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THE ROLE OF CIRCULAR ECONOMY IN ACHIEVING SUSTAINABLE DEVELOPMENT GOALS: EVIDENCE FROM E7 COUNTRIES

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Abstract. Currently, the achievement of sustainable goals has now become obligation for economies due to uncertain economic situations at global level. Thereby, this prominent issue demands the focus at academia level. The study, in this regard, attempts to explore circular economy in view with sustainable development goals (SDGs) in the criteria of E7 nations. The study has used the level of investment, level of production and consumption, level of employment, and level of education to measure the circular economy of the country. The study has also used industrialization and inflation to predict sustainable development goals achievement as the control variable. The time span chosen for the is 2001–2020 and method of moment quantile regression (MMQR) approach has been used to evaluate the variables. Results revealed that the circular economy (level of investment, level of production and consumption, level of employment, and level of education), industrialization, and inflation are positively significant with SDGs achievement in E7 countries. The study helps the policymakers in formulating policies related to SDGs achievement by improving the circular economy in the country.

Keywords: circular economy, level of investment, sustainable development goals, level of production and consumption, level of employment, level of education, industrialization, inflation.

JEL Classification: E31, Q01, I24, I25, E24, E22.

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1. Introduction

Population growth and economic activity expansion, particularly as a result of intense global competition, have created numerous social and environmental issues for the countries. It puts the country's further development at risk. Even if business organizations are making some efforts to bring improvement in the situation, all of these efforts fall short of what is required to suppress the socio-environmental problems and detach from the obstacles that are considered as a barrier in future development. That is why reformers and academics are emphasizing on the factors which are essential to gain sustainable development (Çera et al., 2022; Vinuesa et al., 2020). Social and environmental awareness continues to increase among people across the world. So, government and authorities are developing various policies, implementing numerous programs, and initiating campaigns to promote social and environmental well-being along with economic progress. The purpose is to achieve sustainable development by ensuring resource availability and social harmony (Fuso Nerini et al., 2019; Sidhu et al., 2024). In accordance with this, a number of UN nations came together in

the General Assembly to discuss the agenda 2030 for Sustainable Development. The agenda included 169 objectives across 17 SDGs. A resolution in favor of implementing the SDGs as the targets for global sustainable development was passed. The Millennium Development Goals (MDGs), which were in place prior to this resolution, differed from the 17 SDGs. It occurs because these goals were made to resolve socio-environmental challenges at global level (Dat et al., 2022; Sachs et al., 2019).

The said goals are made on the basis of three categories; social, environmental and financial development. The agenda to impose of such goals is to make the world peaceful and prosper. These goals are interlinked, such as if the environmental goals have been achieved; they will initiate progress on social and economic goals (Fonseca et al., 2020; Sagarik, 2023). The circular economy plays a fundamental role in achieving SDGs. Circular economy covers the production and consumption paradigm where few things such as sharing, renting, reusing, repairing, and recycling are being prioritized (Gou et al., 2024). The basic principles of circular economy are reduction of wastes, control of pollution, natural regeneration system, improved quality of products and services, keeps products and services in use, sustains social welfare. The investment, production and consumption, employment level, and education level are four factors on which a circular economy is based. The level of investment, production and consumption, employment level, and education level determine how effective the economy is in following the aforementioned principles (Hussain et al., 2022; Karuppiah et al., 2021). The increase in investment provides social strength. Sustainable production and consumption improve the production processes and encourage responsible consumption patterns. The increase in employment level enhances economic activities and raise living standard. And rising education level improves human capital of the country. This all is helpful to environmental sustainability and ultimately provides a healthy, prosperous, peaceful, and just society. This also improves economic progress and financial development. So, the circular economy with the rising level of investment, sustainable production and consumption, rising employment level, and education level is useful to attain SDGs (Suárez-Eiroa et al., 2019; Wang et al., 2023).

The current study focuses on SDGs in emerging seven countries, including Brazil, India, Indonesia, Mexico, China, Russia, and Turkey. In Brazil, SDG 7: "affordable energy and clean energy" has been achieved. The country is making progress in SDG 1 which states that "no poverty", SDG 4: "quality education", SDG 6: "clean water and sanitation", SDG 13: "climate action", and SDG 17: "partnerships for the goals". India scored 66 out of 100 on all 17 SDGs. On the 17 SDGs, India is ranked 120 in 2021, down three points from 117 in 2020 (Anwar et al., 2022; Yodchai et al., 2022). In terms of progress in achieving SDGs declared by UN-GA, India is at 121 ranks across the 163 countries. Indonesia is making progress in getting SDG 4: quality education, SDG 13: climate action, and SDG 12: "responsible consumption and production". The country is also making improvements on SDG 1, SDG 5, SDG 7, SDG 8, SDG 9 and SDG 10 which reflects on the requirement of inequalities (Rafique et al., 2021). Mexico is making fast progress on SDG 5 and the country is making improvements on SDG 1, SDG 4, SDG 7, SDG 13, SDG 12 and SDG 17 (Gyamfi et al., 2021a, 2021b; Ngo & Ngo, 2023).

