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THE NEXUS BETWEEN URBANIZATION, ECONOMIC DEVELOPMENT, CORRUPTION AND ECOLOGICAL FOOTPRINTS IN COMMONWEALTH OF INDEPENDENT STATES COUNTRIES

Abstract:

Developing countries have achieved significant economic growth over the past few decades. Economic growth contributes to the development of infrastructure facilities, reducing poverty and improving the standard of living of the population. To achieve rapid economic growth, developing economies sacrifice their reserves of natural resources, which leads to serious environmental degradation. The same economic structure, trade ties, similarity in the mindsets of population, common economic environment and history bound the current Commonwealth of Independent States (CIS) countries. In this perspective we assume possible similarities in terms of ecology and ecological footprints within the CIS countries. Therefore, this study investigates the impact of economic growth, natural resources, urbanization, foreign direct investments, trade, corruption on the ecological footprint of the CIS countries in the time frame spanning from 1996 to 2018. For empirical analysis we follow the log-linear form of the Stochastic Impacts by Regression on Population, Affluence and Technology (STIRPAT) model. STIRPAT is a coordinated research program dedicated to understanding the dynamic relationships between human systems and the ecosystems on which they depend aimed to identify the major drivers of environmental harm and to reveal the levers to reduce that harm (Dietz & Rosa, 1994; York et al., 2003). Results of Pesaran's CD test and Bias-corrected LM test evidence the cross-sectional dependence across countries. The unit root test show stationary of variables at 1st difference. Besides, testing for slope heterogeneity allows us to reject the null hypothesis and conclude that slope coefficients are heterogeneity. Additionally, our study explores the effects on ecological footprint in CIS counties by using the pooled mean group (PMG) estimator. We also report estimates applying the mean-group (MG) estimator and dynamic fixed-effects (DFE) estimator for comparison and robustness purpose. The empirical evidence from PMG estimations shows positive and significant influence of economic growth, urbanization, natural resources rent and foreign direct investments on the ecological footprint in the group of CIS countries. Our findings demonstrate the negative impact of these factors on environmental quality. Finally, the CIS countries' governments should collaborate to reduce the excessive use of natural resources and promote institutional development favorable for the environment.

Keywords:

Urbanization, Economic development, Corruption, Ecological footprints, Commonwealth of Independent States, STIRPAT model, Pooled mean group (PMG) estimator

JEL Classification: Q01, Q59, O10

1. Introduction

The ecological footprint has increased by almost 190 percent over the past 50 years. This suggests that there is a certain imbalance in the relationship between people and the environment in which they live (Ahmad et al., 2020). The ecological footprint is the effect of human activity, measured in terms of the area of biologically productive land and water needed to produce consumed goods and disposal of waste generated. It measures the demand and supply of natural resources. The demand side of the ecological footprint quantifies the biological resources that a given populace needs to yield the assets it expends and to ingest its waste, particularly carbon emissions (Kongbuamai et al., 2021).

It is worth noting that more than 80 percent of the world's population lives in environmentally disadvantaged countries. Thus, humanity consumes much more resources than the planet can recover. Over the past few decades, developing countries have achieved significant economic growth. They currently contribute to 40% of global GDP and make up 59% of the world's population (Ahmad et al., 2020). Economic growth contributes to the development of infrastructure facilities, reducing poverty and improving the standard of living of the population. However, the development processes entail some negative consequences. Basically, this happens when countries overlook the environmental issues while trying to achieve economic success. In order to achieve rapid economic growth, developing economies sacrifice their reserves of natural resources, which leads to serious environmental degradation. In fact, developing countries have significant natural resources, such as coal, gas, wood and minerals. For example, the territory of the former USSR countries has the highest share of natural resources in the world. It covers most of the world's reserves of wood, charcoal, gold, as well as the world's second largest deposit of natural minerals.

The current ecological relationship between the former USSR countries is interesting, since for many years of the 20th century these states had the same economic structure and a common history. The current CIS countries are united by their past experience and established economic and trade ties. Given the similarity in the mindsets of the population and the common economic environment of these states, there is an assumption about possible similarities in terms of ecology and ecological footprints, which also affect the economies of countries in the same way.

