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Article

Examining Circular Economy Practices and Sustainability Performance in Knowledge-Based Companies in Iran

Amfiteatru Economic Journal

Provided in Cooperation with:

The Bucharest University of Economic Studies

Suggested Citation: Khodaparasti, Ramin Bashir; Garabollagh, Hooshmand Bagheri (2023) : Examining Circular Economy Practices and Sustainability Performance in Knowledge-Based Companies in Iran, Amfiteatru Economic Journal, ISSN 2247-9104, The Bucharest University of Economic Studies, Bucharest, Vol. 25, Iss. 62, pp. 196-212, <https://doi.org/10.24818/EA/2023/62/196>

This Version is available at:

<https://hdl.handle.net/10419/281699>

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EXAMINING CIRCULAR ECONOMY PRACTICES AND SUSTAINABILITY PERFORMANCE IN KNOWLEDGE-BASED COMPANIES IN IRAN

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<p>Please cite this article as: Bashir Khodaparasti, R. and Bagheri Garabollagh, H., 2023. Examining Circular Economy Practices and Sustainability Performance in Knowledge-Based Companies in Iran. <i>Amfiteatru Economic</i>, 25(62), pp. 196-212.</p> <p>DOI: 10.24818/EA/2023/62/196</p>	<p>Article History Received: 23 August 2022 Revised: 3 November 2022 Accepted: 5 December 2022</p>
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Abstract

The present study, relying on the resource- and industry-based views and stakeholders, has developed a model that shows the role of technology adoption, ways to reduce waste to zero, uncertainty in the market and green economic incentives in promoting circular economy practices, and improvement of the sustainability performance of knowledge-based companies. This paper used a quantitative research approach and a structured questionnaire tool, in which survey data was collected from managers and experts of knowledge-based companies to test hypotheses using structural equation modeling (SEM). The statistical population of the research was all managers and experts from knowledge-based companies in the field of electronic and electrical equipment production in Iran, numbering 384 people. The results showed that technology adoption, zero waste practices, and green economic incentives have a positive and significant effect on circular economy practices, while uncertainty in the market does not have a significant effect on circular economy practices. The results also showed that circular economy practices have a positive and significant effect on the sustainability performance of knowledge-based companies. In addition, the circular economy practices and the company's sustainability performance could be improved by adopting of circular economy entrepreneurship as a moderating variable.

Keywords: Circular economy practices, technology adoption, zero waste practices, green economic incentives, sustainable performance of knowledge-based companies.

JEL Classification: A10, L26, Q01, Q53, Q55

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Introduction

The necessity of organizational sustainability has caused companies to resort to circular economy practices to find a solution to eliminate negative social and environmental effects on their activities (Agyabeng-Mensah et al., 2021). The speed and continuity of the destruction of natural resources, the increase in environmental pollution, and the increase in global warming have pushed countries towards the circular economy with the aim of ensuring the purchase of reprocessing, production, and supply of resources for the improvement and health of people. The concept of circular economy is a model of production and consumption that includes sharing, renting, reusing, repairing, renovating, and recycling existing materials and products as much as possible. In other words, the circular economy is a set of measures to improve environmental sustainability (Pietzsch et al., 2017). Circular economy is based on the efficiency of using resources, especially urban and industrial waste (Abou Taleb and Al Farooque, 2021). The operation of circular economy practices depends on the decision-making of all comprehensive stakeholders. Some companies have taken practical steps with the aim of developing the necessary structures and proceedings to create sharing, transfer of science, and awareness (Pigosso and McAlloone, 2021). This practice finally helps to review and revise the current traditional production process and adopt modern practices, including zero waste and lean management, to produce higher quality products, reuse and recycle goods and resources with the aim of achieving the goals of the circular economy (Karuppiah et al., 2021). According to the report of the World Economic Forum, the adoption of the circular economy leads to the growth of the gross domestic product by 0.8 to 7 percent, adds 0.2 to 3 percent more jobs, reduces carbon emissions by 8 to 70 percent, leads to economic growth and business effectiveness in developing countries. Although the implementation of the circular economy has been comprehensively investigated in developed economies such as England, the USA, Australia, European countries, China and a few developing economies such as Mexico and India, empirical research on the factors influencing the acceptance of the circular economy in emerging economies (low- and middle-income economies) is still few (Mazur-Wierzbicka, 2021; Dey et al., 2022).

The existing literature shows that the circular economy has a great potential to achieve sustainability goals; because it can significantly reduce waste and ultimately improve the sustainability performance of the company. Some studies also argue that the circular economy can minimize the consumption of natural resources without affecting consumption (Khan et al., 2021). At the same time, modern technologies play an important role in facilitating circular economy practices. For example, the development of digital networks to facilitate the flow of information about the supply chain process can significantly reduce waste and improve decision-making toward a circular economy. Therefore, investigating the role of technology adoption in the implementation of the circular economy system and achieving the goals of sustainable development of companies is highly needed (Bockel et al., 2021). The insight and exploitation of entrepreneurship in the field of circular economy are limited in the existing literature. One of the few examples available in the literature is Cullen and DeAngelis (2021) article, which measured circular entrepreneurship from a business model viewpoint. It is worth mentioning that one of the important goals of knowledge-based companies is the circular economy to preserve limited resources for future generations by relying on technology and recycling methods. Second, knowledge-based companies are the driving force of the national, regional, and global economy. Since these companies can contribute to the transformation of environmental conditions, seriousness in applying

environmental standards can pave the way for the commercialization of the products of these companies. Furthermore, considering that Iran has a very high capacity in terms of renewable energy, scientific companies can help develop renewable energy technology and reduce environmental pollution in the country by entering this field. Furthermore, according to the perspective of stakeholder theory, the company's efforts to apply circular economy practices for green economy incentives toward sustainability show business coherence. This flexibility in responsive strategy reflects the responsibility of businesses towards stakeholders. By doing this, businesses get better coordination from stakeholders. Hence, this leads to a sustainable corporate practice that improves productivity and recycling intensity and reduces greenhouse gas emissions. Therefore, to achieve this goal, the following research questions are formulated:

