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The Nexus Between Remittances, Natural Resources, Economic Growth, Healthcare and Environmental Sustainability In CIS Countries

Bekhzod Kuziboev[1,2]*, Zoi Zografou[3], Olimjon Saidmamatov[1], Sanat Chupanov[4]

[1]Faculty of Socio-Economic Sciences, Urgench State University, Urgench, 220100, Uzbekistan, [2]University of Tashkent for Applied Sciences, Str. Gavhar 1, Tashkent 100149, Uzbekistan, [3]Faculty of Economics, Department of Applied Economics and Economy, University of South Bohemia, České Budějovice, 370 05, Czech Republic, [4]Non-Government Educational Institution, Mamun University, Khiva, Uzbekistan. *Email: bekhzod.kuziboev@gmail.com

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ABSTRACT

Globally, the issues about sustainable development are on the increase, especially in emerging economies as CIS countries. Due to rising migration and remittances, natural resources are degraded, and economic expansion might pose serious challenges to the environment and healthcare. Thus, this research looks at how life expectancy is affected by economic growth, natural resources and carbon dioxide (CO_2) emissions in 11 CIS countries (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Ukraine, and Uzbekistan) by con-trolling energy consumption from 1990 to 2019. The Dumitrescu - Hurlin causality test discloses a cointegration between life expectancy, remittances, natural resources, economic growth, and CO_2 Emissions. The empirical analysis indicates that life expectancy is positively correlated with remittances and GDP while water withdrawal and CO_2 emissions have negative impact on life expectancy in the case of CIS countries. Our empirical findings may provide insightful policy implications towards strengthening the public healthcare system. Therefore, appropriate policy responses can be developed towards advanced public healthcare and environmentally sustainable sources of energy in order to achieve the sustainable development goals.

Keywords: Life Expectancy, Remittances, GDP, Environmental Sustainability
JEL Classifications: O13, O40, O44, Q56

1. INTRODUCTION

A deeper comprehension of the factors influencing life expectancy in a country is essential for economic growth since a healthy country is a prerequisite for a wealthy country (Rahman et al., 2022a). In 2015, the United Nations Development Programme (UNDP) announced that everyone has access to clean energy, fighting pollution, and promoting economic growth, urbanization, and good governance (Goal-3, Goal-7, Goal-8, Goal-11, and Goal-16) to ensure good health, well-being, and longevity by 2030 (The United Nations, 2015). Carbon emissions continue to be the main cause of the decline in environmental sustainability. Over the past 130 years, carbon dioxide (CO_2) emissions have increased by about 45% (Carbon Footprint, 2018). Because of the detrimental effects of weather change and catastrophic climatic events, particularly in the Aral Sea basin (Saidmamatov et al., 2021; Apergis and Kuziboev, 2023) that continue to threaten the entire world, climate change has therefore emerged as one of the most important and urgent issues of the twenty-first century (Danish et al., 2017; Saidmamatov et al., 2023).

Furthermore, the globe has yet to achieve economic development that guarantees ecological resource usage and waste (Ali et al., 2022). Nevertheless, there hasn't been a published study that empirically examines the nonlinear relationships between water consumption, remittances, economic growth, and life expectancy in CIS countries. The current study examines how life expectancy (LE) is influenced by remittances (RE), CO_2 emissions (CO_2), GDP per capita (PGDP) and water usage (WATER) in 11 CIS countries (that includes Aral Sea basin as well) for the period 1995 to 2022.

This research intends to fill this gap by using Dumitrescu-Hurlin causality test considering the critical role of healthcare, natural resources, economic growth in CIS region. Remittances are becoming a vital component of the global economy as they are a major source of income for many low- and middle-income countries. Foreign direct investment and government development funds have been eclipsed by remittances (Brown et al., 2020). Rising CO_2 emissions are caused by increased use of natural resources brought by industrialization and economic progress (Dauda et al., 2019).