The purpose of this study is to analyze the relationship between economic development, technologies, urbanization and environmental degradation of the developing CIS countries as Azerbaijan, Armenia, Belarus, Kazakhstan, Kyrgyzstan, Moldavia, Russian Federation, Tajikistan, Turkmenistan, Uzbekistan. The objective is to evaluate empirically the impact of economic development on the ecological footprint of CIS countries. The results of this study demonstrate that economic growth, natural resources rent, foreign direct investments and corruption perception increase the ecological footprint in CIS countries, while growth of urban population, trade and Environmental policy affect negatively.

For the rest of the paper, Section 2 summarizes the related literature. Section 3 describes the data, model specification and methodology. Section 4 provides empirical results discussion. Finally, Section 5 concludes the study.

2. Literature review

Environmental degradation has recently been a key aspect of many research studies. A few recent studies have focused on measuring the relationship between the ecological footprint and other environmental, economic, and social factors. We identify four aspects of the literature aimed at examining the connections between the ecological footprint, urbanization, economic growth, natural resources, trade, investment, innovation and income inequality.

2.1 Nexus of urbanization, economic growth, value-adding manufacturing and ecological footprint

A pool of recent studies has focused on analyzing the linkage between urbanization, economic growth and ecological footprint. For instance, Kassouri (2021) explores the threats of urbanization on water, land and overall ecosystems across 28 sub-Saharan African countries. Empirical results show that built-up land and marine resources are mostly affected by urban expansion. Evidence of Yang et al. (2021) displays that economic growth and industrial value-added are responsible for increasing EFP, while globalization and urbanization have a reducing effect on it. Ahmad et al. (2021) based on the example of G7 countries extend the previous finding by using eco-innovation and financial globalization in their analysis. They found the opposite and positive effect of urbanization on EFP, along with negative effect of eco-innovation on EFP. GDP and urbanization are also seen as reducing factors of ecological footprint in Bangladesh (Gupta et al., 2022). Khan et al (20210) demonstrate the increase of EFP due to value-adding manufacturing.

2.2 Nexus of natural resources, energy consumption, trade, urbanization, economic growth and ecological footprint

Many studies extend evidence presented in the previous sub-section by including natural resources and trade in the analysis. For example, Ahmed et al. (2020) and Ahmad et al. (2020) demonstrates an increase of EFP due to urbanization and natural resources rent in China and 22 countries with emerging economies. Findings of Khan et al. (2021) partially confirm results of Ahmed et al. (2020) and extend them by positive effect of trade, while natural resources rent in top 10 manufacturing countries promote the reduction of economic degradation. However, Danish et al. (2020) provide evidence of decreasing EFP due to positive contribution of natural resources rent and urbanization. Gupta et al. (2022) shows that natural resources rent improves environmental quality in Bangladesh. Besides, some studies also consider energy consumption, renewable and non-renewable sources of energy. Energy consumption and urbanization increase EFP in G7 countries, according to Ahmed et al. (2020). Ali et al. (2021) reveal increasing EFP caused by trade and GDP. Nathaniel et al. (2020) and Salman et al. (2022) also found a positive effect of non-renewable energy on EFP in addition to the results of Ali et al. (2021). Renewable energy appears to be a source of reducing EFP in a global scale (Li et al., 2020; Ali et al., 2021; Danish et al., 2020; Salman et al., 2022).

2.3 Nexus of income and ecological footprint

Several studies emphasize the investigation of inequalities in income distribution and ecological footprints. Alvarado et al. (2021) by using a QR approach find that the level of inequality in 17 Latin American countries increases EFP at the lower quantiles, while at the middle and upper quantiles it decreases the same. Inequality is also seen to be a decreasing factor of reducing EFP in African countries (Ekeocha, 2021).

