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AN ECONOMETRIC ANALYSIS OF FDI AND TRADE IN UZBEKISTAN

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Abstract. We employ the cointegration technique to examine the validity of the Environmental Kuznets Curve (EKC) model for Uzbekistan, specifically focusing on CO_2 emissions. The study period spans from 1990 to 2020. The postulated model exhibits cointegration, and empirical verification confirms the validity of the EKC hypothesis. Moreover, there is evidence to suggest that energy use is contributing to an increase in CO_2 emissions per person, but Foreign Direct Investment has been shown to be beneficial in decreasing CO_2 emissions per person. Nevertheless, the impact of trade is deemed inconsequential. We advise the Uzbek government to actively seek additional foreign investment in order to bolster efforts towards achieving a more environmentally sustainable state.

Keywords: Environmental Kuznets Curve, Foreign Direct Investment, Trade Openness

O’ZBEKISTONDA TO’G’RIDAN TO’G’RI XORIJIY INVESTITSIYA VA SAVDONING EKONOMETRIK TAHLILI

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Annotatsiya. Kointegratsiya usulidan foydalangan holda O'zbekiston uchun Karbonat angidrid gazi ajralib chiqishi jarayonining ekologik Kuznets egri chizig'i (EKC) modelining to'g'riligini tekshirdik. O'rganish davri sifatida 1990 yildan 2020 yilgacha bo’lgan vaqtni oldik.Yaratilgan model kointegratsiyani ko'rsatdi va empirik tekshirish natijasi EKC modelining to'g'riligini tasdiqladi. Bundan tashqari, energiyadan foydalanish kishi boshiga CO_2 emissiyasini oshirishini ko'rsatadigan dalillar mavjud, ammo to'g'ridan-to'g'ri xorijiy investitsiyalar kishi boshiga CO_2 emissiyasini kamaytirishda foydali ekanligi aniqlandi. Shunga qaramay, savdoning ta'siri ahamiyatsiz deb topildi. O‘zbekiston hukumatiga ekologik barqaror davlatga erishish yo‘lidagi sa’y-harakatlarni kuchaytirish uchun qo‘shimcha xorijiy sarmoyalarni faol izlashni maslahat beramiz.

Kalit so’zlar: Ekologik kuznets egri chizig’i, To’g’ridan to’g’ri xorijiy invesitsiya, Savdoning ochiqligi

Introduction

Various factors might be considered as determinants of CO_2 emissions. The statement is accurate as a multitude of complex factors contribute to the

fluctuations in emissions within a given region. There is an ongoing and extensive discussion over the methods to regulate emissions in a certain area, utilizing a combination of micro, macro, and financial aspects. Commonly debated factors include gross domestic product (GDP), Foreign Direct Investment (FDI), trade openness (TO), governmental expenditure, energy costs, and others. The various aspects mentioned above contribute to the exploration of the Environmental Kuznets Curve (EKC) hypothesis, as proposed by Grossman and Krueger in 1995. The Kuznets curve has both theoretical and practical ramifications. It posits that as a country experiences economic progress, there is initially an upward tendency in emissions. However, as the country continues to develop, emissions and pollution begin to decrease, resulting in an overall improvement in the environment.

Mahmood and Alkhateeb (2017) examine the EKC hypothesis in the context of Saudi Arabia's CO_2 emissions model by incorporating trade in their empirical analysis. The study supports the EKC hypothesis by confirming the positive relationship between income and CO_2 emissions, as well as the negative relationship between income squared and CO_2 emissions. Furthermore, trade appears to exert a detrimental environmental influence both in the short and long term. According to Shahbaz et al. (2013), financial development and commerce contribute to the reduction of pollution in Malaysia. However, energy consumption and GDP are identified as factors responsible for environmental degradation in the country. An argument is logically sound yet allows for additional examination as income is highly likely to result in economic growth, and trade also contributes to income generation. Hence, if a nation is witnessing a rise in income, it is likely that financial development or trade play a part in this, making it unlikely that income growth occurs without an increase in emissions and without the influence of financial development and trade.