China has achieved SDG 1 and SDG 4: quality education. China is also making progress on SDG 2, SDG 9, SDG 12 and SDG 13. There is work on SDG 3, SDG 5, SDG 7, SDG 8, SDG 10, SDG 11, SDGs 16, and 17. Russia has made significant progress on SDG 1, SDG 4, and SDG

8. Turkey is making progress on SDG 1and SDG 7. There is a struggle to bring improvement on SDG 2, SDG 4, SDG 6, SDG 11 and SDG 17 (Marín-García et al., 2022; Shafi et al., 2022).

Currently, the E7 economies are making higher growth and saving their position in the market. But then, economic expansion causes many environmental issues disturbing the social life of people, and these economies are unable to overcome these issues. Hence, future survival and development are at risk (Nghia, 2024; Yang et al., 2022). There is a need to develop such an economy in these countries, which would prove to be a solution to these environmental and social issues, and therefore, the country's development can be sustainable. Considering this need, the authors had the aim to address the following question:

- *Does factors of circular economy such as level of investment, production and consumption, employment level, and education level, along with inflation and industrialization really help countries to achieve SD goals?*

Highlighting the significance of topic with relevant statistics, the study makes useful contribution in several ways. First, in the previously conducted literature, the studies have only addressed the role of the circular economy in achieving SDGs. Very few studies have examined the factors of the circular economy while analyzing SDGs achievement. Since in the present study, the level of investment, production and consumption, employment level, and education level were taken as proxies of a circular economy for the analysis of SDGs achievement, it's a great contribution to literature. In the existing literature, the effects of investment levels, output and consumption levels, employment levels, educational levels, inflation, and industrialization on the achievement of the SDGs have all been studied, but not simultaneously. These elements are combined in the current article to examine how they relate to achieving the SDGs. So, it contributes to the literature. Moreover, little study has been conducted to examine the impacts of circular economy factors like level of investment, production and consumption, employment level, education level, inflation, and industrialization on SDGs in E7 countries. The current article address the identified gap by analyzing the role of circular economy factors like level of investment, production, consumption, employment level, education level, inflation, and industrialization in achieving SDGs in E7 countries.

The organization of the paper includes the following parts: The introduction part shows the need for this research and its objectives. The literature review is the evaluation of the relationship between circular economies, such as level of investment, production and consumption, employment level, education level, inflation and industrialization, and SDGs through the lens of past literature. The methodology describes the source of data collection and the processes to analyze these data. Then, the results are explained and supported by previous studies through comparison. In the end, the concluded remarks have been presented along with implications and suggestions for future use.

2. Literature review

The increase in human activities, particularly economic practices, though necessary for humans, still has some side effects on human health and their social and economic welfare in the future. Considering these side effects and their eternal consequences at the universal level, the United Nations gathered in General Assembly and, with shared opinion, proposed

17 SDGs (Kumar et al., 2021; Shahzad et al., 2022). These goals are based on triple bottom of effect, hence are interconnected to each other. The circular economy promotes energy efficiency, resource efficiency, reduction of pollution, natural resilience, sharing, lower cost, and improved production. In a circular economy, the level of investment, production and consumption, employment level, and education level determines the achievement of circular economy objectives, which is a step to approaching SDGs (Fatimah et al., 2020; Sulphey et al., 2023). On the other hand, Gou et al. (2024) postulated that benefits of IOT in circular economy enables the new potential for circular economy as it not only helps in upgrading product quality but also improve decision making process. Different authors have talked about the nexus of circular economy with the level of investment, production and consumption, employment level, education level, inflation and industrialization, and SDGs. The relationship between a circular economy with the level of investment, production and consumption, employment level, education level, inflation and industrialization, and SDGs have been discussed below in the light of past literature.