- What are the effects of multiple factors (such as: technology adoption, zero waste practices, etc.) on circular economy practices?
- How do circular economy practices (design, supply, production, distribution, consumption and recovery) promote sustainable performance for knowledge-based companies in the field of electrical and electronic equipment manufacturing in emerging economies?
- How does circular economy entrepreneurship moderate the effect of circular economy practices on sustainability performance?

The contribution of this article can guide managers in their efforts to improve the company's sustainability performance. Also, the novelty of this study is to provide scientific knowledge and practical mechanisms for the introduction and application of circular economy practices to business behaviours and practices in a real-world context which exists as a research gap in the current literature. The following sections include a review of the literature and the research methodology. Next, the research results, discussions, and conclusions are presented. Finally, the limitations of research are highlighted.

1. Literature review, theoretical model and hypothesis development

1.1. Technology adoption

The resource-based perspective is based on organizational internal resources and is used in our study to investigate the role of digital organizational capabilities in the implementation of circular economy practices. Jakhar et al. (2018) believe that the principles of circular economy are advanced methods that are created using intellectual and physical resources. Digital platforms can allow companies to transform their processes and become more adjustable to achieve sustainable business performance and decrease risk (Rodríguez-Espíndola et al., 2022). Studies show that it is necessary to investigate the impact of technology adoption on corporate sustainability performance and circular economy practices, especially in developing countries (Machado et al., 2020). Khan et al. (2021) in a study examining digital technology and circular economy practices found that blockchain technology has a positive and significant effect on circular economy practices. Therefore:

H1: Technology adoption has a positive effect on circular economy practices.

1.2. Zero waste practices

Waste management emphasizes more on the waste pyramid, which indicates the importance of preventing the accumulation of dry waste (Fatimah et al., 2020). However, in the hierarchy of solid waste, the complete reduction of waste in the material production cycle is not foreseen (Van Ewijk and Stegemann, 2016). Seadon (2010) states that a reductionist method cannot be sustained. Therefore, there is a need for the presence of feedback circuits, i.e., focusing on process adaptation and waste elimination, as well as a more complex approach for dry waste management in a developing and sustainable society. Current societal, environmental, and economic demands require methods to identify and ensure the transformation of waste into resources and the optimal use of materials (Fudala-Ksiazek et al., 2016). Zero waste practices protect the environment, reduce costs, and bring more jobs back into the industrial cycle in waste control and management, which strongly supports sustainability (Pietzsch et al., 2017). Therefore, it can be hypothesized that:

H2: Zero waste practices have a positive effect on circular economy practices.

1.3. Uncertainty in the market

The industry-based perspective focuses on the industry environment and often includes uncertainty in the market. Uncertainty in the market includes the number of changes made over time and in a business in the composition of customers and their Predominance (Peng et al., 2020). Companies are trying to be risk averse to market uncertainty and prioritizing their profitability needs over long-term initiatives such as the circular economy (Games and Rendi, 2019). Jesus and Mendonsa (2018) introduce the market as the main background of the circular economy. In fact, higher levels of uncertainty and external factors (turbulent conditions) can make companies more risk-averse and affect the implementation of sustainable practices (Kirchherr et al., 2018). The findings of Rodirguez-Spindola et al. (2022) indicate that uncertainty in the market has a positive and significant effect on technology adoption. Therefore, it can be hypothesized that:

H3: Uncertainty in the market has a positive effect on circular economy practices.

1.4. Green economic incentives

Incentives are benefits that include financial or supplemental rewards that encourage the design or adoption of environmental practices. Green economic incentives positively influence the company's decision-making process and improve internal capabilities, although many SMEs believe that additional investment in the circular economy costs more than the expected returns (Chang et al., 2011). The incentive rewards that influence managers' behavior toward a circular economy are subsidies, grants, and tax concessions. In addition, financial support can drive the company's internal capabilities to implement circular practices toward green production (Centobelli et al., 2021; Alonso-Almeida et al., 2021). The current study considers components of green economic incentives to include premium prices for green products, tax benefits, government subsidies, and recycled raw materials at lower prices. Based on the existing literature on the relationship between circular economy practices, environmental commitment, and green economic incentives (Hosseini-Motlagh et al., 2020), it is hypothesized that:

H4: Green economic incentives positively affect circular economy practices.

