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Article

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Quantile and Threshold Effect of Electricity Consumption on Happiness in Central Asia

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ABSTRACT

The study for the 1st time examines electricity-happiness nexus in Central Asia over the period 1996-2022 employing Panel methods such as Quantile and threshold regressions. The findings document that the association between electricity and happiness is negative in general. However, the results reveal that economic development stage plays a crucial role in the context of electricity-happiness nexus. More specifically the negative effect of electricity on happiness decreases as economic development grows. Policy implications that focus on developing the economies in a sufficient level to achieve stable electricity supply and transition on renewable energy, should be encouraged consequently the rate of happiness will increase in Central Asian region.

Keywords: Happiness, Electricity, Economic Development, Central Asia, Quantile, Threshold
JEL Classifications: C01, C33, Q4, I31

1. INTRODUCTION

Today, energy is one of vital factor in people's daily activities and closely related to many development outcomes, including well-being too. Apergis and Kuziboev (2023) also highlight energy as the dominant factor in the twenty-first century. However, equitable and reliable access to energy, including electricity, remains a major challenge mostly for developing countries in the world (Nasrudin et al., 2022). Especially in Central Asian region, despite the abundance of local energy resources, energy supply is very unevenly distributed between urban and rural areas. Almost half of the total population of Central Asia lives in rural areas and lacks access to modern energy services to meet basic needs (Mehta et al., 2021; Saidmamatov et al., 2023) and this effects on people's happiness without any doubt. A comprehensive empirical study on the happiness-energy access relationship is rare in the context of developing Central Asia countries. The literature on subjective well-being consists variety of variables that can influence happiness or satisfaction, including income (Cheung and Lucas, 2015; Gori-Maia, 2013; Salinas-Jiménez et al., 2011) and household characteristics (Appleton and Song, 2008; Yuan, 2016). Other studies have stated macro-level information as the factors that determine a person's level of life satisfaction, including economic growth and income inequality (Mikucka et al., 2017; Roth et al., 2017). The financial level is probably the main factor in determining happiness or life satisfaction. The Easterlin Paradox, a well-known explanation for the happiness-income paradox, contends that while subjective well-being is influenced by income in the short term (10 years or more), it does not change over the long term (cross-section) (Clark and Shields, 2008; Easterlin et al., 2010).

Globally, increased emissions of greenhouse gases and climate change have put people's subjective well-being (SWB) in danger. Additionally, earlier studies have sought to look into how SWB is affected by environmental quality (Cuñado and Gracia 2013; Song et al., 2020; Ozturk and Acaravci, 2016; Guo et al., 2021). Rehdanz and Madison (2005) found that people's happiness is negatively impacted by weather changes brought on by global warming in 67 different nations. In the samples of 21 countries and Spain, Tiwari (2011) and Cuñado and Gracia (2013) discovered that CO_2 emissions have a negative impact on happiness. According to Schmitt (2013), there is an inverse relationship between happiness in Germany and increases in carbon dioxide, nitrous oxide, and airborne particulate matter. Ahumada and Iturra (2021) and Guo et al. (2021) recently discovered that, in Chile and China, respectively, air pollution has damaged the SWB. According to Song et al. (2020), unhealthy, middle-aged, and elderly Chinese adults' happiness is negatively impacted by poor air quality.