Conversely, Alkhateeb et al. (2018) discovered that the financial market has played a role in the generation of CO_2 emissions in Saudi Arabia. Another body of literature suggests that higher oil prices and revenues can lead to increased investments, employment, and economic growth in countries with abundant oil resources (Alkhateeb et al., 2017b; Mahmood and Alkhateeb, 2018; Alkhateeb et al., 2017ba). As a result, this economic growth may give rise to environmental concerns. Nevertheless, the environmental impact of the oil market exerts a greater influence on economies that heavily rely on oil. Examining the ramifications of economic growth and its impact on emissions in oil-dependent economies, it is imperative to investigate the progression of this discourse in oil-abundant economies such as Uzbekistan. Incorporating the factor of trade's impact on economic growth and subsequent environmental deterioration would be beneficial in the case of Uzbekistan, given its current push towards liberalization.

Uzbekistan has seen numerous structural transformations over its history. These structural changes have also led to considerable adjustments in

perceptions of important economy-wide concepts such as poverty, inequality, and productivity. The country's promotion of liberalization in the early 1990s was seen, although facing various challenges that had an impact on its overall growth and foreign direct investment (FDI). The increasing liberalization, economic growth, and foreign direct investment (FDI) may lead to a faster rate of energy use, hence contributing to increased emissions. This pattern confirms the existing research that suggests that improved macroeconomic performance is associated with increased emissions. However, it also provides an opportunity to examine the impact of income, foreign direct investment (FDI), and openness on Uzbekistan's CO_2 emissions, particularly during the period of liberalization policies. Therefore, the objective is to examine the Environmental Kuznets Curve (EKC) and other factors that influence the environment by analyzing Uzbekistan's data from the period of post-liberalization, which spans from 1990 to 2020. The findings would offer valuable support to the Uzbekistanian government, economists, and environmentalists in identifying the necessary adjustments for enhancing the country's economic and environmental sustainability. These conclusions can serve as a guide for future policy reformation.

Literature review

Saidi and Hammami (2017) proposed a bidirectional association between environmental degradation and income in high-income nations, however the impact was shown to be less pronounced in other countries. Furthermore, there is a diverse range of literature accessible about the suitability of the Environmental Kuznets Curve (EKC) theory in numerous worldwide locales. Only a few of them are principally undertaken within the framework of Uzbekistan. This allows for an analysis of how the aforementioned components would interact within the country. Furthermore, this study examines the post-liberalization period to get insights into the impact of liberalization on a country's environmental profile. The findings will provide light on the types of sustainable policies that may be beneficial for the country to maximize its growth.

Abdouli and Hammami (2017) noted that when examining nations in the Middle East and North Africa (MENA), foreign direct investment (FDI) appears to significantly impact the environmental conditions in the region. An analysis was conducted on data from 1990 to 2012 for seventeen economies in the Middle East and North Africa (MENA) region. The study examined the relationship between foreign direct investment (FDI), pollution, and income. It was determined that there were two distinct relationships: one between emissions and GDP. This reciprocal link indicates that both FDI and GDP have an influence on emissions in the MENA area. Conversely, emissions can also have an impact on FDI and GDP in these nations. The findings demonstrate the significant practical implications of the Environmental Kuznets Curve (EKC) in the region, highlighting the interconnectedness of macroeconomic and environmental concerns. Omri et al. (2015) examine the connection between

the overall economic performance and the quality of the environment in 12 countries in the Middle East and North Africa (MENA) region. They argue that income and emissions have a two-way relationship, meaning that they affect each other. On the other hand, the relationship between total output (TO) and CO2 emissions appears to be neutral, meaning that they do not have a significant impact on each other. Both studies were done in the same geographical area and resulted in establishing a reciprocal relationship between the instruments being analyzed.