2. LITERATURE REVIEW

2.1. Life Expectancy - Remittance

Remittances are essential to well-being as it increase chances for a higher standard of living, lessen child labour, facilitate knowledge transfer, and provide information about newborn health care (Shafiq and Gillani, 2018). Zhunio et al.. (2012) use a sample of 69 low- and middle-income countries to study the impact of international remittances on aggregate health and educational out-comes. They find that remittances are crucial for raising life expectancy, lowering infant mortality, and improving primary and secondary school attainment.

Amega and Tajani (2018) used 5-year interval data on 46 Sub-Saharan African (SSA) countries from 1975 to 2014 to examine the impact of remittances on health and education outcomes. Remittances were found to dramatically improve SSA's health and educational outcomes using system GMM. Additionally, it has been shown that raising health-related standards of education has a positive effect on health and vice versa. Shafiq and Gillani (2018) uses a panel dataset covering 132 countries from 1980 to 2015 to examine the effect of remittances on child health. The findings demonstrate how remittances play a part in fostering children's health. According to the study, increasing remittances could be a useful policy intervention to enhance the health of children. Ajayi et al.. (2009) use a set of cross-country data gathered from 38 countries to investigate the effect of foreign remittances on well-being in sub-Saharan Africa. The outcome suggests that sub-Saharan Africa's well-being has improved somewhat as a result of foreign remittances.

2.2. Life Expectancy - Water Withdrawal

Numerous natural and socioeconomic factors can have an impact on life expectancy (Shafiq and Gillani, 2018). After examining a sample of the world's 31 most polluted nations, Rahman and Alam (2022b) discovered that environmental degradation eventually poses a threat to human longevity. In the sample countries, health spending, access to clean water, and better sanitation all have a positive impact on life expectancy, but environmental degradation is found to be a threat. In the case of 148 countries, Kim and Kim (2016) discovered a positive correlation between socioeconomic indicators (such as water) and healthy life expectancy.

2.3. Life Expectancy - GDP

Life expectancy is widely used as an indicator of human development and the relationship between population health and economic growth has long been debated (Patterson, 2023). Population health status has representative character for the reputation of the country (Rayhan et al., 2019). Better life expectancy is primarily determined by economic growth (Shahbaz et al., 2019). People's purchasing power is rising as a result of rising per capita income. Especially, population of CIS countries mostly rely on remittances sent by migrants working in the countries with advanced economies (Abdurazakova, 2013).

Due to its growing effects on long-term economic growth, the importance of health has been extensively documented in the literature on development economics (Shi et al., 2022). Rahman and Alam (2022b) find that while environmental pollution has a negative impact on life expectancy, economic growth and sound governance have positive effects. Evidence from (Guzel et al., 2021) demonstrates that in 16 low-developing nations, life expectancy is positively correlated with in-come per capita.

2.4. Life Expectancy - CO_2 Emission

Global climate change is a result of environmental degradation, which has an impact on many people's health (Majeed and Ozturk, 2020). According to (Rahman and Alam, 2022 b), there is a lack of research on environmental degradation, despite it being a critical factor in determining life expectancy. According to (Nejat, 2015), carbon dioxide (CO_2) emissions are thought to be responsible for approximately 75% of greenhouse gas (GHG) emissions worldwide, and it is thought to be the main gas driving climate change. Studies on the subject indicate that one of the most important variables influencing human health is environmental degradation, or CO_2 emissions (Hill et al., 2019; Mohmmed et al., 2019). Environmental degradation significantly reduces life expectancy in Bangladesh over the long and short terms, according to Hossain's (2020) research.