2. LITERATURE REVIEW

2.1. Happiness and Electricity Consumption

So far a number of studies on the impact of energy usage on human happiness have been carried out. It is believed that energy consumption has a positive impact on happiness rate in the study by Afia (2019) who investigated empirically the relationship between the consumption of energy, economic growth and happiness and found out that the use of energy in all countries has a major positive impact on happiness directly and indirectly, resulting in an overall positive effect for the whole country when it comes to happiness. Another term Subjective Well-Being (SWB) is measured with two indicators first one is life satisfaction and another one is happiness and Song et al. (2023) stated that the accessibility of total electric power both in cities and urban areas leads to subjective well-being which improves happiness of people. For the last several years there have been a great number of inventions that make people's lives easier and happier. On the other hand, these type of mechanisms require more electricity consumption. Furthermore, numerous research have confirmed the significance of electricity as one type of energy. Access to electricity allows society to benefit from better lighting and other electronic devices like rice cookers, radios, and televisions that can increase productivity, the caliber of one's work, and other aspects of people's welfare (Khandker et al., 2013; Niu et al., 2013). Additionally, having access to electricity helps people use other contemporary energy sources like clean cooking, which is more cost-effective and efficient than traditional energy. As a result, people would spend less overall on energy and have more money to spend on other things like food, health care, and education (Samad et al., 2010). Nasrudin et al. (2022) studied the energy-happiness paradox hypothesis using the case of a developing nation, Indonesia. An instrumental variable technique was employed to make use of historical information from digital maps of the state of Indonesia's energy infrastructure in 1985 as well as a recently released national-level household survey on life satisfaction and the findings show a positive effect of electricity access on people's happiness.

In the study by Acheampong et al. (2021) this relationship was investigated in energy-poor regions such as South Asia, sub-Saharan Africa and Caribbean American 79 countries for the period 1990-2018 by using the Lewbel two-stage least squares approach to control for endogeneity and found out that access to both electricity and clean energy impacts positively on human development factors such as human capital, life expectancy, maternal mortality, happiness index and plays crucial role for further developing. In 2007 Gross National Happiness Survey announced the happiness index indicator such as education, health, access to electricity, safe water, sanitation and others. Santos (2013) carried out research on reducing the poverty and improving people's life in Butan with the indicators given above. For the robustness study, twelve alternative measures are computed using a range of values for the various parameters. Additionally, bootstrapping estimates produces 95% confidence intervals. The results reveals that people in this area could stop their poverty by improving mainly two factors one is access to roads and the other is electricity. Pfeiffer et al. (2022) used a sample of 48 non-expert individuals to conduct an extensive facial expression analysis and eye-tracking inquiry with the goal of identifying the emotions elicited by various time-scaled power usage graphs at the appliance level. According to the findings, time-scaled power usage graphs at the appliance level can elicit a range of emotions, including happiness, surprise, rage, disdain, disgust, and melancholy. Furthermore, women were more likely than males to express joy while viewing power consumption graphs at the appliance level. Hyun and Ku (2020) investigated the possibility of proactive coping mediating the link between power and both mental illness and happiness. The researchers hypothesized in particular that power, which is connected to goal-oriented inclinations, high-level construals, and positive qualities, triggers the use of proactive coping methods, results in more happiness and less mental illness. Overall, this study illustrates the psychological processes that underlie how power affects happiness and mental illness from a coping viewpoint. Xu and Ge (2022) tested the revolution energy consumption impact on farmer's happiness with empirical analyses in the case of China. The authors studied both direct and indirect effects and the results showed that farmers' happiness has grown by 22.7% thanks to the revolution in rural energy usage, furthermore through the mediating effect of more leisure time, the revolution in rural energy use has marginally raised farmers' happiness; but, the impact of higher use costs on the satisfaction of low-income farmers was virtually significant. The overall consequences were more noticeable to low-income households in the less developed western region when it came to electricity use.

2.2. Happiness and Economic Development

Most economists agree that economic development makes people happier. Such a strategy has received consistent support from empirical research across numerous nations and cultures, which also shows a favorable relationship between well-being and happiness. Hagerty and Veenhoven (2003) analyzed nine countries with low GDP per capita, by grouping countries according to income levels by covering longer time series. The findings indicated that social comparisons between nations have no influence, but they do support a 2-year period of partial adaption to new wealth. Most crucially, rising national income does indeed lead to rising national happiness, but for a given rise in income, the short-term influence on happiness is greater than the long-term effect. While short-term changes in happiness and income are positively correlated, long-term patterns in happiness and income are unrelated. The most obvious example of this contradiction is China, where life satisfaction has remained stagnant despite a fourfold increase in real GDP per capita over the period of two decades from a low starting point (Easterlin, 1974). According to some researchers, GDP has no bearing on the degree of happiness. Contrarily, more recent research seems to support the notion that GDP and happiness are positively correlated. A theme that emerged from nearly all of the studies was that happiness is a diminishing marginal utility of money. While additional finance can increase happiness in countries with extreme poverty, it is hardly noticeable in those with extreme wealth (Rus and Blăjan, 2021). On average, wealthy people are happier than those who are poor, and wealthy nations are happier than poor ones. Nevertheless, rising national prosperity is not necessarily followed by rising national contentment.