The investment level determines the execution of the circular economy practices and their effectiveness in the achievement of SDGs. Sharma et al. (2021) states that in the circular economy, the investment level plays a decisive role in the selection of technologies, resources, and business processes. If within the economy, the investment level is rising, eco-friendly and more efficient technologies, good quality resources, and better working processes can be employed. These all improve the environmental performance along with giving higher profits. Hence, the SDGs regarding energy, climate, health, life, and economic growth can be attained. Rodriguez-Anton et al. (2019) examines the effectiveness of a circular economy through the level of investment and checks its impacts on SDGs. The empirical information for the investment level, circular economy, and SDGs achievement from the EU. The exploratory factor analysis and correlation analysis confirm that there is a positive association between investment level and circular economy with SDGs achievement. When there is an increase in investment level for the circulation economy, its practices can be effectively implemented. The effectively working circular economy accelerates the progress to achieving SDGs. Belmonte-Ureña et al. (2021), posit that sharing is a significant part of the circular economy. The improving investment level enables the firms to employ better communication technologies, develop integration among the firms, and develop the capacity to hire common machines and resources. As a result, the sharing economy reduces the use of harmful materials and energy sources and helps control chemicals and wastes. Hence, the SDGs related to energy, environmental quality, human health, and reduction of cost issues can be achieved. van Leeuwen et al. (2018), with the data from the Netherlands, show that the investment in energy and raw material factories strengthens the circular economy and, therefore, leads to SDGs achievement.

The production and consumption within the circular economy influence the execution of related economy practices, and when the principles of the circular economy are followed effectively, the SDGs can be achieved (Belmonte-Ureña et al., 2021; Łącka & Brzezicki, 2022). Tseng et al. (2020), examine the relation between a circular economy with sustainable consumption and production and SDGs achievement. The study explains that the firms consider the impacts of consumption of the resources, the products, and different services in the

fulfillment of their needs and employing the resources and efforts in the production process. They try to adopt responsible behavior while engaged in production and consumption practices. This creates a sustainable work environment and saves resources. So, it contributes to the progress of achieving SDGs. Marrucci et al. (2019) investigates the relationship between production and consumption, circular economy, and SDGs achievement. The research methodology includes the revision of 455 relevant studies, which were checked by employing a systematic approach. The study posits that when the firms within the circular economy apply sustainable consumption and production, they meet the needs and produce the goods and services which may not damage the climate, resources, and health of the users. This improves the product quality and reduces the waste to the least possible point. So, the industry and economy grow without creating problems for the environment and the society that is included in the SDGs. Schroeder et al. (2019) test the relationship between production and consumption, circular economy, and SDGs achievement. Forty-plus Google searches were done, and the focus was on the sites of the EU. The study claims that in the circular economy, sustainable production and consumption significantly contribute to the achievement of SDGs achievement.

In the circular economy, the level of employment affects the economic conditions and standard of living. Thus, the eco-logical friendly and economic change in the production and consumption patterns strengthens the foundations of SDGs like social well-being, environmental sustainability, and financial development (El Wali et al., 2021; Tien & Huang, 2023). Yu et al. (2022), analyzes the relationship between circular economy, CSR, employment rate, and SDGs. The study implies that the increase in the employment level enhances labor for business firms. The firms can carry out production and operational activities more frequently, and increased marking gives more profits. The surplus profits increase the firm capacity to carry the eco-friendly activities like the transition from non-renewable to renewable energy, the use of waste-free production processes, the use of recyclable resources and raw materials, and employing efficient technologies. These all reduce emissions and pollution and protect social rights, which are the parts of SDGs. Corona et al. (2019), tells that in the circular economy, the level of employment raises the income level, and people can afford technologies that use recyclable resources and services to give production. The more efficient technology with renewable resources reduces waste and enhances the life of products and services. So, the SDGs such as affordable and clean energy, clean water and sanitation, healthy food, good health, life protection, and nature's resilience. A research study was conducted by Chen et al. (2023) and Dantas et al. (2021) to investigate the relationship between circular economy, employment level, industry 4.0, and the achievement of SDGs. For testing the relationship, the data were collected from 50 articles on topics relevant to these factors. The study confirms that in the circular economy, the increase in the employment level raises the income level and enhances the use of industry 4.0 technologies. Hence, the SDG 7, SDG 8, SDG 9, SDG 11, SDG 12, and SDG 13. So, there is a positive relationship between employment levels in a circular economy with SDGs achievement.