1.5. Circular economy practices and sustainable performance

The circular economy changes the traditional linear business model to a circular one (design, supply, production, consumption, and recovery) using the principles of reduction, reuse, and recycling (Prieto-Sandoval et al., 2018). Elkington (1998) incorporated the idea of sustainability using the concept of triple bottom line which is the base of the three economic, social, and environmental pillars. Moving toward sustainability presents important challenges for small- and medium-sized companies (Games and Rendi, 2019). Therefore, knowledge-based companies are trying to introduce sustainable practices. Knowledge-based companies play a key role in implementing a circular economy. In knowledge-based companies, it is important to link the application of circular economy practices with sustainable performance to ensure real improvement, especially to facilitate and guide the transfer. An analysis of the relationship between environmental performance, circular economy practices, and the consequences of sustainability practices on financial and environmental performance has been conducted, but the literature is not conclusive. Studies show that it seems important to think more about the impact of circular economy practices on the dimensions of sustainability performance in companies. Based on this, it can be argued that circular economy practices have a positive relationship with sustainable company performance and sustainable supply chain management. This argument is consistent with the stakeholder theory and the resource-based perspective theory (Velenturf and Purnell, 2021). As a result, the following hypothesis can be formulated:

H5: Circular economy practices have a significant effect on sustainability performance.

1.6. Circular economy entrepreneurship

Circular economy entrepreneurship refers to the discovery and exploitation of opportunities in the field of circular economy. Based on this, all activities related to the company's business are oriented in a way that includes environmental and social issues in the direction of sustainable development. Many fluctuations and disruptions in the supply chain affect the security of the food supply chain. Hence, entrepreneurship tends toward sustainability in order to improve resource efficiency and protect the environment (Nikolaou et al., 2018).

Circular economy entrepreneurship includes promoting the circular economy through innovative products, services, and business models. People welcome positive innovation by taking advantage of new opportunities. In this context, circular economy entrepreneurship is related to the innovative and successful spirit of existing businesses or start-ups, focusing on moving the supply chain towards sustainability.

In this study, the circular economy entrepreneurship construct was developed based on references to previous research by Cullen and De Angelis (2021) and Lynde (2020). Accordingly, circular economy entrepreneurship consists of the following four items: Positive feedback from entrepreneurial opportunities, combining environmental and social advantages, innovating business models towards a circular economy, and sharing resources to increase the overall performance of society (Cullen and De Angelis, 2021). According to the above discussion, circular economy entrepreneurship can be related to circular economy

practices in guiding sustainable supply chain management and sustainable performance of the company in such a way that it continuously discovers and examines entrepreneurial opportunities in the field of circular economy. In this regard, entrepreneurial opportunities are related to the goal of turning waste into economic value. This stream of discussion is consistent with resource-based theory and stakeholder theory. Based on the topics presented, the sixth hypotheses is formulated:

H6: Circular economy entrepreneurship moderates the influence of Circular economy practices on Sustainable performance.

The model developed for the present study is based on the above literature. The proposed model consists of seven variables with different roles as follows: technology adoption, zero waste practices, uncertainty in the market, and green economic incentives are independent variables. Circular economy practices are a mediating variable. Sustainability performance of knowledge-based companies is a dependent variable, and circular economy entrepreneurship is a moderating variable. The research conceptual model is shown in figure no. 1.

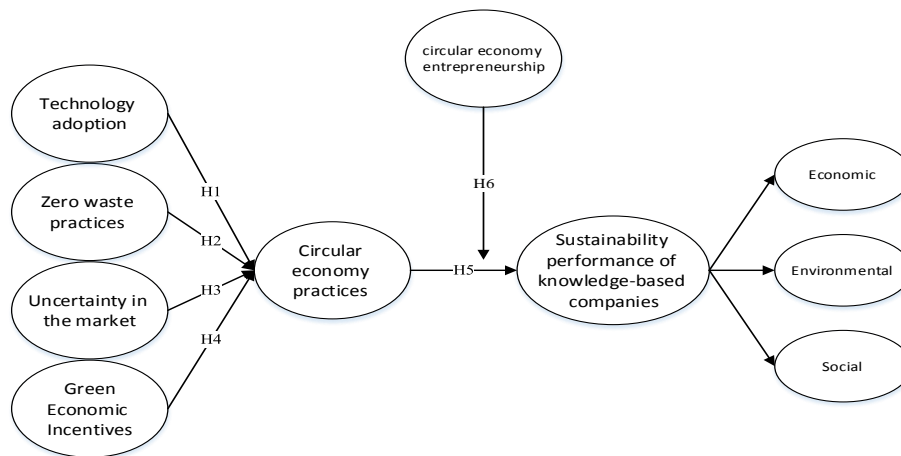


Figure no. 1. Conceptual model of research

2. Methodology

2.1. Research methods

For the implementation of this research, a quantitative approach and a structured questionnaire were used, which were distributed among the members of the statistical sample by the researcher himself. The survey was conducted from April 2022 to July 2022. Managers and experts of knowledge-based companies that are environmentally oriented are the statistical population of this research. In the process of data collection, 6923 knowledge-based companies have been approved in Iran, and from among these companies 3092, companies are engaged in the production of electronic and electrical equipment (daneshbonyan.isti.ir). Since the total number of managers and experts belonging to these companies is 21,644 people, as a result, based on the Krejcie-Morgan table, the required sample size was 377 people. For more certainty, 400 standard questionnaires were distributed

among managers and experts by simple random sampling method. Among these, several questionnaires were removed due to errors in answering the questions, and only 384 questionnaires were kept and used for the purpose of analysis and review. Cronbach's alpha coefficient was used to ensure the reliability of the research variables. The data was coded using the Statistical SPSS.

2.2. Data analysis

After a complete review of the available literature, the scales used in this study were selected. Then, using the study of Gehlbach and Brincourt (2011), the Q-Sort method was used to determine whether the classification of the structural expert panel is consistent with the literature or not. The researchers held a meeting with six relevant experts such as executives, supply chain managers, experts, and university professors in Urmia to ensure the validity of the construct measurement items. The experts were able to sort the variables based on seven theoretical constructs, showing the formal and content validity of the theoretical constructs. In addition, a 5-point Likert scale was adopted to measure all items. As can be seen, the source of each structure is listed in table no. 1.