2.4 Nexus of investment, innovation economic growth and ecological footprint

Part of the research also focuses on the relationship between innovation, investment and ecological footprint. For instance, technological innovations abate EFP (Ahmad et al., 2020; Gupta et al., 2022). Empirical evidence of Salman et al. (2022) provides evidence of the reducing impact of indigenous and foreign investments on EFP in developed countries. In ASEAN countries indigenous and foreign investments do not increase EFP (Salman et al., 2022). Ahmed at al. (2020) also confirm that foreign direct investments help to reduce the ecological footprint.

The results of this literature review show the diversity of the existing literature concentrated around the study of ecological footprint factors in countries around the world. Nevertheless, we found a lack of research devoted to ecological footprints in the CIS countries. Hence, our emphasis is on the study of the relationship between economic development, natural resource consumption, urbanization and environmental degradation in CIS countries.

3. Data and methods

3.1 Model specification

Our study applies the Stochastic Impacts by Regression on Population, Affluence and Technology (STIRPAT) model, that has also been employed by Nathaniel & Khan (2020), Yang et al. (2021), Kassouri (2021), Salman et al. (2021), Salman et al. (2022). A key foundation of this model is the IPAT model, proposed by Ehrlich & Holden (1970), which reflects three main factors affecting environmental quality. Hence, environmental impact (I) is related to population (P), affluence (A) and technology (T):

$$I = P \times A \times T \tag{1}$$

The STIRPAT model expands the IPAT model by considering that the determinants can change non-proportionally and non-monotonically. STIRPAT is a coordinated research program dedicated to understanding the dynamic relationships between human systems and the ecosystems on which they depend. The main goal is to identify the major drivers of environmental harm and to reveal the levers to reduce that harm (Dietz & Rosa, 1994; York et al., 2003).

$$I_t = \lambda_0 P_{it}^{\beta 1} A_{it}^{\beta 2} T_{it}^{\beta 3} \mu_{it} \tag{2}$$

where I_t – an indicator of environmental degradation, P, A and T are the population, affluence and technology, respectively. i and t denotes a country and time dimensions. β and μ are parameter coefficients and error term, respectively. In our study I refers to ecological footprint, P denotes demographic effect (urban population growth), A represents economic factors (GDP growth) and T refers to technological effect (trade), following the study by Nathaniel & Khan (2020). Based on review of literature, we propose some modifications of the STIRPAT model by inclusion of the following variables: corruption, foreign direct investment and natural resources rent (according to Nathaniel & Khan, 2020; Ahmad et al., 2020; Salman et al. 2022). Thus, the expanded model is specified as:

$$EFP_{it} = \beta_0\, GDP_{it}^{\beta 1} URBG_{it}^{\beta 2} TRD_{it}^{\beta 3} FDI_{it}^{\beta 4} CORR_{it}^{\beta 5} NR_{it}^{\beta 6} CORR \times EPI_{it}^{\beta 7} \varepsilon_{it} \tag{3}$$

For empirical analysis we follow the log-linear form of the STIRPAT model, employed by previous studies (Yang et al., 2021; Kassouri, 2021; Salman et al., 2022). Thus, taking the natural logarithm of Eq. (3), the non-linearized model is outlined as follows:

$$\begin{aligned} lnEFP_{it} = \beta_0 &+ \beta_1\, lnGDP_{it} + \beta_2\, URBG_{it} \\ &+ \beta_3\, TRD_{it} + \beta_4\, FDI_{it} + \beta_5\, CORR_{it} + \beta_6\, NR_{it} + \beta_7\, CORR \times EPI_{it} + \varepsilon_{it} \end{aligned} \tag{4}$$

where β_0 and ε_{it} are constant and error term, respectively. β_1 to β_7 represent the coefficients of independent variables.

3.2 Data description

The present study examines the dynamic linkage between the ecological footprint, natural resources, economic growth, energy, trade, urban population growth and corruption in 10 emerging economics, in the time frame spanning from 1996 to 2018. The study considered yearly data for ten CIS countries. The selection of the study duration is based purely on the availability of the relevant data needed to carry out the analysis and represents a time period sufficient for reliability of the applied econometric method. The variables utilized in the study are defined in Table 1.