An extensive investigation performed on 54 nations, including Uzbekistan, reveals a reciprocal relationship between foreign direct investment (FDI) and income. An analogous correlation is demonstrated in the context of Foreign Direct Investment (FDI) and pollution. There is a unidirectional relationship observed between income and pollution. The authors suggest that governments should prioritize Foreign Direct Investment (FDI) as a means to transform their country's energy profile. They also propose a framework for other nations to examine how this topic aligns with their economic and environmental frameworks (Omri et al., 2014). In their 2014 study examining numerous nations, including Uzbekistan, Onafowora and Owoye found an N-shaped relationship instead of a U-shaped one. In addition, energy consumption has an impact on pollution and income in economies, while TO (presumably referring to a specific variable or factor) did not demonstrate any influence on the environment within the group.

In a study conducted by Ibrahiem (2015), it was discovered that there are long-term relationships in the model of Uzbekistan, and an increase in energy usage leads to a boost in foreign direct investment (FDI) and economic growth. The report offers policy recommendations for the Uzbekistanian government to prioritize renewable energy as a means to guarantee financial and economic growth while maintaining environmental sustainability. While numerous study articles discuss the robust association between macroeconomic indicators and the environment in various places, some contradict this notion and propose the contrary. Ben et al. (2015) employed panel cointegration methods to examine the immediate and long-term correlation between CO_2 emissions, GDP, renewable energy consumption, and international trade in a group of 24 sub-Saharan African nations from 1980 to 2010. The short-run Granger causality analysis indicates that there is a reciprocal causal relationship between emissions and economic growth, as well as between emissions and real exports. Additionally, there is a one-way causal relationship from real imports to emissions, and a one-way causal relationship from trade (exports or imports) to renewable energy consumption. The long-term estimations indicate that the theory of an inverted U-shaped Environmental Kuznets Curve (EKC) is not substantiated for these countries. Specifically, it is found that exports exert a positive influence on CO_2 emissions, while imports have a negative effect on CO_2 emissions. Salahuddin and Gow (2014) did a study on the GCC region, in

which they included an additional variable of energy usage. The study yielded diverse findings, indicating that while energy consumption, income, and emissions are interrelated, no correlation was discovered between income and pollution. These results yield divergent implications compared to the previously listed studies and provide an opportunity for more analysis.

Methodology

Based on the theoretical predicted factors influencing CO_2 emissions, we propose the following model:

$$CO_t = \alpha_0 + \alpha_1 GDPC_t + \alpha_2 GDPC_t^2 + \alpha_3 ECPC_t + \alpha_4 FDI_t + \alpha_5 TO_t + u \quad (1)$$

Every variable in equation 1 has undergone a natural logarithm change. CO_t, $GDPC_t$, and $ECPC_t$ represent the per capita CO_2 emissions, GDP, and energy usage, respectively. FDI is the logarithm of the percentage of foreign direct investment (FDI) to gross domestic product (GDP), while TO is the logarithm of the percentage of trade (exports + imports) to GDP. A square term is calculated by taking the square of the natural logarithm of GDP per capita. This square term is then used in a regression analysis to test the validity of the Environmental Kuznets Curve (EKC) hypothesis. The presence of the EKC hypothesis can be confirmed by a positive influence of GDPC_t and a negative influence of . The data represents the time span from 1990 to 2014. The starting year of 1990 is chosen to account for the implementation of a liberalized economic system. The period ends in 2014 to ensure the availability of the most comprehensive data on energy and emissions variables. All series are obtained from the World Development Indicators (WDI) dataset. Energy usage is anticipated to contribute to environmental damage. The environmental impact of FDI can be either beneficial or detrimental, and it is contingent upon the type of technology employed by foreign investors. Additionally, trade openness (TO) can have both favorable and unfavorable environmental impacts, which are contingent upon factors such as energy usage, the composition of exports and imports, and the technological processes involved in manufacturing the exported goods. The hypothesized equation 1 should be evaluated for the presence of a unit root. However, we may skip this step since we are employing the auto-regressive distributive lag (ARDL) technique developed by Pesaran et al. (2001) to estimate the hypothesized model. The upper and lower bounds of the Autoregressive Distributed Lag (ARDL) model are determined based on the assumption of an AR(1) process and an AR(0) process, respectively. Thus, it is permissible to disregard integration analysis prior to considering cointegration. The ARDL model can be represented as follows:

$$\Delta CO_t = 0_0 + 0_1 CO_{t=1} + o_2 GDPC_{t=1} + 0_3 GDPC^2_{t=1} + o_4 ECPC_{t-1} + o_5 FDI_{t=1}$$
$$+0_6 TO_{t-1} + \sum_{j=1}^{P} \varphi_{1j} \Delta CO_{t-j} + \sum_{j=0}^{q} \varphi_{2j} \Delta GDPC_{t-j} + \sum_{j=0}^{q} \varphi_{3j} \Delta GDPC^2_{t-i} +$$
$$+ \sum_{j=0}^{q} \varphi_{4j} \Delta ECPC_{t-j} + \sum_{j=0}^{q} \varphi_{5j} \Delta FDI_{t-j} + \sum_{j=0}^{q} \varphi_{6j} \Delta TO_{t-j} + \Psi_{it} \quad (2)$$

Equation 2 can be subjected to regression and evaluated to determine if the null hypothesis of $o_1=o_2=o_3=o_4=o_5=o_6=0$ holds true, in order to confirm the presence of cointegration. The long-term estimate can be calculated using a normalizing approach, while the short-term results can be obtained using the estimated coefficients in equation 3 below. An indication of a short-term correlation can be supported by a negative coefficient τ in equation 3:

$$\Delta CO_t = \sum_{j=1}^{P} \theta_{1j} \Delta CO_{t-j} + \sum_{j=0}^{q} \theta_{2j} \Delta GDPC_{t-j} + \sum_{j=0}^{q} \theta_{3j} \Delta GDPC^2_{t-i} +$$
$$\sum_{j=0}^{Q} \theta_{4j} \Delta ECPC_{t-j} + \sum_{j=0}^{Q} \theta_{4j} \Delta FDI_{t-j} + \sum_{j=0}^{q} \theta_{4j} \Delta TO_{t-j} + \tau ECT_{t=1} + \omega_i \quad (3)$$

Data analysis

Table 1 displays the ARDL values of the postulated model for CO_2 emissions per capita. The bound test yielded a value of F = 9.7845, providing evidence of cointegration at a significance level of 1%. The presence of a negative coefficient of ECT_{t-1} (-1.1856) indicates a strong correlation between a short relationship and a faster rate of convergence.

Table 1

CO_2 emissions per capita model

Regressor	Parameters	S.E.	t-Stat	P value
$GDPC_t$	22.3478	11.0529	2.2131	0.0448
$GDPC_t^2$	-1.9193	0.3575	-2.3294	0.0504
$ECPC_t$	1.3415	0.3437	2.7281	0.0141
FDI_t	-0.0796	0.0360	-2.2905	0.0370
TO_t	-0.0043	0.0754	-0.1705	0.4453
C	-133.9380	57.8798	-2.1269	0.0430
$\Delta GDPC_t$	31.5869	17.4851	1.7531	0.0369
$\Delta GDPC_t^2$	-1.4746	0.1736	-10.8657	0.0000
$\Delta GDPC_{t-1}^2$	0.28036	0.0245	7.1713	0.0001
$\triangle ECPC_t$	0.2103	0.1191	0.7542	0.0152
$\triangle ECPC_{t-1}$	-0.6507	0.1506	-3.7861	0.0028
$\triangle FDIt$	-0.0373	0.0084	-2.9017	0.0073
ΔFDI_{t-1}	0.0668	0.0070	6.1845	0.0001
$\triangle TOt$	-0.0047	0.0859	-0.0603	0.3455
ECT_{t-1}	-1.1856	0.1355	-11.0278	0.0000