Chen et al. (2020), checks the association between education level, green chemistry principles, circular economy, and SDGs achievement. The necessary information was arranged from articles on the relevant topics, especially those conducted for Canada, China, Japan,

South Korea, Germany, Sweden, the United States, Taiwan, and United Kingdom. The study reveals that it is education that creates awareness of green chemistry principles. The increasing education level within the country ensures the effective implementation of circular economy practices according to its common principles. In an effectively working circular economy, the resources are utilized efficiently, and the wastes are tried to be minimized (Tran-Thi-Thanh & Nguyen-Thi-Phoung, 2023; Vhutali & Saba, 2024). In this condition, the SDGs relate to production and consumption, industry, infrastructure, economic growth, innovation, clean energy, climate action, and life protection. Moktadir et al. (2020), states that individuals are given complete professional information and trained for greater professional efficiency as the educational system develops. Professionals who have received education and training are better able to manage an economic practice based on ideas like reducing pollution from resource use and waste, enhancing the quality of the services and goods consumed, and renewing the natural system. This lessens environmental problems and assists in achieving SDGs. Türkeli and Schophuizen (2019) wrote about the education level impacts on circular economy and SDGs achievement. The authors found that the increase in the level of professional education to students or education to people during their professional life creates socially favorable and eco-logical friendly awareness and develops the required skills for this. In such a circular economy, economists know how environmental and social issues can be reduced through bringing technological improvement. Pla-Julián and Guevara (2019), throws light on the association of education level, sustainable energy technologies, circular economy, and SDGs achievement. The study highlights that education institutions make students aware of sustainable energy technologies and how they can implement them. When these students come into their practical professional life, they try to implement energy transition and energy efficiency. This also gives rise to technological development, infrastructure improvement, and climate action (Mushib, 2023; Zhang, 2023). So, SDG 3, SDG 4, SDG 6, SDG 7, SDG 8, SDG 9, SDG 13, SDG 14, and SDG 15 are struggled to be achieved.

Besides the circular economy with the level of investment, production and consumption, employment level, and education level, inflation and industrialization also have an influence on SDGs achievement (Fan et al., 2023; Turek et al., 2023). Micah et al. (2020), there are several barriers to the execution of circular economy practices as well as there are some drivers. In order to remove these barriers and attain drivers, large financial resources are required. As in the inflationary period, the financial resources are abundant in the market; the circular economy practices can be effectively implemented. This helps to improve work right on the achievement of SDGs. Khaled et al. (2021) examine the inflation role in SDGs achievement. The study posits that in inflation, the economic conditions are satisfactory, and the firms can make some extra efforts to improve their performance and make it sustainable. When the individual firms struggle for sustainable development, it becomes easy to achieve SDGs. Similarly, Pimonenko et al. (2020), analyze the influences of industrialization on achieving SDGs. The study proclaims that they have the opportunity to learn about a new world, better technologies, resources, and economic skills thanks to the growing industrialization of rural areas. The people who live in rural areas are able to use contemporary production methods and preserve the environment. As a result, they help to attain the SDGs. According to the arguments of Opoku and Yan (2019), industrialization plays a crucial role in getting SDGs.

Several technological tools, mechanical instruments, and technical services are based on industrialization. With the industrialization growth, the technological development is possible and this is fruitful in getting the SDGs. Hence on the basis of arguments we propose following Hypotheses:

H1: *Circular economy and SDG goals are positively correlated to each other.*

H2: *Inflation and SDG goals are positively correlated to each other.*

H3: *Industrialization and SDG goals are positively correlated to each other.*

3. Research methods

The paper investigates the effectiveness of the level of investment, level of production and consumption, level of employment, level of education, industrialization, and inflation on the SDGs achievement in E7 countries. Secondary data from OECD (n.d.), United Nations database (UNSD, n.d.), and WDI has been used covering the time period from 2001 to 2020. Following is the model expression that has been developed in regard to the understudy variables.

$$SDG_t = \alpha_0 + \beta_1 LIN_t + \beta_2 PCL_t + \beta_3 EML_t + \beta_4 EDL_t + \beta_5 INF_t + \beta_6 IND_t + e_t, \quad (1)$$

where: *SDG* – Sustainable Development Goals; *t* – Time period; *i* – Country; LIN – Level of investment; *PCL* – Production and consumption level; *EML* – Employment level; *EDL* – Education level; INF – Inflation; *IND* – Industrialization.

The article has used the SDGs as the DV and used circular economy as the predictor and measured with the level of investment, level of production and consumption, level of employment, and level of education to measure the circular economy of the country (see Table 1). The study has also used industrialization and inflation to predict SDG achievement as the control variable. The data obtained for SDGs gathered from multiple sources such as UN statistics division (UNSD) SDG indicators database, UN development program (UNDP) human development reports (n.d.) and Global Findex database (The World Bank, 2023). These sources are chosen because they offer necessary indicators to measure performance of country on multiple dimensions of sustainability. To measure circular economy, multiple data sources are needed to scrutinize production and consumption patterns, employment level, investment level as well as educational level. For this, the study considered sources such as OECD (n.d.) environment statistics, WD indicators, European Investment Bank reports, 2023), UNSD (n.d.) environment statistics, Global footprint network, UNESCO and International Labor Organization (n.d.) stats. To measure inflation through consumer price index (CPI), we gathered data from IMF (n.d.), World Bank (World Bank Group, n.d.-a, n.d.-b) and OECD (n.d.). We also considered additional platforms such as ILO to get accurate and up to date information related to inflation rates. Finally, internationalization was assessed through industry value added (% of GDP) and multiple databases were considered to obtain reliable data. Databases such as WDI, IMF, n.d.) world economic outlook database (IMF, 2023), national statistical offices and Asian development bank (ADB) key indicators (SEADS, 2023).