In honor of economist Richard Easterlin (2013), who was the first to notice a perplexing phenomenon well-known as Easterlin Paradox. The United States saw a spectacular economic boom between 1946 and 1970. But this did not reveal an increase in happiness during the post-war boom (Kesebir, 2016). Kanaujiya and Maurya (2022) analyzed the relationship between economic development and happiness and believed that if economic growth is not fast it could not be enough to rise up the level of happiness. The cause is that individuals place less importance to happiness and view slower economic growth as unimportant from the standpoint of raising their level of living. The World Bank's World Development Indicators (WDI) database is used in this study to analyze data by using panel data econometrics and parametric testing. The study finds that happiness does increase with development, and countries that have extended periods of rapid economic expansion show this trend. In earlier studies most of researchers concluded that happiness has not improved via his research despite improvements and increases in per capita gross domestic product (Esmail and Shili 2017). Teng Guo and Lingyi Hu (2011) looked into the connection between happiness and several economic factors in the US. Their findings demonstrated that personal well-being may be forecasted and measured. The authors' conclusion which has been supported by numerous earlier studies is that there is an inverse link between happiness, unemployment, and inflation.

While there are numerous measures that attempt to measure happiness, including the Gross National Happiness, the Happiness Index, the Genuine Wealth Index, the Happy Planet Index, the OECD Better Life Index, the Human Development Index, the Well-Being Index, the Social Development Index, and many others, they are not widely accepted due to their subjectivity and inaccuracy. Furthermore, as these metrics depend on a multitude of variables, some of which are not even fully understood, improving these metrics is considerably more challenging than improving GDP, which is dependent on objective, rigorously measurable metrics.

2.3. Happiness and CO_2 Emissions

The previous publications of Easterlin (1974), Scitovsky (1976), and Hirsch (1976) served as the foundation for the empirical study of happiness. But these studies primarily used income as the basic predictor of happiness. However, it soon became clear that happiness and quality of life were largely unaffected by one's level of income and other factors such as socioeconomic condition of the state, environmental quality, healthcare are also included. Currently environmental factors are considered the main ones that have relationship with happiness. Most of them are connected with greenhouse gases such as carbon dioxide emission (CO_2) nitrous oxide (N_2O), methane (CH4). According to Apergis and Majeed (2021) these greenhouse gases including CO_2 effects on people's happiness negatively. They came to this conclusion after examining 95 countries for the period of 25 years. The results also reveals that while economic prosperity is increasing life satisfaction, greenhouse gases are significant drivers of lowering cross-national happiness levels. The results are still reliable when other specifications, extra control variables, and alternative estimating techniques are used. According to numerous researches environmental deterioration poses a severe threat to people's happiness and health (McMichael, 2003). The primary cause of environmental pollution and global warming is the rise in greenhouse gas concentrations. Emissions of carbon dioxide (CO_2) are one of the greenhouse gases that contribute significantly to environmental deterioration. For instance, Mkrtchyan et al. (2018) used Russian household data to link climate variables with happiness, while Lohmann et al. (2019) used data from 515 respondents in a small island society (Bougainville Island) in the Pacific Ocean to explore the relationship between natural hazards and well-being; Rantala and Puhakka (2019) looked at the effects of nature on the wellbeing of children and families in Finland; and Zander et al. (2019) looked at the However, because they only offer case-specific and cross-sectional findings that cannot be broadly generalized, these studies are constrained in their applicability. Year after year happiness through the environment is becoming more difficult because of how much climate change has negatively impacted the environment over time.

