Pol. J. Environ. Stud. Vol. 34, No. 1 (2025), 755-766
DOI: *10.15244/pjoes/186581* ONLINE PUBLICATION DATE: 2024-06-28

Original Research

From Linear to Circular: Assessing the Influence of Circular Economy Practices on Business and Environmental Dynamics

Ying Liu[1, 2], Muhammad Usman[3], Ahsan Akbar[4*], Martina Hedvicakova[5]

[1]School of Logistics and Supply Chain, Sichuan Vocational & Technical College, 629000 Suining, P. R. China
[2]Azman Hashim International Business School, Universiti Teknologi Malaysia, 54100 Kuala Lumpur, Malaysia
[3]UE Business School, Division of Management and Administrative Sciences, University of Education, Lahore, Pakistan
[4]International Business School, Guangzhou City University of Technology, Guangzhou 510080, China
[5]Department of Economics, Faculty of Informatics and Management, University of Hradec Kralove, Hradec Kralove, Czechia

Received: 27 December 2023
Accepted: 27 March 2024

Abstract

We are living in an era of transition from linear to circular modeling, where resources are reused and recycled, which helps to protect the environment. Therefore, the aim of this study is to investigate the impact of circular economy practices on corporate performance and environmental challenges. To evaluate the said narrative, we collect data from World Development Indicators. The sample of the study consists of 25 countries with a 20-year time frame (2000–2020). The regression estimates provide significant results and support our narrative that circular economy practices enhance corporate performance and improve the environment. The said findings are further robustly checked by using alternate proxies for the circular economy, corporate performance, and environment. These results propose that circular economy practices help to decrease costs, increase profits, initiate recycling, control pollution, manage waste, and thus contribute to enhancing corporate performance and providing positive environmental outcomes. These findings are useful for policymakers, academics, and practitioners. The said stakeholders can use these findings to formulate effective policies that encourage businesses to adopt circular economy practices, thus contributing to sustainable development goals.

Keywords: circular economy model, waste management, resource efficiency, environment protection, pollution control
JEL Codes: Q50; Q52; Q53; R11

*e-mail: akbar@gcu.edu.cn

Introduction

The economic system we are living in is considered "linear", wherein we extract resources from nature, produce things, use them, and ultimately discard them [1, 2]. The consumption of materials has risen by more than 65% in the previous twenty years, reaching around 95 billion metric tons [3]. Unfortunately, we are neither limiting our production of waste nor managing it, thereby harming the environment and human health. Statistically speaking, the recycling rate of material is around 7.2% [4]. Such an alarming situation motivates the human race to find better alternatives. One of the best alternatives is to build an economy that is based on a "circular" economy (CE), where resources are extracted, produced, used, and then reused rather than disposed of [5].

Academics, policymakers, and organizations are giving their utmost attention to the CE model to overcome the challenges raised by the linear economy, such as pollution, waste, resource depletion, etc. [6, 7]. Contrary to the linear economy, the CE model provides an opportunity to use resources more sustainably and efficiently, thus producing less pollution and waste [8]. Moreover, the CE model is also good for growth because, in the CE model, waste becomes a resource and is then reused for production [9, 10].

The CE practices intend to sustainably utilize natural resources by designing products smartly, using materials longer, and shaping the recycling process [11, 12]. Beyond reducing pollution and waste, CE practices contribute to resolving other challenges as well, e.g., climate change, global warming, biodiversity damage, and other environmental concerns [13, 14]. Moreover, CE practices are also an important means to achieve the SDGs (Sustainable Development Goals). Therefore, the adoption of CE practices provides a number of benefits to humans, corporations, and the environment [15].

The CE model establishes a new arena for growing businesses [16, 17]. It helps to initiate modern ways of manufacturing through recycling and reusing of materials and resources, thus reducing the reliance on material extraction [18]. These initiations eventually reduce the material cost and minimize the production time, thereby enhancing performance and profits [19]. Moreover, the CE model leads to the betterment of corporations by providing innovative solutions regarding production ideas, waste management, and resource efficiency [20].

Semi-urbanization, characterized by transforming rural regions into semi-urban regions, has a significant impact on carbon emissions and CE practices [21]. Although this phenomenon could lead to enhanced emissions through transportation, land usage, and energy consumption, CE practices can help minimize the said emissions [22]. CE practices increase the efficiency of resource utilization, promote recycling, and reduce waste, thus helping to combat carbon footprints and environmental challenges caused by semi-urbanization. Following CE practices can also raise sustainable patterns of production and consumption, thereby reducing the dependence on carbon-intensive products and services [23].

The CE model helps to reduce the environmental shortcomings of the linear economy model [24]. CE practices significantly limit the activities that produce GHGs (greenhouse gases), particularly from industrial production [25]. Excessive extraction of raw materials and discarding of waste have negative consequences for the environment [26]. However, CE practices can limit the said activities and improve nature. Moreover, the adoption of CE practices creates a vital ecosystem that is not only good for the environment but also for public health [27, 28].

CE practices and their business and environmental implications have significant contributions for both policymakers and practitioners. This study's objective is to look at how business and environmental settings might reap the benefits of CE practices. What makes this study even more noteworthy is the practical implications it gives for how businesses can boost their bottom lines while still making a positive impact on sustainable development. Furthermore, policymakers can benefit from the findings of this study when formulating environmental policies. Another motivation for conducting this study is its implications, particularly in the context of achieving sustainable development goals (SDGs).