Possibly the first study to look at how carbon dioxide (CO_2) emissions affected life expectancy for 68 low- and middle-income countries between 1990 and 2017 was (Mahalik et al., 2022). For all of the emerging countries in the sample, the results corroborate the data showing a negative correlation between life expectancy and CO_2 emissions. Crucially, income growth in isolation cannot guarantee a healthier lifestyle for the populace or address environmental degradation. The drivers of carbon dioxide (CO_2) emissions (million metric tonnes) in the top 10 emitting countries are examined by Mohmmed et al.. (2019). As the results demonstrate, population and income—particularly in China and the US—have a substantial impact on changes in CO_2 emissions (Ebenstein et al., 2015; Baloch et al., 2019).

3. DATA

To empirically investigate the association among life expectancy, economic development, environmental degradation, remittances

Table 1: Definition and sources of the variables World Development Indicator, 2020

Variable types	Notation	Name	Definition	LOG transformation
Explained variable	*LE*	Life expectancy	Total life years	*logLE*
Explanatory variables	*PGDP*	Economic development stage	GDP per capita, constant 2015 US$	*logPGDP*
	CO_2	CO_2 emissions	CO_2 emissions (kt)	$logCO_2$
	REM	Remittances	Remittances, received in current USD	*logREM*
	WATER	Water usage	Water, total in billion cubic meters	*logWATER*

LE: Life expectancy, PGDP: Economic development, REM: Regarding remittances

and water usage, a balanced panel dataset including 11 CIS (Commonwealth of Independent States) countries, is built for the period 1995-2021 employing annual data. In the study, life expectancy, measured in total life years, is used as the explained variable, while economic development, measured in gross domestic product per capita in USD, CO_2 emissions, measured in kt (kiloton), remittances, measured in USD, water usage, measured in billion cubic meters are applied as the explanatory variables. The data of CO_2 emissions, gross domestic product per capita, fossil fuel and renewable energy consumption are obtained from World Development Indicators whereas the data of women governance is downloaded from United Nations Development Programme. Table 1 provides the definition and sources of the studied variables.

Table 2 reports the descriptive statistics for the variables. We observe that, average life years (*LE*) are 69.11 during the period 1995-2021 in CIS. Per capita GDP (*PGDP*) is on average equal to 3132.226 USD. Averagely 208731.0 kt CO_2 emissions (CO_2) are released. Regarding remittances (*REM*), on average 1990000000 USD is received in CIS countries. Total water usage (*WATER*) is 17.82 billion cubic meters in CIS countries during the period covered. The standard deviations of *PGDP*, CO_2 and *REM* are large implying that both of them are more spread out from the mean. Standard deviations of the *LE* and *WATER* are relatively small. The Jarque - Bera normality test indicates that all variables are not normally distributed

4. METHODOLOGY

The baseline model to explore the relationship among life expectancy (*LE*), economic development (*PGDP*), environmental degradation (CO_2), remittances (*REM*) and water usage (*WATER*) can be described as the following (Eq. 1):

$$logLE_{i,t} = a_0 + a_1 logPGDP_{i,t} + a_2 logCO2_{i,t} + a_3 logREM_{i,t} + a_4 WATER_{i,t} + \varepsilon_{i,t} \quad (1)$$

where, a_0 is an intercept; a_1, a_2, a_3, a_4 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.

Table 2: Descriptive statistics of the studied variables

	LE	PGDP	CO_2	REM	WATER
Mean	69.11929	3132.226	208731.0	1.99E+09	17.82635
SD	2.891446	3235.886	451512.6	2.87E+09	21.21049
Minimum	59.12900	137.1819	2133.810	1020000	0.837000
Maximum	75.43900	15974.62	1703589	1.81E+10	75.90000
Jarque-Bera (P)	0.002168	0.000000	0.000000	0.000000	0.000000
Observations	297	297	297	297	297

SD: Standard deviation, LE: Life expectancy, PGDP: Economic development, REM: Regarding remittances

Table 3: The results of Breusch-Pagan life expectancy test for heteroskedasticity

Type of the test	p-value
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

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

$$Q_{logCO2_{i,t}}\left(\tau|x_{i,t}\right) = \beta_0 + \beta_1 logPGDP_{i,t} + \beta_2 logCO2_{i,t} + \beta_3 logREM_{i,t} + \beta_4 logWATER_{i,t} + \varepsilon_{i,t} \quad (2)$$

where $Q_{logHAP_{i,t}}\left(\tau|x_{i,t}\right)$ is the quantile distribution of $\log CO_{2i,t}$ (explained variable), which is constrained by the position of the explanatory and control variables; τ represents the quantile of each section (i).