3. DATA

To empirically examine the association among happiness, electricity consumption, economic development and CO_2 emissions, a balanced panel dataset including five Central Asian countries, Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan, is created spanning the period 1996-2022 employing annual data. In the study, happiness, measured in index, is used as the explained variable, whereas electricity consumption, measured in per capita in kilowatt-hours (kWh), is applied as the core explanatory variable. Economic development, measured in gross domestic product per capita in USD, and CO_2 emissions, measured in metric tons per capita, are used as control variables. All data are obtained from World Development

Table 1: Definition and sources of the variables

Variable types	Notation	Name	Definition	LOG transformation	Data source
Explained variable	*HAP*	Happiness	Happiness index, (0-10)	*logHAP*	The Global Economy
Core explanatory variable	*EC*	Electricity consumption	Per capita electricity consumption in kilowatt-hours (kWh)	*logEL*	World Development Indicators
Control variables	*PGDP*	Economic development stage	GDP per capita, constant 2015 USD (United States Dollar)	*logPGDP*	
	CO_2	CO_2 emissions	Carbon dioxide emissions, metric tons per capita	$logCO_2$	

Indicators. Table 1 provides the definition and sources of the employed variables.

According to the descriptive statistics of the variables given in Table 2, happiness index (*HAP*) is 4.73 for Central Asian region on average. Each person averagely consumes 2848.93 kWh electricity (*EC*). Gross domestic product (*PGDP*) shares 2716.42 USD per person on average. Each person averagely emits 5.94 metric tons carbon dioxide (CO_2).

4. METHODOLOGY

The baseline model to explore the relationship among happiness (*logHAP*), electricity consumption (*logEC*), economic development (*logPGDP*) and CO_2 emissions ($logCO_2$) can be prescribed as the following (Eq. 1):

$$logHAP_{i,t} = a_0 + a_1\, logEC_{i,t} + a_2\, logPGDP_{i,t} + a_3\, logCO2_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where, a_0 is an intercept; a_1, a_2, a_3 are elasticity coefficients; ε is an error term, i is cross-sections, t is time period.

It should be noted that economic fluctuations such as financial crisis, natural disasters, geopolitical conflicts and etc. sometimes cause heteroskedasticity. In this case, OLS estimator loses the efficiency for the estimation since it takes average values of the variables. To cope with heteroskedasticity, quantile regression model (Koenker and Bassett, 1978) can be used since quantile regression does not require normal distribution of the data.

Panel quantile regression model is shown in equation (2).

$$Q_{logHAP_{i,t}}\left(\tau | x_{i,t}\right) = \beta_0 + \beta_1 EC_{i,t} + \beta_2 PGDP_{i,t} + \beta_3 CO2_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where $Q_{logHAP_{i,t}}\left(\tau | x_{i,t}\right)$ is the quantile distribution of $logHAP_{i,t}$ (explained variable), which is constrained by the position of the explanatory and control variables; τ represents the quantile of each section (i).

We also assume that the effect electricity consumption (*logEC*) on happiness (*logHAP*) varies depending on the level of economic development (*logPGDP*) of Central Asian countries. This assumption leads us to apply a panel threshold regression model (Wang, 2015) to estimate threshold relation of electricity consumption (*logEC*) on happiness (*logHAP*). The panel threshold regression model can be represented by equation (3):

Table 2: Descriptive statistics of the studied variables

	HAP	*EC*	*PGDP*	CO_2
Mean	4.73	2848.93	2716.42	5.94
Standard deviation	1.26	1158.33	3307.80	5.34
Minimum	0.92	1449.86	137.18	0.28
Maximum	6.30	5956.82	13890.63	17.89
Observations	135	135	135	135

Table 3: The results of White's and Breusch-Pagan test for heteroskedasticity

White's test	0.00
Breusch-Pagan test for heteroskedasticity	0.00

For White's and Breusch-Pagan test for heteroskedasticity, we report P-value of Chi-square

$$\begin{aligned} logHAP_{i,t} &= c_0 + c_1 logEC_{i,t} * I\left(logPGDP_{i,t} \le \gamma\right) \\ &+ c_2 logEC_{i,t} * I\left(logPGDP_{i,t} > \gamma\right) + c_3 logPGDP_{i,t} \\ &+ c_4 logCO2_{i,t} + u_i + \varepsilon_{i,t} \end{aligned} \quad (3)$$

Where I() expresses the indicator function. The threshold regression model explores the effect of electricity consumption (*logEC*) on happiness (*logHAP*) with the changes in economic development regimes (*logPGDP*). c_0 is intercept, c_1, c_2, c_3 and c_4 are elasticity coefficients, u_i is the individual effect, $\varepsilon_{i,t}$ is the disturbance.