The CE model provides a strong framework that is, by default, aligned with sustainable development goals (SDG) presented by the United Nations. The CE model proposes the reusing and recycling of resources to minimize waste production and maximize product lifespan (SDG-12). Moreover, through the development of efficient and environmentally friendly technologies, CE practices foster innovation (SDG-09). Furthermore, CE practices create new job prospects, which subsequently enhance economic activities (SDG-08). Lastly, CE practices mitigate the emissions of greenhouse gases, which is ultimately favorable for the environment (SDG-13).

This study is different from the previous studies in multiple aspects. Most of the earlier studies either chose the corporate sides of CE practices [29, 30] or environmental implications [31, 32]. However, we used both elements in this study because there are significant relationships between CE practices, corporate performance, and environmental challenges. Moreover, we use a large dataset consisting of twenty-five countries and twenty years of observations. Lastly, we use econometric estimation techniques and diverse proxies for the variables.

The structure of this paper is organized as follows: Section 2 elaborates on the philosophy of the study. In Section 3, the methodology is discussed in detail. Empirical analysis is presented in Section 4. Lastly, in Section 5, the study is concluded and policy implications are provided.

Philosophy of the Study

The Impact of CE Practices on Businesses

The impact of a CE on businesses is positive yet complicated. Barros et al. [33] identified the effect of CE practices on business sectors. The study emphasized the need to adopt circularity concepts in forming strategies and achieving sustainable economic growth. According to Bjørnbet et al. [29], holistic CE approaches are necessary as compared to the narrow approaches for sustainable manufacturing. Suchek et al. [34] established the CE as an alternative model to the linear system, and the study contributed to extending the literature by identifying priority areas and encouraging future research.

Aranda-Usón et al. [35] found that circular business models improved regional conditions and enhanced returns for businesses. Geissdoerfer et al. [36] revealed the framework for sustainable development by adopting circular business models and supply chain practices. Rizos et al. [30] discussed the momentum of the growth of the CE, its economic benefits, barriers to adopting CE business practices, and implications for policymakers.

CE practices help businesses reduce costs by improving resource efficiency [37, 38]. By designing products/processes that prioritize waste reduction and resource optimization, businesses have the opportunity to reduce material requirements and waste disposal [39]. These practices help businesses effectively decrease their dependence on procurement and, simultaneously, control their waste. These steps could significantly save costs and provide environmental benefits. Moreover, CE practices help manage resource security for businesses [40].

CE assists in enhancing corporate innovation and competitiveness [41]. By using CE practices, businesses can enhance their operational efficiency and cater to clients who prioritize environmental sustainability [42]. As a result, businesses may become more competitive, and new markets for environmentally friendly goods and services can emerge [43]. By developing new, environmentally friendly products and services, businesses can gain the attention of customers and receive incentives [44]. With the said methods, businesses can achieve higher income and enhance their market share.

When businesses adopt sustainable practices, it increases their reputation and worth [45]. Customers, investors, and other stakeholders have more faith in the company's character and its commitment to sustainability when that character is consistently demonstrated [46]. As a result, this has the potential to increase consumer loyalty, draw in more investors, and expand access to capital [47]. Based on the said discussion, we can hypothesize that:

H_1: CE practices have a positive impact on business performance.

The Impact of CE Practices on the Environment

The CE model is eco-friendly. A previous study by Castro et al. [32] has described the core concepts, principles, and components of the CE model. In addition to identifying a linkage between CE practices and ecological sustainability, the study compared the CE model with sustainability. To mitigate any immediate environmental impacts, Antonioli et al. [48] observed the environmental effects of adopting CE practices, particularly among SMEs. Based on the said study, employees should be more educated in terms of CE models, thus becoming able to provide better environmental outcomes.

According to Joensuu et al. [31], CE practices are good for the environment because they reduce resource usage and the need for new materials. Similarly, Abad-Segura et al. [49] also found positive environmental consequences of CE regulatory standards. The results show that community economy programs not only boost competitiveness but are also good for the environment. Camilleri [50] investigated the opportunities and threats of the European CE policy and its environmental implications. The findings demonstrated a positive relationship between CE practices and environmental policies and strategies. Similarly, the recent study by Bekun et al. [51] found an asymmetric association between the consumption of coal energy, urban population, emission levels, and economic progress, particularly in the context of South Africa.

CE practices help to reduce waste, greenhouse gas emissions, and resource depletion [8]. These benefits will eventually provide an opportunity to strengthen corporate liaison with environmental authorities [52]. Businesses are also able to increase their profits while simultaneously helping the environment, only with the help of unique methods of CE, i.e., recycling and reusing [53].

By following CE standards, businesses can enhance their environmental performance and reduce the likelihood of breaking the law [54, 55], thus being able to avoid penalties [56]. There are fewer chances of facing fines and legal actions in the long run if CE practices are observed. There are also some other ways for businesses to demonstrate their concern for the environment, e.g., corporate social and environmental responsibilities. By adhering to the said responsibilities, businesses can attract more customers and investors and thereby achieve better financial performance [57, 58].

The extreme mining of resources and undue manufacturing both have significant negative effects on the environment, while CE processes can help to reduce these adverse impacts [59]. New materials are less necessary as a result of CE regulations, which lower energy demand and GHG emissions [60, 61]. By implementing CE practices, businesses can reduce their reliance on valuable and scarce resources while also decreasing the quantity of waste they produce [62]. In this way, businesses can avoid disruptions

in the supply chain, produce a better environment, and enhance their reputation [63]. Based on the said arguments, we can hypothesize that:

H_2: CE practices have a positive impact on the environment.