Table 1: Variables

Variables	Symbol	Measure	Source
Ecological footprint	EFP	Ecological footprint index	Global Footprint Network[1]
Economic growth	GDP	GDP per capita (current US$)	Data Bank. The World Bank
Natural resources	NR	Total natural resources rents (% of GDP)	Data Bank. The World Bank
Foreign direct investments	FDI	Foreign direct investment, net inflows (% of GDP)	Data Bank. The World Bank
Trade	TRD	Trade (% of GDP)	Data Bank. The World Bank
Corruption	CORR	Corruption Perceptions Index	Corruption Perceptions Index[2]
Urban population growth	URBG	Urban population growth (annual %)	Data Bank. The World Bank
Environmental policy	EPI	Environmental Performance Index	23 degrees[3]

Source: Author's compilation

The total Ecological footprint of each country consists of six different types of footprints: Built-up Land; Carbon Footprint; Cropland; Grazing Land; Forest Land; Fishing Ground. We also apply the Corruption Perceptions Index (CPI), reflecting the degree of the population's perception of corruption in the country. The CPI ranks 180 countries and territories around the world by their perceived levels of public sector corruption. A scale of 0-100 is applied where 0 equals the highest level, and 100 equals the lowest level of perceived corruption.

The Environmental Performance Index (EPI) was created to measure the environmental performance of a state's policies and to evaluate the environmental sustainability relative to other countries' paths. We employ environmental policy as a binary variable, where 1 is assigned to a countries whose level of environmental policy is higher or equal to the average of the sample of CIS countries, and 0 is assigned to countries with a low level of environmental policy.

Therefore, the hypotheses formulated in this study aim to discuss the impact of economic growth, urbanization, corruption perception, resource consumption and trade development on

[1] Source link: (https://www.footprintnetwork.org/)
[2] Source link: (https://www.transparency.org/en/cpi/2020)
[3] Source link: (https://global-reports.23degrees.eu/epi2022/root)

the ecological footprint. For this purpose, this study tests three hypotheses, presented as follows.

Hypothesis 1 (H1): Urbanization, trade and economic development in CIS countries increase the ecological footprints in these countries.

Hypothesis 2 (H2): Corruption in CIS countries is a major factor that increases ecological footprints.

Hypothesis 3 (H3): Foreign direct investment and natural resources rent increase ecological footprint.

4. Empirical results

The first step of analyzing the impact of economic growth, natural resources, urbanization, foreign direct investment, trade and corruption refers to the implementation of Ordinary least squares (OLS) method for estimating parameters in a linear regression model. The results for the panel are presented in Table 4.

Table 4: Results of OLS

	lnGDP	NR	URBG	FDI	TRD	CORR	CONS	R-sq
Panel	0.37***	0.02***	-0.1***	-0.01**	0.002**	-0.008	-2.1***	0.68

Source: Author's compilation

*Notes: *, **, *** denotes significance at the 10%, 5%, 1% significant levels, respectively*

The panel data estimation demonstrates the significant effect of all explanatory variables except corruption on ecological footprint for the group of countries under consideration.

The results of various preliminary tests for the CIS countries are shown in Table 5. Our empirical result of cross-sectional dependence suggests the presence of CD. We also employ a cross-sectionally augmented Dickey-Fuller (CADF) test since our data are unbalanced. Results of the unit-root test show that all variables are stationary at the 1st difference. Moreover, testing for slope heterogeneity (Pesaran, Yamagata, 2008) allows us to reject the H0 hypothesis that slope coefficients are homogenous and conclude the heterogeneity of the slope coefficients.