The crucial consideration to employ panel quantile and threshold regression models is test for heteroskedasticity. To this end, we apply White's test (White, 1980) and Breusch-Pagan test (Breusch and Pagan, 1979) for heteroskedasticity. In order to check if cross-sectional dependence exists or not, we apply perform the cross-sectional independence test proposed by Pesaran (2004). Moreover, as unit root tests, we perform IPS (Im et al., 2003) and the CIPS (Pesaran, 2004) unit-root tests. To identify the long-run relations among the studied variables, Pedroni (2004) and Westerlund (2005) panel cointegration tests are run.

5. EMPIRICAL RESULTS

First of all, we conduct test for heteroskedasticity. The obtained results are given in Table 3. The null hypothesis is that the data is homoscedastic, whereas the alternative hypothesis means the data is heteroskedastic. The null hypothesis is rejected if $P < 0.05$. Due to the results, there is a presence of heteroskedasticity in the data.

Table 4: The results of lag selection criteria

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	−207.6121	NA	0.000662	4.030707	4.131810	4.071676
1	560.7180	1463.486	3.96e-10	−10.29939	−9.793874*	−10.09454
2	597.4501	67.16733	2.67e-10*	−10.69429*	−9.784358	−10.32557*
3	610.6448	23.12220	2.83e-10	−10.64085	−9.326512	−10.10826
4	626.2384	26.13772	2.87e-10	−10.63311	−8.914356	−9.936638
5	632.4950	10.01066	3.49e-10	−10.44752	−8.324356	−9.587175
6	654.8698	34.09483*	3.14e-10	−10.56895	−8.041367	−9.544722

*Represents the criterion selecting the lag order. LR: Sequential modified LR statistic, FPE: Final prediction error, AIC: Akaike information criterion, SIC: Schwarz information criterion, HQ: Hanan-Quinn information criterion

Table 5: Results of cross-section dependence tests and panel unit-root tests

Variables	CD test	IPS test		CIPS test	
		Level	1st difference	Level	1st difference
logHAP	3.88***	−0.32	−2.53***	−1.82	−4.44***
logEC	−2.49**	0.44	−3.49***	−0.0923	−3.56***
logPGDP	15.58***	0.76	−1.97**	−3.28***	−4.45***
logCO$_2$	1.59	1.16	−4.93***	−1.74	−4.29***

*** and ** represent statistical significance at the levels of 1% and 5% respectively. Lag length are selected as 2, based on AIC criterion

As a next step, we perform VAR (vector autoregressive) lag selection criteria. Table 4 shows the optimal lag orders given the criterions, LR, FPE, AIC, SIC, HQ. We choose optimal lag as 2 following AIC (Akaike information criterion).

Table 5 denotes the results of the cross-sectional dependence (CD) and (IPS, CIPS) unit root tests. The null hypothesis of the cross-section dependence (CD) test is no cross-section dependence. The null hypothesis of the (IPS, CIPS) unit root tests are the presence of unit root. The null hypothesis is rejected when P-value is statistically significant at 1% and 5% levels. The obtained results show that there is an existence of cross-sectional dependence for the variables, *logHAP*, *logEC*, *logPGDP* whereas *logCO2* has no cross-sectional dependence. As regards to unit root tests, all variables are integrated at the first differences, I(1).

The incoherence in the cross-sectional dependence test results leads us to apply both Pedroni and Westerlund cointegration tests. Because, the former does not consider cross-sectional dependence while the latter takes cross-sectional dependence into account. The null hypothesis for both cointegration tests is no long-run relationship among the variables. The null hypothesis is rejected when P-value is lower that 0.05 ($P < 0.05$) which is statistically significant.