Over a long period of time, the GDP per capita has a positive impact, but the square of the GDP per capita has a negative influence on CO_2 emissions per capita. An inverted U-shaped link has been discovered, providing evidence for the presence of the Environmental Kuznets Curve (EKC) theory, which suggests that income increase has environmental repercussions. The turning point can be identified as the year 2003, when the per capita income reached 13,201 in constant local currency. Hence, it can be asserted that Uzbekistan has entered the second phase of the Environmental Kuznets Curve (EKC) since 2003, and additional economic growth may lead to positive environmental outcomes in Uzbekistan.

The impact of ECPC is positively correlated with increasing elasticity, indicating that a 1% increase in energy demand results in an approximate 1.3% rise in per capita emissions. Foreign Direct Investment (FDI) in Uzbekistan is having a detrimental effect on the emissions per capita, albeit with a small degree of responsiveness. FDI appears to contribute to the mitigation of environmental degradation, potentially attributable to the utilization of environmentally friendly technology by foreign investors. Moreover, a 1% rise in the percentage of Foreign Direct Investment (FDI) to Gross Domestic Product (GDP) ratio leads to a reduction in per capita emissions by around 0.089%. The impact of TO is negligible, leading us to the conclusion that trade has neither detrimental nor advantageous consequences for the environment.

Table 2

Diagnostics

Bound assessment	F-value = 9.7845
	At 10% (2.147 – 3.10)
	At 5% (2.35 – 3.48)
	At 1% (3.20 – 4.34)
Heteroscedasticity	F-value=0.7512 (0.6576)
Serial correlation	F-value=2.3277 (0.0582)
Normality	F-value=2.1516 (0.2585)
Functional form	F-value=0.0803 (0.5715)

Table 2 presents the findings from the short-term analysis, which confirm the validity of the Environmental Kuznets Curve (EKC) hypothesis. Nevertheless, the delayed impact of the square term of GDP per capita is indicating adverse environmental consequences. The current year's impact of energy consumption is negligible, but it is having a detrimental effect on CO_2 emissions. Foreign Direct Investment (FDI) continues to have favorable environmental effects, however there is a slight degradation of the environment in the long run. The short-term analysis also reveals that the trade effect is not significant, suggesting that trade does not have any impact on emissions.

Conclusion

Examining the Environmental Kuznets Curve (EKC) is crucial for studying the impact of a country's macroeconomic performance on the environment. We examine the Environmental Kuznets Curve (EKC) hypothesis in Uzbekistan throughout the period of 1990-2020, which corresponds to a period of economic liberalization. We employ the ARDL Cointegration test for this purpose. We have discovered evidence of cointegration in the hypothesized model, as well as the presence of a short-term link. Furthermore, we validate the presence of the Environmental Kuznets Curve (EKC) hypothesis in Uzbekistan, with a specific turning point occurring at a per capita constant income of 13,201. Uzbekistan is positioned in the second phase of the Environmental Kuznets Curve (EKC) due to its current economic expansion. Thus, we might infer that Uzbekistan currently has a stable economic foundation.

Moreover, foreign direct investment (FDI) inflows have a beneficial impact on the environment, as they are associated with a reduction in per capita emissions in the country. The impact of TO is negligible. Thus, it appears that trade is not detrimental to the country. The short-term estimations also support the important discovery of long-term estimates. Our findings suggest that it would be advisable for the government of Uzbekistan to pursue increased liberalization in foreign commerce. Furthermore, it is essential to enhance the attraction of foreign direct investment (FDI) through both quantitative and qualitative incentives, which can subsequently contribute to the promotion of a more environmentally sustainable ecosystem.

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