The respondents included executive managers (17.7%), technology managers (12.8%), business managers (14.8%), technical managers (9.9%), supply chain managers (15.9%), research and development experts (9%), quality control expert (11.2%) and financial expert (8.7%). The qualifications of the respondents included doctorate (17.2%), master degree (51%), bachelor degree (30%), and associate degree (1.8%). In addition, 21% of the respondents were women, and 79% were men. Finally, the current study adopted Kaiser, Mayer and Olkin's sampling adequacy criterion and Bartlett's test regarding the appropriateness of the sample size for factor analysis. The amount of sig was calculated to be less than 5% and the KMO index was 0.798, and the number for this index shows the adequacy of sampling to perform the exploratory factor analysis.

3. Results and discussions

The partial least square structural equation model (PLS-SEM) was used to analyze the data. PLS-SEM is suitable for building exploratory theory studies that identify the drivers of a construct (Hir et al., 2011). Hir et al. (2019) believe that PLS-SEM is suitable for testing the proposed hypotheses, and the proposed framework of the current study promotes the construction of exploratory theory instead of theory testing.

3.1. Reliability and validity

As the results of Table no. 1 show the reflective measurement model (which is evaluated to confirm its validity and reliability of the model) meets all quality and reliability criteria. All factor loadings are higher than 0.7, composite reliability is higher than 0.7, and mean variance extracted values are higher than 0.5 (Hair et al., 2019). Discriminant validity is acceptable when the average variance extracted for each construct is greater than the shared variance of that construct and other constructs in the model (Fornell and Larcker, 1981). As shown in Table no. 2, the values on the main diameter of the matrix are greater than all the values in the corresponding column.

Table no. 1: Constructs and measuring items

Items	λ	AVE	Composite Reliability	Cronbach Alpha
Technology adoption (Bürklin and Wynants, 2020)	-	0.763	0.899	0.811
We utilize digital platforms to promote operational practices and product innovation	0.838			
We utilize digital platforms to attract new clients	0.878			
We utilize digital platforms to track and monitor products in the value chain	0.870			
We utilize digital platforms for the virtualization of digital channels	0.892			
We utilize digital platforms for making decisions to support recycling and reuse	0.890			
Zero waste practices (Agyabeng-Mensah et al., 2021)	-	0.760	0.905	0.827
We design reusable products	0.863			
We design recycling products	0.872			
We train our employees in sustainable production practices	0.897			
We partner with suppliers that utilize zero waste processes	0.863			
We use technologies that prevent environmental pollution and waste	0.865			
Uncertainty in the market (Jambulingam et al., 2005)	-	0.770	0.833	0.798
We observed that the competitive environment of the company is unpredictable	0.888			
We have a very competitive business environment in our company	0.864			
Competitors promptly benefit from any mistake	0.881			
Green economic incentives (Singh et al., 2018)	-	0.795	0.870	0.807
The government gives tax benefits for the execution of circular economy practices	0.894			
Industrial buyers are willing to pay price premiums for green products	0.876			
Accessibility of recycled raw material with a cheaper rate than virgin raw material	0.906			
Circular economy practices (Dey et al., 2022)	-	0.786	0.906	0.902
We cooperate with suppliers/clients for the ecological design of services and products	0.855			
At the design stage, after the products served their initial purpose, we consider the possibility to reuse them	0.907			
We utilize recycled materials as input in our processes	0.877			
We use practices and policies to dispose of machinery and equipment on time	0.907			
Circular economy entrepreneurship (Cullen and De Angelis, 2021; Lynde, 2020)	-	0.813	0.892	0.855

Items	λ	AVE	Composite Reliability	Cronbach Alpha
We constantly exploit and explore new opportunities in the area of circular economy	0.913			
We have always thought of exploiting and finding new business opportunities in the circular economy	0.911			
We always think that it is the responsibility of businesses to stakeholders to proactively innovate business models in line with the circular economy.	0.880			
Sustainability performance (Dey et al., 2022)	-	0.756	0.885	0.840
We have reduced our production costs compared to previous years,	0.916			
We have raised the average return on net assets from green products	0.829			
We have lowered inventory carrying cost	0.877			
We have lowered the cost of handling and transportation	0.858			
We have lowered business waste over our processes	0.867			
We are committed to the best practices for environmental protection	0.891			
We have reduced CO2 emissions	0.883			
We have raised revenue from green practices and products	0.870			
In recent years we have improved work safety	0.874			
Compared to previous years, we have improved our work environment	0.866			
Our employees and managers are committed to incorporating environmental management	0.872			
We have created jobs to support the community that helps to grow entrepreneurship	0.876			

Table no. 2: Discriminant Validity

Latent Variables	Mean	SD	1	2	3	4	5	6	7
1. Technology adoption	3.656	1.105	0.873						
2. Zero waste practices	2.789	0.972	0.678	0.871					
3. Uncertainty in the market	3.537	1.230	0.709	0.674	0.877				
4. Green economic incentives	4.636	1.032	0.644	0.542	0.722	0.891			
5. Circular economy practices	4.598	1.088	0.690	0.497	0.511	0.733	0.886		
6. Circular economy entrepreneurship	4.230	1.007	0.553	0.326	0.408	0.610	0.789	0.901	
7. Sustainability performance	4.795	1.179	0.450	0.278	0.366	0.503	0.546	0.627	0.871