The results of cointegration tests provided in Table 6 shows that the long-run association exists among the studied variables, *logHAP*, *logEC*, *logPGDP*, *logCO2*. Consequently, we might proceed in model estimations.

According to the estimations run by panel quantile regression model given in Table 7 electricity consumption (*logEC*) negatively impacts on happiness in Central Asia across all quantiles and in POLS method as well. This effect does not correspond to the theoretical relation. As regards with economic development (*logPGDP*) has a positive association with happiness in all quantiles whereas environmental degradation (*logCO2*) has

Table 6: Results of panel cointegration tests

Cointegration tests	Statistic	P-value
Pedroni test		
Modified Phillips-Perron t	2.34	0.00
Westerlund test		
Variance ratio	1.72	0.04

Lag length selection based on AIC criterion with intercept and trend; **$P<0.05$, ***$P<0.01$

positive relation with happiness only in high quantiles (65%, 75%, 85%, 95%) furthermore both of these factors are in positive relationship with happiness in POLS method.

The relation between happiness (*logHAP*), and electricity consumption (*logEC*) is not in line with theoretical background. We assume that the level of electricity consumption (*logEC*) is not sufficient in Central Asia which depends on economic development (*logPGDP*) stage. On this occasion we add additional control variable which is the integration of electricity (*logEC*) and economic development (*logPGDP*) and see how the impact of electricity consumption (*logEC*) on happiness (*logHAP*) changes (Table 8). Due to the results the association between electricity consumption (*logEC*) and happiness (*logHAP*) becomes positive in lower quantiles (5%, 25%, 35%), this happens in POLS method as well. Over assumption which refers the consideration of economic development (*logPGDP*) in electricity (*logEC*) - happiness (*logHAP*) nexus, is validated.

The impact of economic development (*logPGDP*) becomes different more specifically the relation is positive in quantiles (5%, 15%, 25%, 35%, 45%, 55%) whereas it is negative in (75%, 85%, 95%). Regarding CO_2 emissions (*logCO2*) its effect on happiness is positive in high quantiles (75%, 85%, 95%) as the same Table 7.

Given the evidence that economic development (*logPGDP*) stage plays an important role in electricity consumption (*logEC*) - happiness (*logHAP*) nexus we proceed in our estimations with panel threshold regression model.

Table 7: The estimated coefficients by the means of quantile regression

Independent variables	QR										POLS
	Percentile										
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)	Model (11)
	5%	15%	25%	35%	45%	55%	65%	75%	85%	95%	
logEC	−0.82***	−0.51***	−0.35***	−0.27***	−0.25***	−0.29***	−0.37***	−0.38***	−0.43***	−0.14***	−0.38***
logPGDP	0.53***	0.40***	0.23***	0.20***	0.20***	0.15***	0.16***	0.14***	0.11***	0.02*	0.24***
$logCO_2$	−0.04	−0.06	0.04	0.03	0.01	0.03	0.04*	0.07***	0.10***	0.07***	0.05**
Constant	3.78**	2.51*	2.48***	2.16***	2.01***	2.71***	3.34***	3.55***	4.14***	2.64***	2.76***
N	135	135	135	135	135	135	135	135	135	135	135
R_2	0.55	0.47	0.44	0.41	0.37	0.33	0.30	0.27	0.22	0.16	0.58

*, **, *** show significant at 10 %, 5 % and 1 % level respectively

Table 8: The estimated coefficients by the means of quantile regression

Independent variables	QR										POLS
	Percentile										
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)	Model (11)
	5%	15%	25%	35%	45%	55%	65%	75%	85%	95%	
logEC	4.74***	1.80	1.52**	0.90*	0.55	0.75	−0.23	−1.35***	−1.94***	−2.30***	1.56***
logPGDP	5.67***	2.46**	2.11***	1.47***	1.05*	1.27**	0.30	−0.87**	−1.49***	−1.81***	2.23***
$logCO_2$	0.06	−0.06	0.01	0.02	0.03	0.00	0.04	0.09***	0.07***	0.08***	0.05**
logEC logPGDP*	−0.67***	−0.26*	−0.23***	−0.15**	−0.10	−0.13*	−0.01	0.12**	0.19***	0.23***	−0.24***
Constant	−38.75	−15.51	−12.74	−7.50*	−4.35	−5.97	2.22	11.60***	16.44***	19.29***	−12.79***
N	135	135	135	135	135	135	135	135	135	135	135
R_2	0.59	0.52	0.49	0.44	0.40	0.35	0.30	0.29	0.27	0.21	0.64

