.328 (0.948)	−4.064*** (0.000)	I (1)

(1) *, **, *** denote statistically significant at the 10%, 5% and 1% levels, respectively. *P* value is inside brackets. Source: Author` s calculation

Table 6: Selection order criteria

NARDL (1,1,0,1,1)						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	−244.2172	NA	6.31e+10	27.69080	27.93812	27.72490
1	−210.4463	45.02787*	1.67e+09*	24.04959*	24.34638*	24.09051*
2	−210.4378	0.010399	1.90e+09	24.15975	24.50601	24.20750

Source: Authors' analysis results

In the study, in Kazakhstan, in the long run, CO_2 and REC are negatively correlated with GVACI with the corresponding elasticity coefficients of −4.216132 and −2.157076, all other things being equal (Table 7). The results show that ENC is positively correlated with GVACI with the corresponding coefficient of 8.062908, all other things being equal.

The obtained empirical data show that in Kazakhstan Electric net consumption (ENC) in the short term, on the contrary, negatively correlates with GVACI with an elasticity coefficient of −1.342157. The results of the model confirmed a positive relationship between the Growth of Refined petroleum products consumption and the growth of GVACI, that is, an increase in RPPC by 1% leads to an increase in GVACI by 0.398279%. In addition, in the short term, CO_2, REC and CROIL_PR also positively correlate with GVACI, an increase in CO_2, REC and CROIL_PR by 1% increases GVACI by 0.7018201%, 0.3590681% and 0.1062001%, respectively. To check the stability of the nonlinear NARDL model, diagnostic tests were carried out (Table 7). These include tests for normality, serial correlation and heteroscedasticity. For this model, the null hypothesis of no serial correlation, homoscedasticity and normality cannot be rejected. This indicates that the NARDL model is free of serial correlation and heteroscedasticity.

Table 7 presents the results of the diagnostic tests. For the NARDL model, the serial correlation is 1.036877 and the probability value is 0.3898. As a result, the null hypothesis is accepted in this analysis and it is concluded that there is no serial correlation in the model. The heteroscedasticity tests show that the F-statistic is 0.646755 and the probability is 0.7110; both values are >0.05% significance level, indicating that the model is homoscedastic.

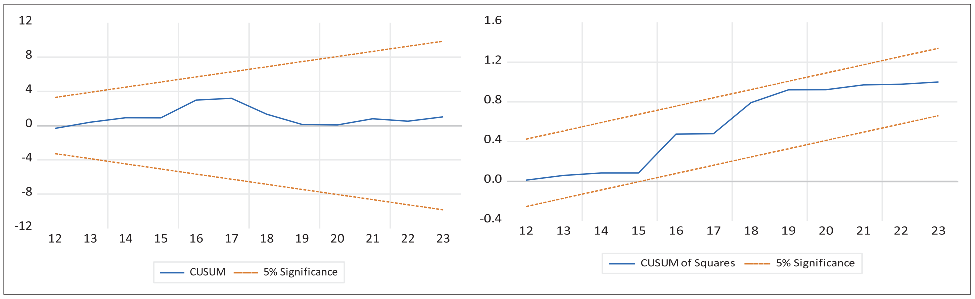
Table 7: Results of NARDL Estimation (2004-2023)

Model 1: Results of NARDL (1,0,0,0,1,0) estimationΔLOG (GVACI)				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Short Run				
LOG (GVACI(-1))*	0.166461	0.110856	1.501598	0.1590
LOG (CO2)**	0.701820*	0.355249	1.975575	0.0717
LOG (REC)**	0.359068***	0.115934	3.097188	0.0092
LOG (ENC)**	−1.342157**	0.561506	−2.390283	0.0341
LOG (RPPC(-1))	−0.069122	0.222894	−0.310113	0.7618
LOG (CROIL_ PR)**	0.106200*	0.055741	1.905243	0.0810
DLOG (RPPC)	0.398279**	0.146192	2.724361	0.0185
Long Run				
LOG (CO2)	−4.216132***	0.918734	−4.589068	0.0006
LOG (REC)	−2.157076*	1.048857	−2.056597	0.0621
LOG (ENC)	8.062908***	2.432279	3.314960	0.0062
LOG (RPPC)	0.415247	1.170317	0.354816	0.7289
LOG (CROIL_PR)	−0.637991	0.624364	−1.021825	0.3270
Diagnostic	F-statistics		P-value	
Serial correlation	1.036877		0.3898	
Heteroskedasticity	0.646755		0.7110	
Jarque-Bera	1.206613		0.5470	

(1) Coefficients are statistically significant at ***1%, **5%, *10% level of significance. (2) Compiled by the authors. Source: Authors' analysis results

The model accepts the null hypothesis of the normality test and concludes that the residuals are normally distributed, as evidenced by the F-statistic of 1.206613 and the probability value is 0.5470, the significance level > 5%. Finally, the diagnostic tests for serial correlation with the Lagrange multiplier, the Jarque-Bera normality test, and the heteroscedasticity test are all successful, indicating the robustness of the NARDL model.

Graph 2: CUSUM and CUSUM squares tests



Source: Author's calculation

4.7. Stability Tests

The CUSUM and CUSUM-squared tests are used to test whether the coefficients of the estimated models remain constant over time, which is an indicator of the stability of the model. The results of the CUSUM and CUSUMSQ robustness tests are presented in Graph 2. At the 5% significance level of the tests, failure to exceed the critical threshold values indicates that the model is robust. This test is also used to study the long-term dynamics of regression.

5. CONCLUSION

The purpose of this research work is to assess the impact of energy consumption sources on creative economy. This was accomplished by using statistical data from 2004 to 2023. For many sectors of the creative economy, statistics are either incomplete or unavailable. On special request, the authors obtained from the National Bureau of Statistics the Total GVA (million tenge) for the creative business, which they then computed themselves. As independent variables carbon dioxide (CO_2) emissions from Power Industry (Energy) (Mt CO2e), Renewable energy consumption (% of total final energy consumption), Electric net consumption (billion kWh), Refined petroleum products consumption (Mb/d) and West Texas Intermediate (WTI or NYMEX) crude oil prices per barrel were taken. A Nonlinear Autoregressive Distributed Lag (NARDL) model was used to conduct calculations and make an assessment.

The model results show that carbon dioxide (CO_2) emissions from the Power Industry and Renewable energy consumption have a positive impact on total GVA for the creative industry in the short run, and a negative impact in the long run. Electric net consumption has a negative impact on total GVA for creative industry in the short run, but a positive impact in the long run. While refined petroleum products consumption and oil price had a positive impact in the short term, neither had a significant impact in the long term. In conclusion, it can be clearly seen that the creative economy and its sectors are dependent on energy consumption. We see that the price of oil and the amount of oil produced in the nation's economy have an impact on the growth of the creative economy. As a result, developments in the oil and gas industry can be indirectly connected to changes in this sector over the last 3-5 years. Short-term prosperity may have long-term or future negative effects as more goods and services are created. Therefore, it is crucial that the creative economy and its sectors aim to have a low influence on climate change and strictly adhere to the objectives of sustainable development.

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