3.2. Structural model assessment

The structural model of the current research is evaluated through four tests as follows: determination coefficient (R^2), predictive relevance (Q^2), goodness-of-fit test (GOF), and hypothesis testing. The R^2 values obtained for the endogenous constructs show that the research model explains 69% of the circular economy practices and 79% of the company's sustainability performance. Chin (1998) has considered three values of 0.19, 0.33 and 0.67 as criteria values for weak, medium, and strong values of the fit of the structural part of the model by the R^2 criterion. According to table no. 3, it can be stated that all R^2 values are at a strong level to fit the structural part of the model. The obtained Q^2 values indicate that the model has sufficient predictive relevance, as the values are above the threshold of 0.000 (Hir et al., 2019). Considering that the model has all the criteria, it can be suggested that the structural model is good. The GOF index in the PLS model is a solution to check the overall fit of the model. The appropriate value for this index is between zero and one. Values close to one show a good quality of the model. This index examines the overall forecasting ability of the model and shows whether the tested model was successful in predicting endogenous local variables or not. To evaluate the fit of the overall model, the GOF criterion is used, where 0.1 is considered as weak values, 0.25 as moderate values, and 0.36 as strong values to measure the validity of PLS models (Wetzels et al., 2009). According to the value obtained for GOF of 0.654, a very good fit of the overall model is confirmed (Table no. 3).

Table no. 3. Investigating the fitness of the structural model

Hidden variable	Communalities	R^2	Q^2
Technology adoption	0.420	-	-
Zero waste practices	0.554	-	-
Uncertainty in the market	0.322	-	-
Green economic incentives	0.630	-	-
CEP	0.705	0.695	0.3564
CEE	0.718	-	-
SP	0.688	0.796	0.2982
(GOF)	Acceptable interval	Result	
0.654	Weak ≥ 1.0 ; Average ≥ 0.25 ; Strong ≥ 0.36	Accepted	

Source: Research finding

Figure no. 2 shows the output of the software in the estimation mode of path coefficients and determination coefficients (R^2). The numbers on the paths indicate the coefficient of the path, the numbers inside the circles for the endogenous variables; It shows the value of the coefficient of determination and the numbers on the arrows of the hidden variables indicate the factor loadings.

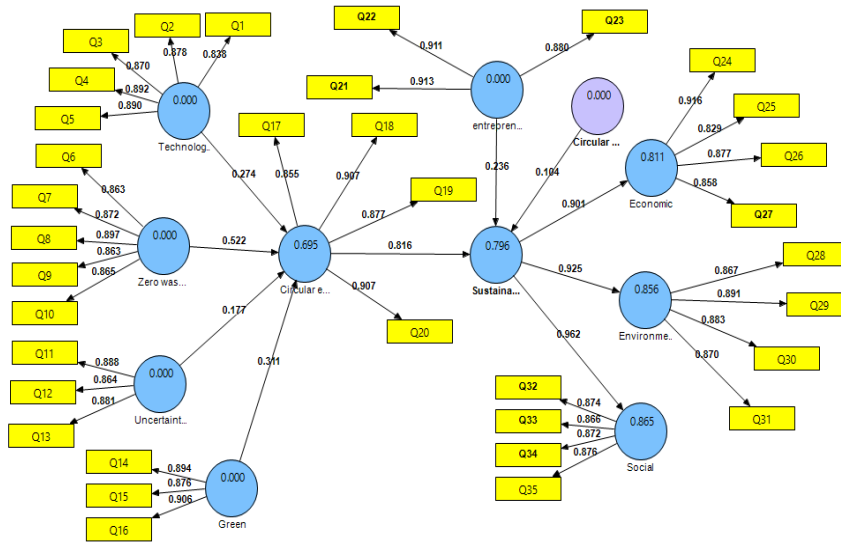


Figure no. 2. Path coefficients and factor loads of the research model

In Figure no. 3, the numbers marked on the arrows indicate T-values. To test the hypotheses of the research model at the 95% confidence level, values greater than and equal to the absolute value of 1.96 mean that there is a direct relationship between the two variables.

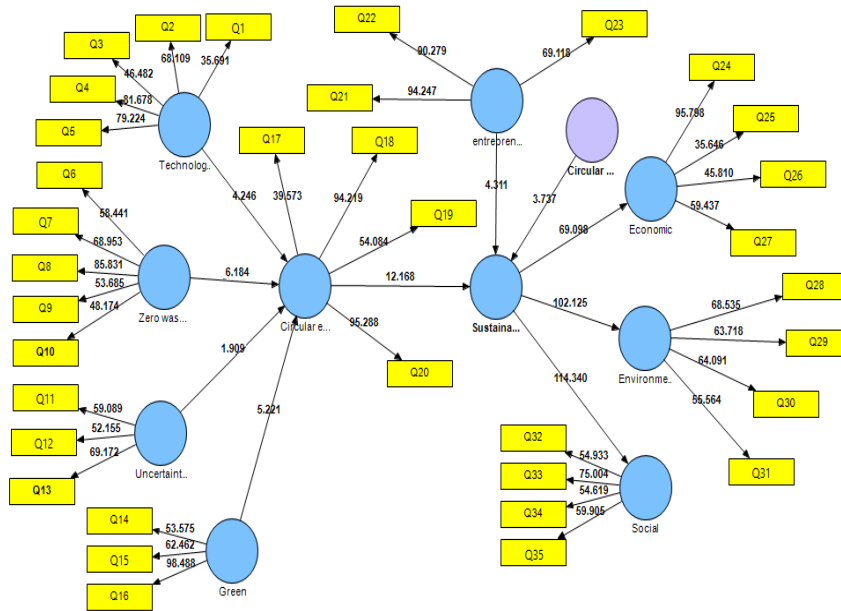


Figure no. 3. Equation model in the coefficient of significance

The summary of the results related to the hypothesis test is reported in Table no. 4. Also, the bootstrapping method was used to test and confirm the validity of research hypotheses.