Methodology

Data Source

The panel dataset is used to evaluate the environmental and business impacts of CE activities. This dataset contains data with a time span of twenty years from the World Development Indicator, which includes macro-level variables. The sample of the study consists of twenty-five countries (see Table 1). We only select countries that have sustainable economic conditions. Based on the said narrative, we consider access to modern technology and financial resources, as the previous literature also recognized that CE practices are more common in countries with access to modern technology and financial resources [64]. This approach provides a comprehensive understanding of the factors contributing to economic sustainability within our sample, enhancing the robustness and depth of our study.

Measurement of Variables

Dependent Variables

Both business performance and environmental consequences are considered dependent variables in this study. We employ three separate proxies to quantify corporate performance, all of which have been proposed in previous studies and offer substantial insight into business performance. Firstly, we use revenue growth, which shows how much a company's income grows over a specific time frame [65]. The second proxy is the return on investment, measured as the returns obtained by investors based on their investments [66]. The last proxy by which we measure corporate performance is earnings per share, calculated by the ratio of net income that goes to each common shareholder [67].

In this study, we quantify the environmental impact by using three proxies. Firstly, we use carbon footprints, measured as the overall emissions of greenhouse gases [68]. Secondly, the utilization of renewable energy sources is used as a proxy, e.g., hydropower, wind, and solar [69]. Thirdly, we use deforestation and the use of land as a proxy to measure environmental concerns [70].

Independent Variable

CE practices are the key independent variable in this study, and to measure them we incorporate three proxies. Firstly, resource efficiency is used, which indicates the overall usage of resources, particularly by corporations [71]. Secondly, we use extended producer responsibility, measured as the producers' responsibility towards the environment [72]. Lastly, we use the adoption of circular economic practices as a measure that represents product life extension, remanufacturing, and recycling [73].

Control Variables

We use various control variables to quantify the impact of CE practices on business and the environment. The first variable is the inflation rate, represented by the consumer price index. The second variable is foreign direct investment, particularly inbound FDI. The third variable is population density, calculated by dividing countries' total population by their land area. The fourth control variable is urban population, which is estimated as the number of people living in urban areas.

Model

Based on the construction of the dataset and the aforementioned variables, we develop two empirical models. Each model contains dependent, independent, and control variables. The first model determines the impact of CE practices on business performance. The second model evaluates the influence of CE practices on the environment.

$$Business\ Performance_{ik} = \beta_0 + \beta_1 CE\ Practices_{ik} + \Sigma_j^{02} \beta_j Control\ Variables_{ik} + \varepsilon_{ik} \quad (1)$$

$$Environmental\ Concerns_{ik} = \beta_0 + \beta_1 CE\ Practices_{ik} + \Sigma_j^{02} \beta_j Control\ Variables_{ik} + \varepsilon_{ik} \quad (2)$$

Table 1. Sample Countries.

Australia	Germany	Japan	Portugal	United Kingdom
Austria	Greece	Kuwait	Qatar	United States
Belgium	Ireland	New Zealand	Saudi Arabia	Spain
Canada	Israel	Norway	Singapore	Sweden
France	Italy	Oman	Switzerland	Netherlands

Empirical Analysis

Table 2 includes a compilation of summary statistics, which encompass the total number of observations, the mean value and standard deviation, as well as the minimum and maximum values of all the variables used for the purpose of analysis.

Table 3 displays the correlation coefficients, which provide information about the intensity, direction, and collinearity among the variables in the dataset. As per the reported values, there is no collinearity concern in the dataset.

The regression results reported in Table 4 show that resource efficiency has a positive and statistically significant impact on all three proxies for business performance, i.e., revenue growth, return on investment, and earnings per share. This indicates that higher resource efficiency is associated with improved business performance across the sample countries. These findings align with prior research that has highlighted a positive connection between resource efficiency and business performance within the realm of CE practices [37, 71]. CE practices support industries in reducing costs through improvements in resource usage. Businesses

Table 2. Summary Statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Revenue Growth	500	2.21	3.96	-11.32	26.17
Return on Investment	500	23.69	5.31	11.89	54.95
Earnings Per Share	500	27.26	10.85	4.66	66.89
Carbon Footprint	500	11.22	7.52	3.41	47.65
Renewable energy use	500	13.68	14.62	0	62.37
Deforestation and land use	500	26.41	18.54	0	69.09
Resource Efficiency	500	104.45	37.04	39.44	239.01
Extended Producer responsibility	500	0.22	0.11	0.06	0.58
Adoption of Circular Business Models	500	6.68	2.45	0	10
Inflation rate	500	1.81	1.91	-4.86	15.05
Foreign direct investment	500	4.64	9.77	-36.14	86.47
Population density	500	426.74	1391.41	2.53	7965.87
Urban population	500	81.64	11.34	55.67	100

Table 3. Correlation Matrix.

	1	2	3	4	5	6	7	8	9	10	11	12
2	0.31											
3	0.40	0.44										
4	0.33	0.39	0.52									
5	-0.14	-0.07	-0.13	-0.42								
6	-0.24	-0.17	-0.31	-0.50	0.59							
7	0.19	0.30	0.35	0.80	-0.17	-0.26						
8	0.16	0.21	0.20	0.80	-0.49	-0.49	0.80					
9	0.08	0.07	0.17	-0.13	-0.03	-0.01	0.04	-0.01				
10	0.31	0.18	0.20	0.32	-0.10	-0.23	0.27	0.28	0.01			
11	0.12	0.01	0.10	-0.08	-0.15	-0.14	-0.18	-0.16	0.11	-0.01		
12	0.21	0.05	0.32	-0.08	-0.21	-0.03	-0.19	-0.23	0.24	-0.04	0.34	
13	0.17	0.13	0.44	0.43	-0.32	-0.24	0.47	0.32	0.10	0.07	0.03	0.35

1 = Revenue Growth, 2 = Return on Investment, 3 = Earnings Per Share, 4 = Carbon Footprint, 5 = Renewable Energy Usage, 6 = Deforestation and Use of Land, 7 = Resource Efficiency, 8 = Extended Producer Responsibility, 9 = Adoption of Circular Business Models,10 = Inflation Rate, 11 = Foreign Direct Investment, 12 = Population Density, 13 = Urban Population

Table 4. Regression (CE Practices and Business Performance).