, * show significant at 10 %, 5 % and 1 % level respectively

Table 9: The results of the threshold effect test for single, double and triple threshold

Threshold	Test 1	Test 2	Test 3
Single	73.28**	73.28**	73.28**
Double		7.90	7.90
Triple			7.93

P-values of F-statistic are reported. **P<0.05

In the estimation of panel threshold regression model we indicate economic development (*logPGDP*) as threshold variable and electricity consumption (*logEC*) as regime-dependent variable.

As a first step of building panel threshold regression model, threshold effect test is run whose results are provided in Table 9. Due to the results it is obvious that panel threshold regression model should be developed considering single threshold point. Since double and triple threshold tests represent none-significant P-values.

In Table 10 we only rely on threshold value Th-1 which corresponds to single threshold regression model (1).

According to model 1 in Table 11 electricity consumption (*logEC*) has negative impact on happiness (*logHAP*) under both regimes 1, 2. However it should be noted that negative impact decreases when economic development (*logPGDP*) grows more than 5.36%. Consequently we cannot ignore the economic development (*logPGDP*) stage in electricity consumption (*logEC*) -happiness (*logHAP*) nexus in Central Asia.

Table 10: The threshold values for the triple threshold model

Model	Threshold	Lower	Upper
Th-1	5.36	5.22	5.45
Th-21	5.36	5.22	5.45
Th-22	7.92	7.75	7.96
Th-3	6.37	6.28	6.39

Table 11: The results of the threshold regression model

Explanatory variable	Coefficient		
	Model 1 (single threshold)	Model 2 (double threshold)	Model 3 (triple threshold)
logPGDP	0.22***	0.27***	0.33***
$logCO_2$	0.03	0.05	0.06
Regime-dependent variable			
logEC			
Threshold regime 1	−0.78***	−0.56***	−0.66***
Threshold regime 2	−0.71***	−0.50***	−0.60***
Threshold regime 3		−0.53***	−0.61***
Threshold regime 4			−0.65***
Constant	5.49***	3.47***	3.93***
R-square	0.58	0.68	0.65
F-statistic	69.58***	60.50***	52.00***

***P<0.01

6. CONCLUSION

In this study, the influence of electricity consumption on the country's happiness index was studied in the case of Central Asian countries. According to the results of the primary calculations with the Panel quantile regression model and the POLS method, electricity consumption has a negative impact on the happiness of Central Asian countries. It can be seen that the economic development factor has a positive correlation with the happiness index in all quantiles, and CO_2 emissions has a positive effect only in the high quantiles.

The relationship between happiness and electricity consumption does not fit the theoretical framework. In our opinion, the reason for this is that the level of electricity consumption in Central Asian countries, which are at the stage of economic development, is insufficient. Evidence of this can be seen in the effect of electricity consumption on happiness by adding an additional control variable, which is the integration of electricity and economic development factors. The results show that the relationship between electricity consumption and happiness is positive at lower quantiles, and this relationship is also observed in the POLS method.

Given the evidence that stage of economic development plays an important role in the electricity consumption and happiness relationship, we estimate with a panel marginal regression model. According to the evaluation results, when the economic development increases by more than 5.36%, the negative impact of electricity consumption on the happiness index decreases.

Research findings reveal that the Central Asian region will benefit greatly from the policy point of view. Policymakers should give priority to increasing the level of happiness of countries, mainly increasing economic development and thereby rising the volume of electricity consumption, because these factors are an important factor in enhancing the level of happiness. Considering that almost half of the total population of Central Asia lives in rural areas, as well as the lack of access to modern energy services to meet their basic needs, the government should encourage the transition to renewable energy sources and pay special attention to attracting foreign investment in the sector.

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