Table no. 4. Results of bootstrapping analysis

Structural path	Code	Beta (β)	T Statistics	f^2	P Values	Supported?
Technology adoption \rightarrow CEP	H1	0.274	4.246	0.301	$p < 0.001$	Yes
Zero waste practices \rightarrow CEP	H2	0.522	6.184	0.560	$p < 0.001$	Yes
Uncertainty in the market \rightarrow CEP	H3	0.177	1.909	0.022	0.225	No
Green economic incentives \rightarrow CEP	H4	0.311	5.221	0.495	$p < 0.001$	Yes
CEP \rightarrow SP	H5	0.816	12.168	0.786	$p < 0.001$	Yes
CEP*CEE \rightarrow SP	H6	0.104	3.737	-	$p < 0.001$	Yes

The f^2 test shows which of the independent variables (exogenous structure) has a greater effect on the measurement of that dependent variable (endogenous structure). The results of f^2 values are measured with three values of weak effect (0.02), medium effect (0.15) and strong effect (0.25) (Cohen, 1988). The results of table no. 4 confirm that circular economy practices have a strong effect on the company's sustainability performance. It is worth mentioning that the effect test is not used for the moderator variable.

3.3. Discussions

Results showed that the technology adoption (H1, $\beta = 0.274$, $t = 4.246$) has a positive and significant effect on circular economy practices. Understanding and applying new technology can help knowledge-based companies realize the potential of digital platforms to support innovation and sustainable performance. This result is consistent with the resource-based perspective, as it supports the idea that using internal capabilities with a sustainability mindset can lead to a better understanding of potential benefits by all members of the firm. In addition, emerging technology can enable circular economy practices. In addition, researchers have confirmed that technology adoption enables the adoption of circular economy practices, such as increasing waste reduction and recycling use, which in turn increases the company's sustainability performance (Bockel et al., 2021).

The findings also show that the methods of reducing waste to zero (H2, $\beta = 0.522$, $t = 6.184$) are positively and significantly related to circular economy practices. These findings are partly supported by previous studies showing that lean production practices positively contribute to environmental performance (Kamble et al., 2020). Bai et al. (2020) found that zero waste practices have a positive effect on circular economy practices. It is worth noting that companies can use zero waste methods to educate consumers about sustainable consumption practices in order to improve their consumption behavior to advance the path of the circular economy.

The results of the third hypothesis show that uncertainty in the market (H3, $\beta = 0.177$, $t = 1.909$) has a small positive effect on circular economy practices. This study did not find support for the above hypothesis. It can be argued that companies are trying to be risk averse with market

uncertainty and prioritizing their profitability needs over long-term initiatives such as the circular economy.

Regarding the effect of green economic incentives (H4, $\beta=0.311$, $t=5.221$), the findings of the current study confirmed it as an antecedent of environmental commitment and circular economy practices. So, improving environmental commitment depends on subsidies and tax benefits for implementing circular economy practices, the ability to pay higher prices for green products, and the availability of recyclable materials at lower prices. In other words, it can be argued that financial support strengthens the internal capabilities of knowledge-based companies to adopt circular actions and practices towards green production.

Circular economy practices (H5, $\beta=0.816$, $t=12.168$) strongly and positively affect the sustainability performance of knowledge-based companies. Therefore, the results of the analysis for the current data set are fully aligned with the propositions in previous theoretical and empirical studies arguing that circular economy practices increase the firm's sustainability performance (Geissdoerfer et al., 2017). The findings show that through a combination of lean management practices, the sustainability performance of companies involved in circular economy practices increases. However, in order to achieve proper sustainable performance, knowledge-based companies must adopt environmentally friendly practices that not only reduce the negative impact on the climate, but are also beneficial to economic growth and society.

Finally, the results of the sixth hypothesis showed that circular economy entrepreneurship (H6, $\beta=0.104$, $t=3.737$) moderates the relationship between circular economy practices on the sustainability performance of knowledge-based companies. This finding supports the previous studies by Liu et al. (2018). On the other hand, the relationship between circular economy entrepreneurship and sustainability performance is positive and significant. In this regard, circular economy entrepreneurship is needed in redesigning processes in supply chain management to maximize resource value creation and promote resource circulation. The experimental findings expressed from the perspective of the present research literature strengthen the theoretical framework of this research. In addition, circular economy practices and circular economy entrepreneurship play an important role as strategic company resources in guiding businesses towards sustainable supply chain management to achieve sustainable performance. Most importantly, applying circular economy practices and circular economy entrepreneurship effectively in knowledge-based companies promotes sustainable performance in a way that motivates different stakeholders to participate in the supply chain.