Dependent Variable Business Performance	Model – 1		
	Regression Estimates		
	Country – Year (Panel)		
	Revenue Growth	Return on Investment	Earnings Per Share
	Coefficients	Coefficients	Coefficients
Independent Variable			
Resource Efficiency	0.0178	0.0406	0.1044
	(3.85)***	(6.3)***	(8.21)***
Control Variables			
Inflation rate	0.5636	0.3114	0.6230
	(6.35)***	(2.53)**	(2.56)**
Foreign direct investment	0.1002	0.0323	0.1877
	(5.92)***	(1.37)*	(4.04)***
Model Statistics			
Number of Observations	500	500	500
F – Stats	33.68	19.76	32.84
Prob. > F-Stats	0.0000	0.0000	0.0000
R-squared	0.1692	0.1068	0.1657
Adjusted R-squared	0.1642	0.1013	0.1606

*p<0.1, **p<0.05, ***p<0.01 t statistics in parentheses

Table 5. Regression (CE Practices and Business Performance). [Robustness Check]

Dependent Variable Business Performance	Model – 1	
	Regression Estimates (Robustness Check)	
	Country – Year (Panel)	
	Return on Investment	Earnings Per Share
	Coefficients	Coefficients
Independent Variable		
Extended Producer responsibility	8.9369	18.0221
	(3.97)***	(3.95)***
Control Variables		
Inflation rate	0.3778	0.8753
	(2.98)**	(3.41)***
Foreign direct investment	0.0203	0.1480
	(0.85)**	(3.05)***
Model Statistics		
Number of Observations	500	500
F – Stats	11.47	14.62
Prob.>F-Stats	0.0000	0.0000
R-squared	0.0649	0.0812
Adjusted R-squared	0.0592	0.0757

*p<0.1, **p<0.05, ***p<0.01 t statistics in parentheses

can also receive benefits. By designing new products and processes that give importance to reducing waste and optimizing the available resources, these steps could significantly enhance sustainable corporate performance [39, 40].

To robustly check the aforementioned findings, we change our proxy for CE practices to extended producer responsibility. The findings in Table 5 showed that extended producer responsibility had a positive and statistically significant effect on both return on investment and earnings per share. This suggests that greater emphasis on extended producer responsibility is associated with improved business performance. The fact that extended producer responsibility encourages more sustainable and effective use of resources, which can result in cost savings and increased productivity, explains the relationship between financial performance and CE practices [74].

In Table 6, we use our third variable, the CE model (i.e., adoption of the circular business model), as an additional robustness check. Table 5 reveals that the adoption of circular business models has a negative and marginally significant effect on return on investment, indicating that companies with a higher degree of circular business practices may experience a lower return on investment. However, it has a highly significant negative impact on earnings per share, suggesting that the adoption of circular business models is associated with lower earnings per share. This negative relationship reinforces the notion that companies implementing circular practices may face challenges in generating higher earnings for their shareholders [75].

Table 7 provides insights into the environmental consequences of CE practices using resource efficiency as a proxy variable. The coefficients of resource efficiency suggest that improved resource efficiency practices have a highly significant effect on environmental consequences. These findings align with previous studies that have emphasized the positive contribution of resource efficiency measures to environmental sustainability [76]. CE practices significantly decrease waste, control emissions, and manage the reduction of resources. These outcomes could subsequently enhance the opportunity to boost corporate relations as well as create a better environment. In return for profit, businesses simultaneously adopt sustainable practices and unique methods and eventually improve the environment [8, 53].

Table 8 shows that extended producer responsibility emerges as a highly influential variable, exhibiting a substantial and statistically significant positive effect on the environment, as evidenced by the coefficient obtained in the analysis. This outcome suggests that companies that embrace and implement extended producer responsibility, thereby assuming greater accountability for their products throughout their

Table 6. Regression (CE Practices and Business Performance). [Robustness Check]

Dependent Variable Business Performance	Model – 1	
	Regression Estimates (Robustness Check)	
	Country – Year (Panel)	
	Return on Investment	Earnings Per Share
	Coefficients	Coefficients
Independent Variable		
Adoption of Circular Business Models	-0.1624	-0.8326
	(-1.69)*	(-4.34)***
Control Variables		
Inflation rate	0.5273	1.1861
	(4.29)***	(4.84)***
Foreign direct investment	0.0090	0.1392
	(0.37)	(2.9)**
Model Statistics		
Number of Observations	500	500
F – Stats	7.03	15.76
Prob.>F-Stats	0.0001	0.0000
R-squared	0.0408	0.0870
Adjusted R-squared	0.035	0.0815

*p<0.1, **p<0.05, ***p<0.01 t statistics in parentheses

Table 7. Regression (CE Practices and Environment).