Table 1. Measurements of variables

S#	Constructs	Measurement	Code
01	SDGs	SDGs index	SDG
02	Circular economy	Level of investment Production and consumption level Employment level Education level	LIN PCL EML EDL
03	Inflation	Consumer price (annual %)	INF
04	Industrialization	Industry value added (% of GDP)	IND

Descriptives has been used to study data normality. Along with it, correlation has been performed in order to assess the strong or weak relation among constructs. Lastly, VIF has been used to check the multicollinearity among predictors and the expression constructed for it is given below:

$$R^2_Y \Rightarrow Y_{it} = \alpha_0 + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + e_{it}; \tag{2}$$

$$j = R^2_Y, R^2_{X1}, R^2_{X2,} R^2_{X3,} R^2_{X4,} R^2_{X5}; \tag{3}$$

$$\text{Tolrance} = 1 - R^2_j, \quad VIF = \frac{1}{\text{Tolerance}}. \tag{4}$$

In the end, the study has examined the linkage among understudy construct via MMQR approach that has recently been proposed by Machado and Santos-Silva (2019). First, it is robust to outliers. Second, it allows "conditional heterogeneous covariance effects" of SDG to impact the whole predictors differently than panel quantile regression, which licenses only shifting means (Adebayo et al., 2022b). Furthermore, this approach could be produced dynamic assessments even if the model is nonlinear (Adebayo et al., 2022a). Hence, this approach is a suitable approach that includes nonlinear and asymmetric associations by managing the effects of endogeneity and heterogeneity (Ike et al., 2020). Therefore, the conditional quantile "locational-scale alternate model" is stated below:

$$Y_{it} = \alpha_i + X_{it}\beta + \left(\delta_i + Z_{it}\lambda\right)U_{it}. \tag{5}$$

Equation (5) shows $P\left\{\delta_i + Z_{it}\lambda > 0\right\} = 1$. That exposed the probability presented. In addition, the Equation also shows α_i, δ_i, $i = 1, \ldots.., n$ that represents the specific fixed effect, while z shows the k-vector of component X. Finally, the components are altered with component l, which is mentioned below:

$$Zl = Zl\left(X\right),\ l = 1, \ldots\ldots, k. \tag{6}$$

Equation (6) shows the U_{it} that exposed the orthogonal to X_{it} and reliable to gain moment conditions. Hence, conditional quantile of Y is expressed via below stated Equation:

$$Q\tau\left(\tau / X_{it}\right) = \left(\alpha_i + \delta_i q\left(\tau\right)\right) + X_{it}\beta + Z_{it}\lambda q\left(\tau\right). \tag{7}$$

The impact of predictors is allowed to be varied across quantiles because of time invariants. Hence, $Q(\tau)$ is established as under:

$$\text{Min}_q = \sum_t \sum_i p\tau\left(R_{it} - \left(\delta_i + Z_{it}\lambda\right)q\right). \quad (8)$$

4. Empirical findings

The paper has evaluated the understudy constructs by scrutinizing the normality of variables' data. The outcomes of Table 2 showcased that SDG's average value was 58.034% followed by LIN 43.966%, PCL 54.923%, EML 24.385%, EDL 90.078%, INF 7.043%, and IND 32.314%.

In addition, the article has also checked the country-wise details of variables used in the study using country-wise descriptive statistics. The study outcomes exposed that the highest SDG was recorded in Turkey, the largest LIN is also shown in Turkey, and the highest PCL are also in Turkey. In addition, the highest EML was recorded in Russia, while the largest EDL was also in Russia, the highest INF was recorded in Turkey, and the largest IND country was China. Table 3 highlights these statistics.

Furthermore, the current study has checked the correlation between the predictors using a correlation matrix. The findings revealed that the circular economy (level of investment, level of production and consumption, level of employment, and level of education), industrialization, and INF are being positively correlated with SDGs achievement in E7 countries (see Table 4). Moreover, the article has also checked the multicollinearity issue using VIF.