5. DISCUSSION AND EMPIRICAL FINDINGS

Testing for heteroskedasticity is a crucial step in applying the panel quantile regression model. In order to achieve this, we utilise the heteroskedasticity tests for Breusch and Pagan (1979) and White (1980). We use cross-sectional dependence test Pesaran (2004) to determine whether or not cross-sectional dependence exists. We also conduct the CIPS (Pesaran, 2004) and IPS unit-root tests (Im et al., 2003) as background checks. Pedroni (2004) and Westerlund (2005) panel cointegration tests are used to look at the long-term relationships between the variables. The Granger causality test is the final step we take to investigate the causal relationship between the explanatory variables and the explained variable.

First of all, we run test for heteroskedasticity. The estimated results are given in Table 3. The data is heteroskedastic, according to the alternative hypothesis, while the null hypothesis states that the

Table 4: The results of lag selection criteria

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	−887.4531	NA	0.001561	7.726867	7.801378	7.756920
1	1415.553	4486.376	4.24e−12*	−11.99613*	−11.54907*	−11.81581*
2	1439.640	45.87894	4.28e−12	−11.98822	−11.16860	−11.65764
3	1453.829	26.41266	4.70e−12	−11.89462	−10.70244	−11.41377
4	1482.130	51.45634*	4.58e−12	−11.92320	−10.35847	−11.29209
5	1500.242	32.14754	4.87e−12	−11.86357	−9.926278	−11.08219
6	1518.515	31.64056	5.18e−12	−11.80532	−9.495474	−10.87368

*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, NA: Not available

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
logLE	34.82***	−1.52	−3.86***	−2.03	−4.28***
logPGDP	36.61***	−0.88	−3.45***	−2.93***	−4.22***
logCO_2	7.60***	−1.47	−5.12***	−2.75***	−5.01***
logREM	32.80***	−2.41***	−8.20***	−3.36***	−5.22***
logWATER	10.18***	−1.93	−5.03***	−2.32**	−4.43***

***and **represent statistical significance at the levels of 1% and 5% respectively. The null hypothesis of the cross-section dependence test is no cross-section dependence. Lag length are selected as 1, based on SIC criterion. CD: Cross-sectional dependence, LE: Life expectancy, PGDP: Economic development, REM: Regarding remittances

Table 6: Results of panel co-integration tests

Type of the test	Statistic	*P*
Pedroni test		
Modified Phillips-Perron t	3.13	0.00
Phillips-Perron t	2.32	0.01
Augmented Dickey-Fuller t	2.00	0.02
Westerlund test		
Variance ratio	−2.88	0.00

**P<0.05, ***P<0.01. Lag length selection based on SIC criterion with intercept

data is homoskedastic. A P-value of less than 0.05 indicates the rejection of the null hypothesis. The data are heteroskedastic due to the findings.

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 1 following SIC (Schwarz 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 all employed variables, *logLE*, *logPGDP*, *log*CO_2, *logREM*, *logWATER*. As regards to unit root tests, all variables are integrated at the first differences, I(1), due to IPS and CIPS unit root tests.

Given the evidence that all studied variables are integrated at the first differences, we proceed in panel cointegration tests. To this end, we consider Pedroni and Westerlund cointegration tests. The null hypothesis for both 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 show that there is a long-run relation among the employed variables, *logLE*, *logPGDP*, *log*CO_2, *logREM*, and *logWATER*. Consequently, we might proceed in model estimations.