Conclusions

The aim of the current study is to clarify the validity of the impact of technology adoption, zero waste practices, uncertainty in the market, and green economic incentives of circular economy strategies and their role in increasing the performance of circular economy practices and company sustainability. The findings of this study provide different policy implications for both the government and company managers. First, in the long term, implementing a circular economy system can increase corporate performance to achieve environmental and economic goals. In Iran, circular economy practices in companies can lead to economic, social, and environmental benefits. Since today, the discussion of recycling and optimal use of waste has become a science; managers should purchase reusable and recyclable materials, and collect waste from customers, and try to sell their waste to other companies on a priority

basis. More importantly, managers should pay special attention to measuring the performance of circular economy activities. In addition, managers can significantly reduce waste by identifying and eliminating non-value-added activities in operations and processes, moving toward circular product flow, and sustainable product and process design. Also, based on the findings of the research, it can be argued that existing companies and start-ups should consider the undeniable role of circular economy entrepreneurship as a responsibility to various stakeholders in the new era. With this approach, companies try to include economic, environmental, and social issues in their business strategy, and all activities are adapted accordingly to address economic, social, and environmental benefits simultaneously.

In the last step, the current study has limitations that can be considered as a space for future studies. First, this research has been done with a quantitative approach. Future research may consider combining methods to enrich research approaches. Second, this study focuses on knowledge-based companies, although knowledge-based companies are the main force of the national and global economy, small and medium-sized companies should also be studied in different fields to see how the background factors affect the research findings.

References

- Abou Taleb, M. and Al Farooque, O., 2021. Towards a circular economy for sustainable development: An application of full cost accounting to municipal waste recyclables. *Journal of Cleaner Production*, 280, no.124047.
- Agyabeng-Mensah, Y., Tang, L., Afum, E., Baah, C. and Dacosta, E., 2021. Organisational identity and circular economy: Are inter and intra organisational learning, lean management and zero waste practices worth pursuing? *Sustainable Production and Consumption*, 28, pp. 648-662.
- Alonso-Almeida, M., Rodriguez-Anton, J. M., Bagur-Femenías, L. and Perramon, J., 2021. Institutional entrepreneurship enablers to promote circular economy in the European Union: Impacts on transition towards a more circular economy. *Journal of Cleaner Production*, 281, no.124841.
- Bai, C., Sarkis, J., Yin, F. and Dou, Y., 2020. Sustainable supply chain flexibility and its relationship to circular economy-target performance. *International Journal of Production Research*, 58(19), pp.5893-5910.
- Böckel, A., Nuzum, A. K. and Weissbrod, I., 2021. Blockchain for the circular economy: analysis of the research-practice gap. *Sustainable Production and Consumption*, 25, pp. 525-539.
- Bürklin, N. and Wynants, J., 2020. Opening New Opportunities to Close the Loop: How Technology Influences the Circular Economy. In: G. Vignali, L.F. Reid, D. Ryding and C.E. Henninger eds., 2020. *Technology-Driven Sustainability: Innovation in the Fashion Supply Chain*. Cham: Palgrave Macmillan, pp. 219-240.
- Centobelli, P., Cerchione, R., Esposito, E. and Passaro, R., 2021. Determinants of the transition towards circular economy in SMEs: A sustainable supply chain management perspective. *International Journal of Production Economics*, 242, no.108297.
- Chang, Y. Y., Hughes, M. and Hotho, S., 2011. Internal and external antecedents of SMEs' innovation ambidexterity outcomes. *Management Decision*, 49(10), pp.1658-1676.

- Chin, W. W., 1998. The partial least squares approach to structural equation modeling. *Modern methods for business research*, 295(2), pp. 295-336.
- Cohen, J., 1988. Statistical power analysis for the behavioral sciences. Lawrence Erlbaum Associates. *Hillsdale*, pp. 20-26.
- Cullen, U. A. and De Angelis, R., 2021. Circular entrepreneurship: A business model perspective. *Resources, Conservation and Recycling*, 168, no.105300.
- De Jesus, A. and Mendonça, S., 2018. Lost in transition? Drivers and barriers in the eco-innovation road to the circular economy. *Ecological Economics*, 145, pp. 75-89.
- Dey, P. K., Malesios, C., Chowdhury, S., Saha, K., Budhwar, P. and De, D., 2022. Adoption of circular economy practices in small and medium-sized enterprises: Evidence from Europe. *International Journal of Production Economics*, 248, no.108496.
- Elkington, J., 1998. Partnerships from cannibals with forks: The triple bottom line of 21st-century business. *Environmental Quality Management*, 8(1), pp. 37-51.
- Fatimah, Y. A., Govindan, K., Murniningsih, R. and Setiawan, A., 2020. Industry 4.0 based sustainable circular economy approach for smart waste management system to achieve sustainable development goals: A case study of Indonesia. *Journal of Cleaner Production*, 269, no.122263.
- Fornell, C. and Larcker, D. F., 1981. Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), pp. 39-50.
- Games, D. and Rendi, R. P., 2019. The effects of knowledge management and risk taking on SME financial performance in creative industries in an emerging market: the mediating effect of innovation outcomes. *Journal of Global Entrepreneurship Research*, 9(1), pp. 1-14.
- Gehlbach, H. and Brinkworth, M. E., 2011. Measure twice, cut down error: A process for enhancing the validity of survey scales. *Review of General Psychology*, 15(4), pp. 380-387.
- Geissdoerfer, M., Savaget, P., Bocken, N. M. and Hultink, E. J., 2017. The Circular Economy – A new sustainability paradigm?. *Journal of Cleaner Production*, 143, pp. 757-768.
- Hair, J. F., Ringle, C. M. and Sarstedt, M., 2011. PLS-SEM: Indeed a silver bullet. *Journal of Marketing theory and Practice*, 19(2), pp. 139-152.
- Hair, J. F., Risher, J. J., Sarstedt, M. and Ringle, C. M., 2019. When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), pp. 2-24.
- Hosseini-Motlagh, S. M., Nouri-Harzvili, M., Johari, M. and Sarker, B. R., 2020. Coordinating economic incentives, customer service and pricing decisions in a competitive closed-loop supply chain. *Journal of Cleaner Production*, 255, no.120241.
- Jakhar, S. K., Mangla, S. K., Luthra, S. and Kusi-Sarpong, S., 2018. When stakeholder pressure drives the circular economy: Measuring the mediating role of innovation capabilities. *Management Decision*, 57, pp. 904-920.
- Jambulingam, T., Kathuria, R. and Doucette, W. R., 2005. Entrepreneurial orientation as a basis for classification within a service industry: the case of retail pharmacy industry. *Journal of Operations Management*, 23(1), pp. 23-42.
- Kamble, S., Gunasekaran, A. and Dhone, N. C., 2020. Industry 4.0 and lean manufacturing practices for sustainable organisational performance in Indian manufacturing companies. *International Journal of Production Research*, 58(5), pp.1319-1337.