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
SDG	140	58.034	5.826	44.983	65.832
LIN	140	43.966	6.298	34.109	55.386
PCL	140	54.923	4.915	45.736	67.635
EML	140	24.385	3.406	16.630	30.300
EDL	140	90.078	10.636	61.015	100.234
INF	140	7.043	6.510	-0.732	54.400
IND	140	32.314	8.187	17.702	48.061

Table 3. Descriptive statistics

	SDG	LIN	PCL	EML	EDL	INF	IND
Brazil	56.096	36.201	54.244	21.885	90.863	6.165	21.482
China	60.137	39.573	55.608	26.805	95.384	2.335	43.863
India	53.586	36.361	53.310	21.843	65.768	6.292	28.341
Indonesia	47.301	48.056	56.349	20.065	93.128	6.511	43.526
Mexico	62.435	45.733	48.683	25.447	93.227	4.283	32.130
Russia	61.315	49.229	51.947	28.187	99.850	9.543	30.290
Turkey	65.369	52.608	64.315	26.461	92.324	14.172	26.565

Table 4. Correlation matrix (source: authors' estimations)

Variables	SDG	LIN	PCL	EML	EDL	INF	IND
SDG	1.000						
LIN	0.369	1.000					
PCL	0.197	0.443	1.000				
EML	0.779	0.359	0.058	1.000			
EDL	0.374	0.567	0.118	0.471	1.000		
INF	0.146	0.265	0.194	0.133	–0.020	1.000	
IND	0.355	0.114	–0.069	–0.060	0.226	–0.226	1.000

The outcomes revealed that the VIF values of all the constructs are <5 and the reciprocal of VIF values of all the constructs are >0.20.

The findings revealed that the circular economy (level of investment, level of production and consumption, level of employment, and level of education), industrialization, and INF are positively connected with SDGs achievement in E7 countries. Table 5 presents the findings extracted from MMQR method. The method is employed to evaluate the impact of circular economy, inflation and industrialization across various quantiles of SDG's distribution. The quantile ranges from 0.1 to 0.9 which explains that how each predictor affect SDG across all quantiles. The precise nature of inflation, industrialization and circular economy factors such as level of investment, production and consumption level, employment level and education level are explained contextually. As it can be seen in Table 5 that the impact of level of investment appears to be significant across 0.1 to 0.7 quantile, however, it becomes insignificant in higher quantiles such as 0.8 and 0.9. It indicates that economies in quantile 0.1–0.7 experience substantial improvement in achieving sustainable goals when they tend to increase investment level. In addition to this, the insignificant relation in high quantiles indicates that additional investment apparently does not spills the very same magnitude of effect on sustainable goals in case of more developed economies. This diminishing return to investment also implies that basic necessities are already fulfilled, therefore, factors other than investment are more crucial in advancing sustainable goals. The impact of production and consumption level is also significant across all quantiles, however, it is notably strong in 0.5 and 0.6 quantile. This indicates production and consumption level consistently affect economic outcome; however, the effect becomes more pronounced at median or above the median, making it the critical factor of SDG. Meanwhile, impact of education level is quite strong in most of the quantiles. The stronger impact across quantiles highlights that higher education level is strongly related to better sustainable performance. It also indicates that education is one such factor that benefits all economies regardless of their economic status as it creates employment opportunities and enhances economic mobility. The impact of employment level has strongest impact on SDG in 0.5 quantile whereas effect of inflation reveals a mixed significance pattern. This highlights that economies in mid-level region in the context of sustainable development goals, are more affected by employment level because higher employment level means more educational opportunities, better health outcomes and less poverty. The mixed pattern of inflation highlights the inconsistency across region, making the

impact complex in nature due to its dependency on economic conditions. Lastly, the effect of industrialization is also significant where the most notable effect can be seen in 0.1 and 0.5 which drops in upper quantiles. These numbers indicate that industrialization produces positive outcomes in less developed regions. However, the decreasing effect in higher quantiles explains that marginal benefits come from industrialization process diminishes especially in developed countries because they are more inclined toward technological advancement. Overall, findings demonstrate that varying significance effect highlight that the effect of all the variables on SDG is not uniform.

Table 5. Panel quartile estimation (MMQR)

Variables	(MMQR)										
	Location	Scale	Quartile grids								
			0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
LIN	0.546***	0.773*	0.764**	0.875**	0.553*	0.643**	0.425*	0.550*	0.322*	0.202	0.110
PCL	0.666**	0.734*	0.283**	0.674*	0.282*	0.882***	0.236**	0.258**	0.142**	0.412*	0.104
EDL	0.534***	0.453**	0.742**	0.029**	0.717*	0.436*	0.658*	0.549*	0.323*	0.874**	0.208
EML	0.887*	0.553**	0.649*	0.664*	0.828**	0.992*	0.556*	0.101	0.810*	0.101	0.110
INF	0.534**	0.267*	0.378**	0.765***	0.653**	0.463*	0.215	0.432**	0.123	0.675**	0.111
IND	0.663*	0.534**	0.542*	0.746**	0.774***	0.442*	0.477*	0.021	0.488*	0.192	0.366*