Dependent Variable Environmental Consequences	Model – 2		
	Regression Estimates		
	Country – Year (Panel)		
	Carbon Footprint	Renewable Energy Use	Deforestation & Land Use
	Coefficients	Coefficients	Coefficients
Independent Variable			
Resource Efficiency	-0.1634	0.0392	-0.0997
	(-24.18)***	(1.86)**	(-3.65)***
Control Variables			
Population density	0.0003	-0.0017	-0.0003
	(1.85)**	(-3.13)***	(-0.48)**
Urban population	0.0230	-0.2821	-0.2267
	(0.99)	(-3.9)***	(-2.42)**
Model Statistics			
Number of Observations	500	500	500
F – Stats	322.16	22.92	15.66
Prob.>F-Stats	0.0000	0.0000	0.0000
R-squared	0.6609	0.1218	0.0865
Adjusted R-squared	0.6588	0.1165	0.0810

*p<0.1, **p<0.05, ***p<0.01 t statistics in parentheses

Table 8. Regression (CE Practices and Environment). [Robustness Check]

Dependent Variable Environmental Consequences	Model – 2		
	Regression Estimates (Robustness Check)		
	Country – Year (Panel)		
	Carbon Footprint	Renewable Energy Use	Deforestation & Land Use
	Coefficients	Coefficients	Coefficients
Independent Variable			
Extended Producer responsibility	-52.4184	76.3144	-89.7523
	(-26.21)***	(13.64)***	(-11.87)***
Control Variables			
Population density	0.0001	-0.0036	-0.0020
	(0.88)	(-8.18)***	(-3.41)***
Urban population	0.1220	-0.0192	-0.0274
	(6.13)***	(-0.35)	(-0.36)
Model Statistics			
Number of Observations	500	500	500
F – Stats	368.31	91.72	61.43
Prob.>F-Stats	0.0000	0.0000	0.0000
R-squared	0.6902	0.3568	0.2695
Adjusted R-squared	0.6883	0.3529	0.2651

*p<0.1, **p<0.05, ***p<0.01 t statistics in parentheses

Table 9. Regression (CE Practices and Environment). [Robustness Check]

Dependent Variable Environmental Consequences	Model – 2		
	Regression Estimates (Robustness Check)		
	Country – Year (Panel)		
	Carbon Footprint	Renewable Energy Use	Deforestation & Land Use
	Coefficients	Coefficients	Coefficients
Independent Variable			
Adoption of Circular Business Models	-0.4083	3252.3990	-0.1141
	(-3.36)***	(7.38)***	(-13.39)***
Control Variables			
Population density	-0.0013	-4.2467	0.0003
	(-5.87)***	(-5.16)***	(1.50)*
Urban population	0.3596	37.9026	-0.1051
	(13.26)***	(0.39)	(-3.60)***
Model Statistics			
Number of Observations	500	500	500
F – Stats	63.48	22.64	73.25
Prob. > F-Stats	0.0000	0.0000	0.0000
R-squared	0.2774	0.1204	0.3070
Adjusted R-squared	0.2731	0.1151	0.3028

*p<0.1, **p<0.05, ***p<0.01 t statistics in parentheses

lifecycle, play a pivotal role in contributing to a higher environmental impact [77].

According to the results presented in Table 9, the adoption of circular business models demonstrates a highly significant impact on the environment, i.e., lowering the carbon footprint, increasing the use of renewable energy, and reducing deforestation. These results indicate that companies implementing circular practices contribute to lower carbon emissions and deforestation and enhance renewable energy usage. These results are in line with the previous studies [78].

Conclusions

This paper explores the impact of CE practices on corporate performance and the environment. The present study used data from the World Bank and quantified the variables using various proxies. Particularly, macro-level data is compiled for twenty years, and a sample of twenty-five countries is selected. The results support our study's hypotheses and verify that incorporating CE methods into corporate operations can lead to cost savings via improved efficiency, resource security, eco-innovation, and healthy competition. The said benefits will eventually turn into higher profitability, shareholder value, the creation of new jobs, and financial prospects. In addition, the CE model can also help the environment by reducing waste, decreasing emissions of greenhouse gases, and solving the issue of resource depletion. Businesses have the opportunity to meet environmental standards and cut costs linked to managing waste, thus avoiding fines and penalties.

Businesses would do well to consider the possible benefits of adopting CE practices, as highlighted by the research findings. Policymakers can use these findings to formulate effective policies that encourage businesses to adopt CE practices, thus contributing to sustainable development goals. This study does have certain limitations as well. Firstly, this study only uses macroeconomic variables to determine the business and environmental impact of CE practices; however, future studies can use micro-level or firm-level data to explore the said nexus. Secondly, we only consider economically stable countries for empirical analysis; however, researchers can consider including data from both developed and developing countries and identify the variation in the results.

Acknowledgments

The research was supported by the project "SPEV–2103, Economic Impacts under the Industry 4.0, Societies 5.0 & 6.0 Concept", 2024, University of Hradec

Králové, Faculty of Informatics and Management, Czech Republic.

Conflict of Interest

The authors declare no conflict of interest.