According to the estimated results provided in Table 7, economic development (*logPGDP*) positively impacts on life expectancy (*logLE*) in all quantiles and POLS method as well, validating theoretical linkage. CO_2 emissions (*log*CO_2) has a negative association on life expectancy (*logLE*) in POLS method and all quantiles except 5% quantile. CO_2 emissions (*log*CO_2) can be also postulated as the theoretical linkage. Regarding remittances (*logREM*), it has positive relationship with life expectancy (*logLE*) in quantiles, 15%, 25%, 35%, 45%, 55%, 65%, 75% and 85% and POLS method which is also relevant with theoretical linkage. The only variable not validated with theoretical linkage is water (*logWATER*). It has a negative impact on life expectancy (*logLE*) in quantiles, 15%, 25%, 35% and 45% and POLS method as well.

In order to cope with endogeneity issue, we apply 2SLS method. From theoretical point of view, impact of CO_2 emissions on life expectancy is instrumented by economic development (Hossain et al., 2020), postulating CO_2 emissions depend on economic development stage (Pu et al., 2022). Moreover, Central Asian countries' economic development stage relies on water resources (World Health Organization, 2020) which means impact of economic development on life expectancy is instrumented by water variable (Kuziboev et al., 2023). Furthermore, remittances play a crucial role in the economic development, meaning effect of economic development on life expectancy is instrumented by remittances (Alam et al., 2016).

Table 8 provides the estimations run by 2SLS method to cope with endogeneity issues (Koenker and Bassett, 1978; Wang, 2015). According to the results, all instruments are appropriate in all models (1, 2, 3) since the impact of instruments are statistically

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

Dependent variable	1	2	3	4	5	6	7	8	9	10	POLS
logLE	5%	15%	25%	35%	45%	55%	65%	75%	85%	95%	
logPGDP	0.024***	0.021***	0.023***	0.022***	0.019***	0.021***	0.022***	0.023***	0.028***	0.028***	0.024***
logCO2	−0.000	−0.007***	−0.007***	0.006***	−0.006***	−0.007***	−0.008***	−0.010***	−0.008***	−0.008***	−0.007***
logREM	0.006	0.007***	0.007***	0.009***	0.010***	0.008***	0.007***	0.005***	0.003**	0.001	0.006***
logWATER	−0.012	−0.004***	−0.004**	−0.006**	−0.008***	−0.005*	−0.003	−0.000	−0.001	−0.001	−0.004***
Constant	3.913***	3.971***	3.972***	3.954***	3.963***	3.990***	4.023***	4.065***	4.085***	4.122***	4.004***
n	297	297	297	297	297	297	297	297	297	297	297

***, ** and * represent the significance at the 1%, 5% and 10% level respectively

Table 8: The results obtained by 2SLS method

Independent variables	Dependent variable *LogLE*					
	Model 1		Model 2		Model 3	
	LogCO$_2$ Instrumented by *logPGDP*		*logPGDP* Instrumented by *logWATER*		*logPGDP* Instrumented by *logREM*	
	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage
logPGDP	0.98***			0.03***		0.03***
logCO$_2$		0.01***	0.43***	−0.01***	0.43***	−0.01***
logREM	−0.13***	0.01***	0.21***	0.00***	0.21***	0.00***
logWATER	0.93***	−0.02***	−0.40***		−0.40***	
Constant	3.86***	3.90***	−0.56	4.01***	−0.56	4.01***
Wald test F	217.06***		97.56***		107.54***	