4.1. Discussions

Findings proclaim that investment level in the circular economy are positively linked SDGs achievement. The findings support the evidences of Elrayah and Mirzaliey (2024) and Nikolaou et al. (2021). They claim that if the level of investment within an economy increases, the business firms, for undertaking their functions, can adopt the processes and technologies which utilize clean and wastes free raw materials and energy sources. In this case, the firms give equal productivity, good quality products and services, and do not create issues for the environment and health. Thus, SDGs like innovation, economic growth, clean productivity, clean environment, and goods can be attained with a higher level of investment. Findings show synchronization with Hysa et al. (2020) and Kadhim et al. (2024), that proclaims that economies with a higher level of investment can carry the programs to reuse, recycle, and remanufacture the products and services. The reduction of waste in the result of these activities enhances the ability to preserve nature and humans, contributing to the progress in achieving SDGs. Findings show synchronization with Abid et al. (2023), Abou Taleb and Al Farooque (2021), which shows that the high flow in investment level enhances natural resources production that provide food for good health, resources for industry and economic growth, contribute to human capital, and improve social life. These all-show SDGs achievement.

Findings showcased that production and consumption in a circular economy increase SDGs achievement due to positive relation. Findings show synchronization with the evidences of Walker et al. (2022), that highlights that when firms are aware about their responsibilities regarding the interests of the people, they perform production and consumption activities by taking care of the consequences of actions. If they find any faults, they try to improve these

processes. The improved social well-being and environmental quality both lead to a sustainable country capacity to achieve SDGs. Findings are confined with Velenturf and Purnell (2021), which examines that production and consumption in a circular economy influence on SDGs achievement. The study posits that the sustainable production of goods and services never affects the production environment and also maintains the quality and quantity of natural resources. A better-quality environment and natural resources assist in achieving SDGs based on an environmental foundation. Findings are coined with the evidences of Padilla-Rivera et al. (2020), which predicts that in the circular economy where individuals and firms both struggle for sustainable production and consumption, renewable energy resources and raw materials are always encouraged to be utilized. The effectiveness of a circular economy as result of sustainable production and consumption helps achieve SDGs.

The study results showed that employment level in a circular economy has a positive linkage with SDGs achievement. Millar et al. (2019) also showcased the similar evidences by claiming that the increase in the level of employment raises the productivity of the firms and brings more profits. When the firms are in a better financial position, they can afford the adoption of technologies which use recyclable resources and services to give production. The use of better technologies and recycling of resources is helpful in getting SDGs. The study of Wysokińska (2018) also shows that high ratio of employment level increases the % of income level and allows individuals to utilize renewable energy and other products in daily life. This improves the individuals' social life without damaging the environmental quality. Thus, it helps to attain SDGs that require environmental protection and better social life. Findings are coined with Reuter et al. (2019), which also confirms that a circular economy where the employment level rises can follow all three principles like reducing wastes and pollution, keeping the services and products in use, and regenerate natural system. This is a key to attaining SDGs.

The study results showed that education level in the circulation economy is linked with SDGs achievement in a positive manner. Kiss et al. (2019) also showed the similar evidences and throws light on the role of education level in SDGs. The study implies that the circular economy grows well when the education system is working efficiently and making progress. Findings are consistent with Schöggl et al. (2020). When the education system grows, the individuals are provided with complete professional knowledge and trained for better professional efficiency. The educated and trained professionals can better run an economy on the principles like reduction of pollution from resources consumption and waste, improving the services and products used, and regenerating the natural system. This reduces the environmental issues and, thereby, helps attain SDGs.

Results claim that inflation and SDGs achievement are positively connected to each other. The study of Din et al. (2022), also highlights that in the inflationary period, the firms have a high capacity to spend on eco-logical friendly strategies like energy transition, energy efficiency, renewable raw material, and handling of wastes. This improves the environmental performance of the firms and SDGs. Similarly, Athari et al. (2021) study, which examines the inflation impacts on SDGs achievement. The study explains that with inflation, production and employment level rises, and quality of the products is also maintained. This also increases the

protection of human rights, creates peace in society, and improves living standard, which all contribute to SDGs achievement.