References

1. MAGUIRE S., ROBSON I. The Origins of the Circular Economy. Emerald Publishing Limited, **2023**.
2. CUI Z., LIU X., LU S., LIU Y. Dynamic Comprehensive Evaluation of the Development Level of China's Green and Low Carbon Circular Economy under the Double Carbon Target. Development, **12**, 14, **2023**.
3. OBERLE B., BRINGEZU S., HATFIELD-DODDS S., HELLWEG S., SCHANDL H., CLEMENT J. Global resources outlook: 2019. International Resource Panel, United Nations Envio, Paris, France, **2019**.
4. GUAN L., LI W., GUO C., HUANG J. Environmental strategy for sustainable development: Role of digital transformation in China's natural resource exploitation. Resources Policy. **87**, 104304, **2023**.
5. EISELEIN P., KEYGNAERT W., BRABANT K. Developing Sustainable Partnerships for Circular Economies: A Literature Review. Stakeholder Engagement in a Sustainable Circular Economy, 99, **2023**.
6. RASHID S., MALIK S. Transition from a Linear to a Circular Economy. In Circular Economy and Sustainability, pp.1, Springer, **2023**.
7. NG C.G., YUSOFF S., ZAMAN N.S.B.K., SIEWHUI C. Assessment on the Quality and Environmental Impacts of Composting at Institutional Community using Life Cycle Assessment Approach. Polish Journal of Environmental Studies, **30** (3), **2021**.
8. YANG M., CHEN L., WANG J., MSIGWA G., OSMAN A.I., FAWZY S., ROONEY D.W., YAP P.-S. Circular economy strategies for combating climate change and other environmental issues. Environmental Chemistry Letters, **21** (1), 55, **2023**.
9. MAHARDHANI A.J. The Role of Public Policy in Fostering Technological Innovation and Sustainability. Journal of Contemporary Administration and Management (ADMAN), **1** (2), 47, **2023**.
10. HE J., LAU W.T., LIU Y. Innovative Production Efficiency in Chinese High-Tech Industries during the 13th Five-Year Plan: Evidence from a Three-Stage DEA Model. Green and Low-Carbon Economy, **2** (1) **2023**.
11. KIRCHHERR J., YANG N.-H.N., SCHULZE-SPÜNTRUP F., HEERINK M.J., HARTLEY K. Conceptualizing the Circular Economy (Revisited): An Analysis of 221 Definitions. Resources, Conservation and Recycling, **194**, 107001, **2023**.
12. BEKUN F.V. Race to carbon neutrality in South Africa: what role does environmental technological innovation play? Applied Energy, **354**, 122212, **2024**.
13. GHOLIAN-JOUYBARI F., HAJIAGHAEI-KESHTELI M., BAVAR A., BAVAR A., MOSALLANEZHAD B. A design of a circular closed-loop agri-food supply chain network – A case study of the soybean industry. Journal of Industrial Information Integration. **36**, 100530, **2023**.
14. NKONYA E., KATO E., KABORE C. Impact of farmer-managed natural regeneration on resilience and welfare in Mali. Green and Low-Carbon Economy, **2** (1), 14, **2024**.
15. ZAMAN A., CACERES RUIZ A.M., SHOOSHTARIAN S., RYLEY T., CALDERA S., MAQSOOD T. Development of the circular economy design guidelines for the Australian built environment sector. Sustainability, **15** (3), 2500, **2023**.
16. CHENG Y., MASUKUJJAMAN M., SOBHANI F.A., HAMAYUN M., ALAM S.S. Green Logistics, Green Human Capital, and Circular Economy: The Mediating Role of Sustainable Production. Sustainability, **15** (2), 1045, **2023**.
17. BEKUN F.V. Mitigating emissions in India: accounting for the role of real income, renewable energy consumption and investment in energy. International Journal of Energy Economics and Policy, **12** (1), **2022**.
18. AMIR S., SALEHI N., ROCI M., SWEET S., RASHID A. Towards circular economy: A guiding framework for circular supply chain implementation. Business Strategy and the Environment, **32** (6), 2684, **2023**.
19. NANDI S., HERVANI A.A., HELMS M.M., SARKIS J. Conceptualising Circular economy performance with non-traditional valuation methods: Lessons for a post-Pandemic recovery. International Journal of Logistics Research and Applications, **26** (6), 662, **2023**.
20. GHISELLINI P., CIALANI C., ULGIATI S. A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. Journal of Cleaner Production, **114**, 11, **2016**.
21. HONG S., HUI E.C.M., LIN Y. Relationships between carbon emissions and urban population size and density, based on geo-urban scaling analysis: A multi-carbon source empirical study. Urban Climate, **46**, 101337, **2022**.
22. AGUIAR M.I., SOUSA A.F., TEIXEIRA G., TAVARES A.P., FERREIRA A.M., COUTINHO J.A. Enhancing plastic waste recycling: Evaluating the impact of additives on the enzymatic polymer degradation. Catalysis Today, **429**, 114492, **2024**.
23. SCHROEDER P., ANGGRAENI K., WEBER U. The relevance of circular economy practices to the sustainable development goals. Journal of Industrial Ecology, **23** (1), 77, **2019**.
24. SAWE F.B., KUMAR A., GARZA-REYES J.A., AGRAWAL R. Assessing people-driven factors for circular economy practices in small and medium-sized enterprise supply chains: Business strategies and environmental perspectives. Business Strategy and the Environment, **30** (7), 2951, **2021**.
25. KAZANCOGLU I., SAGNAK M., KUMAR MANGLA S., KAZANCOGLU Y. Circular economy and the policy: A framework for improving the corporate environmental management in supply chains. Business Strategy and the Environment, **30** (1), 590, **2021**.
26. LAHANE S., KANT R. Investigating the sustainable development goals derived due to adoption of circular economy practices. Waste Management, **143**, 1, **2022**.
27. GURA K.S., NICA E., KLIESTIK T., PUIME-GUILLÉN F. Circular economy in territorial planning strategy: Incorporation in cluster activities and economic zones. Environmental Technology & Innovation, **32**, 103357, **2023**.
28. DENNY D.M.T., CERRI C.E.P., CHERUBIN M.R., BURNQUIST H.L. Carbon Farming: Nature-Based Solutions in Brazil. Green and Low-Carbon Economy, **1** (3), **2023**.