***and ** represent the significance at the 1% and 5% level respectively

Table 9: Granger causality tests

Null hypothesis	Level	First difference
logPGDP does not homogeneously cause logLE	3.38***	0.71
logLE does not homogeneously cause logPGDP	2.35**	0.93
logCO$_2$ does not homogeneously cause logLE	3.62***	1.25
logLE does not homogeneously cause logCO$_2$	4.79***	0.44
logREM does not homogeneously cause logLE	2.70***	1.22
logLE does not homogeneously cause logREM	10.30***	0.76
logWATER does not homogeneously cause logLE	1.04	1.96
logLE does not homogeneously cause logWATER	2.75***	0.57
logCO$_2$ does not homogeneously cause logPGDP	1.69	0.79
logPGGP does not homogeneously cause logCO$_2$	7.51***	1.04
logREM does not homogeneously cause logPGDP	6.40***	1.09
logPGDP does not homogeneously cause logREM	9.32***	1.65
logWATER does not homogeneously cause logPGCP	3.94***	1.02
logPGDP does not homogeneously cause logWATER	4.15***	0.47
logREM does not homogeneously cause logCO$_2$	7.14***	2.51
logCO$_2$ does not homogeneously cause logREM	2.29**	1.25
logWATER does not homogeneously cause logCO$_2$	3.80***	1.05
logCO$_2$ does not homogeneously cause logWATER	3.35***	1.04
logWATER does not homogeneously cause logREM	6.31***	2.17
logREM does not homogeneously cause logWATEr	3.69***	0.80

***and ** for 1% and 5% levels, respectively. Optimal lag has been selected as 1 using SIC. The table reports the P-values for the Granger causality test. Asterisks represent statistical significance

significant in the first stage estimations. Model 1 denotes the impact of CO_2 emissions instrumented by economic development, and the relation between CO_2 emissions and life expectancy is positive contrary to the theoretical association. In Model 2 economic development positively impacts on life expectancy when it is instrumented by water, validating theoretical relationship. There is also a positive association between economic development and life expectancy when economic development is instrumented by remittances which also follows theoretical relation.

Using the Granger causality test, we move forward with our estimation by determining the causal relationship between the variables in our panel. We perform the test on the first differences as well as the series in levels (Table 9). When focusing on the causality among the series in levels, we observe that economic development (*logPGDP*) has a unidirectional causal effect on life expectancy (*logLE*). Moreover, life expectancy (*logLE*) has a unidirectional causal relation with both CO_2 emissions (*logCO*$_2$) and remittances (*logREM*), but, not with *logWATER*. There is only causality from life expectancy (*logLE*) to *logWATER*. All variables except *logWATER* have a causal effect on life expectancy (*logLE*).

When concentrating on the initial differences, the results are significantly different (Alam et al., 2016). We actually observe that there are no causal relationships at all. Overall, the causality analysis demonstrates evidence of significantly stronger level links. The absence of causality from water (*logWATER*) to life expectancy (*logLE*) corresponds to the model estimation (Table 8) that water is not in a sufficient level in order to impact on life expectancy.

6. CONCLUSION AND POLICY RECOMMENDATIONS

The conducted estimations revealed that economic development positively impacts on life expectancy in the CIS countries. Indeed,

CO_2 emissions has a negative association on life expectancy meaning that extra generated carbon emissions decrease life longevity in Post-Soviet countries. From theoretical point of view, impact of CO_2 emissions on life expectancy is instrumented by economic development, postulating CO_2 emissions depend on economic development stage. Regarding remittances, it has positive relationship with life expectancy. Remittances play a crucial role in the economic development, meaning effect of economic development on life expectancy is instrumented by remittances. Revenue coming from migrants earnings is somehow spent for medical and healthcare purposes. The only variable not validated with theoretical linkage is water which has a negative impact on life expectancy. It can be related with the fact that irrigation and agriculture is dominant in these selected countries. Moreover, Central Asian countries` economic development stage relies on water resources which means impact of economic development on life expectancy is instrumented by water variable.

It is important to acknowledge the notable limitations of this study. These shortcomings provide opportunities for further studies. To begin, this paper utilized secondary data that was previously collected. Therefore, further research can concentrate on primary data. Second, data for Turkmenistan was not available for selected variables and authors had to exclude it from the geographic coverage of the research.

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