Findings display that industrialization has a positive linkage with SDGs achievement. Fukuda-Parr and Muchhala (2020) also proclaims that the increasing industrialization in the rural areas gives them a chance to know a new world and, learn about better technologies resources, and acquire more effective economic skills. The inhabitants of the rural areas become able to utilize the modern means of production and maintain the quality of the environment. So, they contribute to SDGs achievement. Similarly Kynčlová et al. (2020) also highlights that with the increase in industrialization, there is development in the technological field and improvement in economic processes. So, eco-friendly performance is possible without disturbing economic activities. The increasing environmental performance contributes to SDGs.

4.2. Study implications

This study, for its contribution to literature, is a significant guideline for academics. In the prior literature, one may find the analysis of simply the role of the circular economy in achieving SDGs. The present study, which measures the circular economy with the level of investment, production and consumption, employment level, and education and checks its role in achieving SDGs, adds to the literature. In previous literature, research has been conducted on the impacts of the level of investment, production and consumption, employment level, education level, and inflation, and industrialization in achieving SDGs but not at the same time. The current article amalgamates these factors to analyze their relationship with SDGs achievement. The present analysis is the circular economy, like level of investment, production and consumption, employment level, and education level, along with inflation and industrialization in achieving SDGs in E7 countries. For this, the current study is a distinctive one in the literature.

As the major focus of this study is on the achievement of SDGs that is a considered a universal need, the study would be useful for all developing and developed economies. This study is full of guidelines for the authoritative persons both at the government and private level that can promote a circular economy and enables the country to achieve SDGs based on social well-being, environmental sustainability, and financial development. It guides them that they must issue policies to raise the level of investment within the country for social and economic projects so that the SDGs can be achieved. It also guides that the policymakers must pay due attention to the economy and encourage sustainable production and consumption in order to accelerate progress toward SDGs achievement. It also suggests to the government and economists that employment opportunities must be raised for the people because this will be helpful to achieve the majority of SDGs. The policymakers must play an active role in enhancing the educational opportunities and education quality for the students so that work on achieving SDGs can be possible. The study helps the policymakers in formulating policies related to SDGs achievement by improving the circular economy in the country. The study conveys that inflation time must be managed properly, and the policymakers must formulate strategies to take benefit from this period to enhance the country's progress on SDGs achievement. It is a guideline for policymakers to encourage industrialization to create a context to achieve SDGs.

5. Conclusions

The study objective was to explore the influences of the circular economy, like level of investment, production and consumption, employment level, and education, on achieving SDGs. It was also to examine the role of inflation and industrialization in achieving SDGs. The information for a circular economy is like level of investment, production and consumption, employment level, education level, inflation, industrialization, and SDGs from the statistics of E7 economies. The results showed that level of investment, production, and consumption, employment level, education level, inflation, and industrialization have a positive association with SDGs achievement. The results stated that the increase in the level of investment assures the undertaking of economic and developmental projects, which not only helps to gain financial goals but to improve environmental sustainability and social welfare. Hence, it helps achieve SDGs. The results showed that when organizations or individuals show a sense of responsibility and efficiency in the production and consumption of resources, products, and services, the negative impacts on the environment can be reduced, and social welfare is improved. So, sustainable production and consumption are useful to achieve SDGs. The results highlighted that the increase in the employment level enhances the production, profits, and income level. This all leads to sustainability practices like recycling, repairing, or reduction of pollution emissions, etc. So, it is helpful to achieve SDGs. Likewise, the increase in education services and improvement of education quality contributes to human capital, which is an essential factor in achieving SDGs. Moreover, the results showed that during inflation, there is in a large amount of money in the market and thereby, the greater amount of investment which leads the country towards the achievement of SDGs. The study concluded that when the industrial sector of the economy taking a larger space, there is increasing sustainability awareness and technological and human development. This accelerates SDG's achievement.

6. Limitations and future recommendations

There are also some limitations that the current study faces. Future authors with literary expertise and more attention overcome these limitations. First, the current study investigates the impacts of the only circular economy, like level of investment, production and consumption, employment level, and education, on achieving SDGs. There are some other factors such as fiscal policy, green finance, and energy efficiency that matter in progress to achieve SDGs. The absence of these variables in the current research makes it limited. It is recommended that scholars to examine more factors affecting SDGs achievement so that a comprehensive research study can be conducted. A specific limited time period was taken to check the influences of the level of investment, production and consumption, employment level, education, inflation, and industrialization on SDGs achievement. The limited period of research for data collection may not be suitable to present valid results for every period of time in the future. So, other interested authors should analyze the relationship between these factors, and SDGs achievement and must conduct research for the higher periods. Furthermore, the data for estimating the relationship between level of investment, production and consumption, employment level, education, inflation, industrialization and achieving SDGs were collected from E7 countries. Thus, the study may be valid only for E7 or some similar countries. The authors collect evidence from more countries.

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Disclosure statement

The author declare that they have no competing interests.

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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