29. BJØRNBET M.M., SKAAR C., FET A.M., SCHULTE K.Ø. Circular economy in manufacturing companies: A review of case study literature. Journal of Cleaner Production, **294**, 126268, **2021**.
30. RIZOS V., BEHRENS A., KAFYEKE T., HIRSCHNITZ-GARBERS M., IOANNOU A. The circular economy: Barriers and opportunities for SMEs. CEPS Working Documents, **2015**.
31. JOENSUU T., EDELMAN H., SAARI A. Circular economy practices in the built environment. Journal of Cleaner Production, **276**, 124215, **2020**.
32. CASTRO A.M., CASTRO J.M., BURGOS R.Y., SUQILANDA E.M. Circular economy and its impact on environmental sustainability. Centro Sur, **6** (4), **2022**.
33. BARROS M.V., SALVADOR R., DO PRADO G.F., DE FRANCISCO A.C., PIEKARSKI C.M. Circular economy as a driver to sustainable businesses. Cleaner Environmental Systems, **2**, 100006, **2021**.
34. SUCHEK N., FERNANDES C.I., KRAUS S., FILSER M., SJÖGRÉN H. Innovation and the circular economy: A systematic literature review. Business Strategy and the Environment, **30** (8), 3686, **2021**.
35. ARANDA-USÓN A., PORTILLO-TARRAGONA P., MARÍN-VINUESA L.M., SCARPELLINI S. Financial resources for the circular economy: A perspective from businesses. Sustainability, **11** (3), 888, **2019**.
36. GEISSDOERFER M., VLADIMIROVA D., EVANS S. Sustainable business model innovation: A review. Journal of Cleaner Production, **198**, 401, **2018**.
37. NELIGAN A., BAUMGARTNER R.J., GEISSDOERFER M., SCHÖGGL J.P. Circular disruption: Digitalisation as a driver of circular economy business models. Business Strategy and the Environment, **32** (3), 1175, **2023**.
38. MILANOVIĆ T., SAVIĆ G., MARTIĆ M., MILANOVIĆ M., PETROVIĆ N. Development of the waste management composite index using DEA method as circular economy indicator: the case of European Union countries. Polish Journal of Environmental Studies, **31** (1), 771, **2022**.
39. AITHAL S., AITHAL P. Importance of Circular Economy for Resource Optimization in Various Industry Sectors – A Review-based Opportunity Analysis. International Journal of Applied Engineering and Management Letters (IJAEML), **7** (2), 191, **2023**.
40. PUNTILLO P. Circular economy business models: Towards achieving sustainable development goals in the waste management sector – Empirical evidence and theoretical implications. Corporate Social Responsibility and Environmental Management, **30** (2), 941, **2023**.
41. DWIVEDI A., SASSANELLI C., AGRAWAL D., GONZALEZ E.S., D'ADAMO I. Technological innovation toward sustainability in manufacturing organizations: A circular economy perspective. Sustainable Chemistry and Pharmacy, **35**, 101211, **2023**.
42. DE VASS T., NAND A.A., BHATTACHARYA A., PRAJOGO D., CROY G., SOHAL A., ROTARU K. Transitioning to a circular economy: lessons from the wood industry. The International Journal of Logistics Management, **34** (3), 582, **2023**.
43. KUHLMANN M., BENING C.R., HOFFMANN V.H. How incumbents realize disruptive circular innovation-Overcoming the innovator's dilemma for a circular economy. Business Strategy and the Environment, **32** (3), 1106, **2023**.
44. CANO J.A., LONDOÑO-PINEDA A.A., CAMPO E.A., FERNÁNDEZ S.A. Sustainable business models of e-marketplaces: An analysis from the consumer perspective. Journal of Open Innovation: Technology, Market, and Complexity, **9** (3), 100121, **2023**.
45. HART S.L., MILSTEIN M.B. Creating sustainable value. Academy of Management Perspectives, **17** (2), 56, **2003**.
46. FRAIHAT B.A.M., ADNAN BATAINEH K., ALN'EMI E.A.S., AHMAD A.Y.B., DAOUD M.K., ALMASARWEH M.S. How corporate social responsibility enhances reputation, and organizational brand image? Journal of Namibian Studies: History Politics Culture, **33**, 5216, **2023**.
47. SUNDAR D., MATHIYAZHAGAN K., AGARWAL V., JANARDHANAN M., APPOLLONI A. From linear to a circular economy in the e-waste management sector: Experience from the transition barriers in the United Kingdom. Business Strategy and the Environment, **32** (7), **2023**.
48. ANTONIOLI D., GHISETTI C., MAZZANTI M., NICOLLI F. Sustainable production: The economic returns of circular economy practices. Business Strategy and the Environment, **31** (5), 2603, **2022**.
49. ABAD-SEGURA E., FUENTE A.B.D.L., GONZÁLEZ-ZAMAR M.-D., BELMONTE-UREÑA L.J. Effects of circular economy policies on the environment and sustainable growth: Worldwide research. Sustainability, **12** (14), 5792, **2020**.
50. CAMILLERI M.A. European environment policy for the circular economy: Implications for business and industry stakeholders. Sustainable Development, **28** (6), 1804, **2020**.
51. BEKUN F.V., ETOKAKPAN M.U., AGBOOLA M.O., UZUNER G., WADA I. Modelling Coal Energy Consumption and Economic Growth: Does Asymmetry Matter in the Case of South Africa? Polish Journal of Environmental Studies, **32** (3), 2029, **2023**.
52. CAMPBELL GEMMELL J., MARIAN SCOTT E. Environmental regulation, sustainability and risk. Sustainability Accounting, Management and Policy Journal, **4** (2), 120, **2013**.
53. HAN D., KALANTARI M., RAJABIFARD A. Building information modeling (BIM) for construction and demolition waste management in Australia: A research agenda. Sustainability, **13** (23), 12983, **2021**.
54. KARMAKER C.L., AL AZIZ R., AHMED T., MISBAUDDIN S., MOKTADIR M. A. Impact of industry 4.0 technologies on sustainable supply chain performance: The mediating role of green supply chain management practices and circular economy. Journal of Cleaner Production, **419**, 138249, **2023**.
55. BEKUN F.V., ADEKUNLE A.O., GBADEBO A.D., ALHASSAN A., AKANDE J. O., YUSOFF N.Y.M. Sustainable electricity consumption in South Africa: the impacts of tourism and economic growth. Environmental Science and Pollution Research, **30** (42), 96301, **2023**.
56. REN Q., ALBRECHT J. Toward circular economy: The impact of policy instruments on circular economy innovation for European small medium enterprises. Ecological Economics, **207**, 107761, **2023**.
57. SAHOO S., KUMAR A., UPADHYAY A. How do green knowledge management and green technology innovation impact corporate environmental performance? Understanding the role of green knowledge acquisition. Business Strategy and the Environment, **32** (1), 551, **2023**.
58. BEKUN F.V., GYAMFI B.A., KÖKSAL C., TAHA A. Impact of financial development, trade flows, and institution on environmental sustainability in emerging markets. Energy & Environment, **2023**.
59. BIANCHI M., CORDELLA M. Does circular economy mitigate the extraction of natural resources? Empirical