- Karuppiah, K., Sankaranarayanan, B., Ali, S. M., Jabbour, C. J. C. and Bhalaji, R. K. A., 2021. Inhibitors to circular economy practices in the leather industry using an integrated approach: Implications for sustainable development goals in emerging economies. *Sustainable Production and Consumption*, 27, pp. 1554-1568.
- Khan, S. A. R., Zia- ul- haq, H. M., Umar, M. and Yu, Z., 2021. Digital technology and circular economy practices: A strategy to improve organizational performance. *Business Strategy & Development*, 4(4), pp. 482-490.
- Kirchherr, J., Piscicelli, L., Bour, R., Kostense-Smit, E., Muller, J., Huibrechtse-Truijens, A. and Hekkert, M., 2018. Barriers to the circular economy: Evidence from the European Union (EU). *Ecological Economics*, 150, pp. 264-272.
- Liu, J., Feng, Y., Zhu, Q. and Sarkis, J., 2018. Green supply chain management and the circular economy: Reviewing theory for advancement of both fields. *International Journal of Physical Distribution & Logistics Management*, 48(8), pp. 794-817.
- Lynde, R., 2020. Innovation & entrepreneurship driving food system transformation. *Physiology & Behavior*, 220, no.112866.
- Machado, C. G., Winroth, M. P. and Ribeiro da Silva, E. H. D., 2020. Sustainable manufacturing in Industry 4.0: an emerging research agenda. *International Journal of Production Research*, 58(5), pp. 1462-1484.
- Mazur-Wierzbička, E., 2021. Circular economy: advancement of European Union countries. *Environmental Sciences Europe*, 33(1), pp. 1-15.
- Nikolaou, I. E., Tsagarakis, K. P. and Tasopoulou, K., 2018. An examination of ecopreneurs' incentives through a combination between institutional and resource-based approach: a preliminary study. *Management of Environmental Quality: An International Journal*, 29(2), pp. 195-215.
- Peng, H., Shen, N., Liao, H., Xue, H. and Wang, Q., 2020. Uncertainty factors, methods, and solutions of closed-loop supply chain – a review for current situation and future prospects. *Journal of Cleaner Production*, 254, no.120032.
- Pietzsch, N., Ribeiro, J. L. D. and de Medeiros, J. F., 2017. Benefits, challenges and critical factors of success for Zero Waste: A systematic literature review. *Waste Management*, 67, pp. 324-353.
- Pigosso, D. C. and McAloone, T. C., 2021. Making the transition to a circular economy within manufacturing companies: The development and implementation of a self-assessment readiness tool. *Sustainable Production and Consumption*, 28, pp. 346-358.
- Prieto- Sandoval, V., Ormazabal, M., Jaca, C. and Viles, E., 2018. Key elements in assessing circular economy implementation in small and medium- sized enterprises. *Business Strategy and the Environment*, 27(8), pp. 1525-1534.
- Rodríguez-Espíndola, O., Cuevas-Romo, A., Chowdhury, S., Díaz-Acevedo, N., Albores, P., Despoudi, S. and Dey, P., 2022. The role of circular economy principles and sustainable-oriented innovation to enhance social, economic and environmental performance: Evidence from Mexican SMEs. *International Journal of Production Economics*, 248, no.108495.
- Sahasranamam, S., Nandakumar, M. K., Pereira, V. and Temouri, Y. (2021). Knowledge capital in social and commercial entrepreneurship: Investigating the role of informal institutions. *Journal of International Management*, 27(1), p.100833.

- Seadon, J. K., 2010. Sustainable waste management systems. *Journal of Cleaner Production*, 18(16-17), pp. 1639-1651.
- Singh, M. P., Chakraborty, A. and Roy, M., 2018. Developing an extended theory of planned behavior model to explore circular economy readiness in manufacturing MSMEs, India. *Resources, Conservation and Recycling*, 135, pp. 313-322.
- Van Ewijk, S. and Stegemann, J. A., 2016. Limitations of the waste hierarchy for achieving absolute reductions in material throughput. *Journal of Cleaner Production*, 132, pp. 122-128.
- Velenturf, A. P. and Purnell, P., 2021. Principles for a sustainable circular economy. *Sustainable Production and Consumption*, 27, pp. 1437-1457.
- Wetzels, M., Odekerken-Schröder, G. and Van Oppen, C., 2009. Using PLS path modelling for assessing hierarchical construct models: Guidelines and empirical illustration. *Management Information Systems quarterly*, pp. 177-195.