Table 5: Results of diagnostic tests

<table>
<tr><th colspan="2"></th><th>lnEFP</th><th>lnGDP</th><th>NR</th><th>URBG</th><th>FDI</th><th>TRD</th><th>CORR</th></tr>
<tr><td colspan="9">Cross-sectional dependence (CD) tests</td></tr>
<tr><td colspan="2">Pesaran's CD</td><td>12.60***</td><td>30.66***</td><td>4.77***</td><td>12.62***</td><td>7.06***</td><td>2.65***</td><td>8.33***</td></tr>
<tr><td colspan="2">Bias-corrected LM</td><td>24.26***</td><td>86.67***</td><td>6.49**</td><td>13.96***</td><td>2.44</td><td>13.42***</td><td>8.73**</td></tr>
<tr><td colspan="9">Unit root test</td></tr>
<tr><td>Levels</td><td rowspan="2">CADF</td><td>-2.38**</td><td>-2.69***</td><td>-1.99</td><td>-2.18*</td><td>-2.18*</td><td>-0.76</td><td>-2.05</td></tr>
<tr><td>1st Difference</td><td>-2.6***</td><td>-3.01***</td><td>-2.37**</td><td>-2.87***</td><td>-3.6***</td><td>-2.26**</td><td>-2.7***</td></tr>
</table>

Source: Author's compilation

*Notes: *, **, *** denotes significance at the 10%, 5%, 1% significant levels, respectively*

According to the main result of diagnostical tests our study explores the effects on ecological footprint in CIS counties by using the Pooled Mean Group (PMG) Estimator. We also report estimates applying the MG and DFE estimators for comparison and robustness purposes. Long-run coefficients are presented in Table 6.

Table 6: Long-run and short-run estimates for the sample of countries

Dependent variable: lnEFP	PMG	MG	DFE
Long-run estimates			
lnGDP	0.08*** (0.000)	0.12*** (0.000)	0.11*** (0.000)
NR	0.002*** (0.005)	-0.003 (0.910)	0.003 (0.251)
URBG	-0.055*** (0.006)	-0.04 (0.507)	0.074** (0.020)
FDI	0.005*** (0.000)	0.003 (0.295)	0.004 (0.185)
TRD	-0.001*** (0.001)	-0.001 (0.231)	0.0003 (0.652)
CORR	0.002** (0.040)	-0.003 (0.154)	-0.001 (0.747)
CORR×EPI	-0.009*** (0.000)		0.002 (0.588)

Source: Author's compilation

*Notes: *, **, *** denotes significance at the 10%, 5%, 1% significant levels, respectively. p-values are in parentheses*

The Hausman test between PMG, MG and DFE allows us to conclude that the PMG estimations are preferred. The empirical results of the PMG estimator show the significance of all variables in long-run estimates. Moreover, it is noticeable that GDP, NR, FDI and CORR increase the ecological footprint in the group of CIS countries. URBG, TRD, and EPI combined with a lower level of CORR decrease ecological footprint.

5. Conclusion

We have studied the relationship between economic development, corruption level, urbanization, trade, foreign direct investment and environmental degradation. Our findings emphasize that the society needs to take into account the rapid development of the economy and to pay special attention to the ecological footprint that people leave behind. Analysis of the ecological footprint data of the CIS countries, along with economic growth, natural resources, urbanization, foreign direct investments, trade and corruption, demonstrated that the economic development of these countries has a negative impact on the environmental quality.

We have come to the conclusion that economic growth increases the ecological footprint in the group of CIS countries, while trade and urbanization decrease the ecological footprint, i.e., hypothesis 1 is partially confirmed.

Moreover, corruption perception is statistically significant when considering its influence on the ecological footprint in the CIS countries, which means that the hypothesis 2 (H2) is partially confirmed. Results showed that lower levels of perceived corruption per se increases ecological footprint, probably due to interrelation of economic activity with corruption under weak institutions. However, the interaction term of this variable with the Environmental Performance Index demonstrates the importance of lower corruption level while implementing environmental policy.

The third hypothesis was confirmed. Foreign direct investment and natural resources rent increase ecological footprint leading to deterioration of the environmental quality. Among the reasons for such impact of FDI might be weak institutions and inefficient regulation concerning FDI and environmental regulation in the CIS countries. This makes countries attractive for the multinational corporations that see these countries as a ‘pollution haven’ instead of transmitting modern environmentally friendly technologies to them. As for natural resources, clean technologies are essential in this industry, as it is among the major sources of environmental pollution. However, transition towards green energy is also highly important wherever it is possible in order to decrease ecological footprint and to protect the environment while developing the country’s economies.

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