evidence based on analysis of 28 European economies over the past decade. Ecological Economics, **203**, 107607, **2023**.
60. DAS A., CHOWDHURY A.R. Energy Decarbonization via Material-Based Circular Economy. In Renewable Energy in Circular Economy, pp. 263, Springer, **2023**.
61. QUITO B., DEL RÍO M.D.L.C., ÁLVAREZ-GARCÍA J., BEKUN F.V. Spatiotemporal influencing factors of energy efficiency in 43 european countries: A spatial econometric analysis. Renewable and Sustainable Energy Reviews, **182**, 113340, **2023**.
62. SHARMA M., JOSHI S., PRASAD M., BARTWAL S. Overcoming barriers to circular economy implementation in the oil & gas industry: Environmental and social implications. Journal of Cleaner Production, **391**, 136133, **2023**.
63. REZANIA S., ORYANI B., NASROLLAHI V.R., DARAJEH N., LOTFI GHAHROUD M., MEHRANZAMIR K. Review on Waste-to-Energy Approaches toward a Circular Economy in Developed and Developing Countries. Processes, **11** (9), 2566, **2023**.
64. LIEDER M., RASHID A. Towards circular economy implementation: a comprehensive review in context of manufacturing industry. Journal of Cleaner Production, **115**, 36, **2016**.
65. CUI Q., HU Y.-X., YU L.-T. Can the aviation industry achieve carbon emission reduction and revenue growth simultaneously under the CNG2020 strategy? An empirical study with 25 benchmarking airlines. Energy, **245**, 123272, **2022**.
66. PANAIT M., HYSA E., RAIMI L., KRUJA A., RODRIGUEZ A. Guest editorial: Circular economy and entrepreneurship in emerging economies: Opportunities and challenges. Journal of Entrepreneurship in Emerging Economies, **14** (5), 673, **2022**.
67. RAHMAWATI Y., HADIAN H.N. The influence of debt equity ratio (DER), earning per share (EPS), and price earning ratio (PER) on stock price. International Journal of Financial, Accounting, and Management, **3** (4), 289, **2022**.
68. WIPRÄCHTIGER M., HAUPT M., FROEMELT A., KLOTZ M., BERETTA C., OSTERWALDER D., BURG V., HELLWEG S. Combining industrial ecology tools to assess potential greenhouse gas reductions of a circular economy: Method development and application to Switzerland. Journal of Industrial Ecology, **27** (1), 254, **2023**.
69. RAZI F., DINCER I. Renewable energy development and hydrogen economy in MENA region: A review. Renewable and Sustainable Energy Reviews, **168**, 112763, **2022**.
70. BALBONI C., BERMAN A., BURGESS R., OLKEN B.A. The economics of tropical deforestation. Annual Review of Economics, **15**, 723, **2023**.
71. SUN Y., GAO P., TIAN W., GUAN W. Green innovation for resource efficiency and sustainability: Empirical analysis and policy. Resources Policy, **81**, 103369, **2023**.
72. JENKINS S., KUIJPER M., HELFERTY H., GIRARDIN C., ALLEN M. Extended producer responsibility for fossil fuels. Environmental Research Letters, **18** (1), 011005, **2023**.
73. SINGH R., KHAN S., DSILVA J. A framework for assessment of critical factor for circular economy practice implementation. Journal of Modelling in Management, **18** (5), 1476, **2023**.
74. GEISSDOERFER M., SAVAGET P., BOCKEN N.M., HULTINK E.J. The Circular Economy–A new sustainability paradigm? Journal of Cleaner Production, **143**, 757, **2017**.
75. JABBOUR C.J.C., SEURING S., DE SOUSA JABBOUR A.B.L., JUGEND D., FIORINI P.D.C., LATAN H., IZEPPI W.C. Stakeholders, innovative business models for the circular economy and sustainable performance of firms in an emerging economy facing institutional voids. Journal of Environmental Management, **264**, 110416, **2020**.
76. MIKHNO I., KOVAL V., SHVETS G., GARMATIUK O., TAMOŠIŪNIENĖ R. Green economy in sustainable development and improvement of resource efficiency. Central European Business Review, **10** (1), 99, **2021**.
77. GUPT Y., SAHAY S. Review of extended producer responsibility: A case study approach. Waste Management & Research, **33** (7), 595, **2015**.
78. MUTEZO G., MULOPO J. A review of Africa's transition from fossil fuels to renewable energy using circular economy principles. Renewable and Sustainable Energy Reviews, **137**, 110609, **2021**.