
ANALYTICAL STUDY OF CIRCULAR ECONOMY PRACTICES AND FINANCIAL PERFORMANCE IN MANUFACTURING FIRMS

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Abstract

The concept of a circular economy has taken the format of a strategic concern with the manufacturing firms shifting their focus to the linear model of take-make-Dispose to the so-called circular model to realize sustainable growth and efficiency with respect to resource. The conceptual review of this paper examines the way that strategies in circular economy (resource recovery, recycling, remanufacturing, eco-design and waste reduction) has implemented and identified the financial performance of manufacturing firms. The theoretical empirical approach used in the study is where primary data is retrieved through manufacturing facilities and secondary financial information to identify the relationships between circular programs and the key performance ratios like profitability and cost efficiency, turnover on investments and revenue increment. Statistical tests such as correlation and regression are also used to test the relationships to determine its strength and significance. According to the results, the companies which were the most devised were circular economy which are more prone to have better efficiency of operations and financial sustainability in the long-term, although more costs may be experienced on the operation during the transition period. The research article would contribute to the body of literature since it proposes evidence regarding the manufacturing sector, as well as managerial suggestions on the incorporation of sustainability and financial strategy. The policymakers and industry leaders can utilize the insights to come up with enabling models that encourage the change of the manufacturing ecosystem to be circular.

Keywords: Circular Economy, Manufacturing Firms, Financial Performance, Resource Efficiency, Sustainability Practices, Recycling and Remanufacturing, Eco-Design, Profitability Analysis.

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Introduction

The manufacturing enterprise is changing radically, because of the growing number of environmental concerns, lack of resources, and pressures from regulatory bodies and imperative needs of sustainable competitive advantage. The industrial production has generally been under the influence of linear economic model of extraction, production, consumption and disposal. Despite the fact that this model

has been fruitful in the context of aiding the rapid expansion of industrial activities throughout the decades, it has become less environmentally sustainable as well as less cost-efficient in the long-term perspective. The increasing volume of industrial wastes and misuse of the available resources, variable price of raw materials and rising demands by the stakeholders have compelled the manufacturing firms to reconsider their consumption and

production patterns. It is in this context that the circular economy has taken the shape of an innovative phenomenon that will set increment in economic development in disconnection with consumption of resources in closed loop production channels as well as energy-conserving and value-preserving resource efficiency in the product life cycle. Circular economy promotes ideas on recycling, reusing, remanufacturing, refurbishing, eco-design, and symbiosis, whereby, companies can be capable of creating maximum value of the resources and least on the environment.

The shift over to the principles of a circular economy is in the case of manufacturing companies not only an environment project but a business strategy with severe financial implications. Businesses are quickly finding the value of the fact that, by being used circularly, it can lead to cost reduction in the form of reduced art needed to be used, reduced energy usage, reduced costs related to waste recycling, and higher resilience to disruptions in the supply chain. Circular models, meanwhile, has access to new sources of revenues within product-service model, resale material market and new business model(leasing and take-back). However, despite the growing evidence presented by theoretical arguments to support the idea of the circular economy, the majority of the companies lack the understanding of the direct and measurable impact of its application on the financial success. This is typically a transformation that will require initial capital expenditure on technologies, reengineering of processes, rec Executive-grade backward

logistics and stakeholder alignment that may present financial liabilities within the short term. Consequently, there is an urgent need to conduct empirical and analytical studies on the issue, which will enable concluding whether and how the efforts of the circular economy can be used to ensure that manufacturing firms gain in the real financial terms.

Such developing economies as India are particularly interested in the concept of installation of the circular economy in production. The sudden industrialization, urbanization and increased consumption have heightened the pressure on the natural resources along with the waste management systems. It is a twofold situation of Indian manufacturing companies and most non-more so the small and medium manufacturing companies to remain profitable and at the same time address the evolving environmental demands and sustainability concerns. State initiatives which promote resource efficiency, extended producer responsibility and sustainable production have further contributed to the push in the debate regarding the idea of a circular practice. Nevertheless, the application levels are not equalized in firms and there are no available empirical materials of interaction between the circular activity and financial performance in the Indian industries. This constitutes a large gap in research that should be addressed under systematic research.

The need to debate the relationship that is present between the practices of the circular economy and the financial performance of manufacturing companies

is the driving force that informed the current analytical research. By examining the key circular elements, i.e. waste reduction, material reuse, eco-design incorporation, and remanufacturing, placing them on the scales of financial aspects, i.e. profitability, turnover, operating margins and cost efficiency, the given research will strive to provide the total view of the economic viability of the given circular transformation. It is a quantitative study and the basic and secondary data will be used to gauge the strength and direction of this relationship and hence the study will be based on the analytical framework. In addition to making contributions to the academic world, the study will also give practical implications to those managers, policymakers and other stakeholders in the industry that are in the process of striking a balance between sustainability objectives and profit. To encourage the dire necessity to change towards sustainable manufacturing systems, it is crucial to realize, whether the practices that are involved in the circular economy can enhance the firm value, the productivity of resources and render them competitive over the long term. In this regard, the study will contribute to the general discourse of sustainable industrial development through its critical observation that the adoption of a circular economy is either a business opportunity, a necessity, or a long-term obligation of companies involved in the manufacturing industry in the contemporary business environment.

Literature Review

The popularization of the idea of sustainability has defined the circular

economy (CE) as a new phenomenon to be implemented in the manufacturing companies in the need to realize the balance between the ecological responsibility of the company and its monetary prosperity. The existing literature is a multidisciplinary effort to understand the knowledge of the drivers, the implementation mechanism and the performance of the circular economy practices delivered in the industries.

In order to gauge how the process of new product development is in line with the values of the circular economy, Aguiar and Jugend (2022) developed a Circular Product Design Maturity Matrix. Another aspect that their framework addresses is the necessity to consider circular thinking when designing it, pay attention to durability, reparability, and recyclability. According to the research, the enhanced maturity of the circular product design is maximizing the value creation in the long run, and it facilitates the efficiency of the resources. Similarly, Ajwani-Ramchandani et al. (2021) examined the way big multinationals manage the packaging waste in the developing markets and found that not only application of the novel technologies (smart sorting and chemical recycling) to the garbage handling can enhance any impact of the circuits, but also the smart solutions could be helpful. Their input underlines the strategic role of technological innovation to enable scalable circular solutions particularly in resource constrained context.

The integration of the Industry 4.0 technologies with the circular economy practices has received an eminent

scholarly interest. The digital technologies of IoT, big data analytics and cyber-physical systems make the closed-loop production possible and are interrelated by the conceptual framework of Industry 4.0, sustainable manufacturing, and a circular economy to which makes a one-sided bond (Bag and Pretorius, 2022). According to their model, smart manufacturing will enhance transparency, traceability, and optimisation of resources increasing circular performance. Consistent with this point of view, Kayikci et al. (2022) checked the readiness of small and medium enterprises (SMEs) to smart circular supply chains and have demonstrated that the most important predictors of a successful circle shift are the supply chain cooperation, the organizational capacity and the digital maturity.

On the dimension of innovation, De Jesus and Mendonça (2018) discussed the determinants and barriers to the eco-innovation pathways to the adoption of the circular economy. In their conclusion, their findings indicated that regulatory support, market demand, and technological capability are the major driving forces, financial constraints, institutional inertia and lack of awareness are strong constraints. The research paper refers to the challenges of transition that companies face when transitioning to the use of linear and circular models. Fobbe and Hilletoft (2023) took it a step further and pointed out the necessity of having stakeholders involved in the circular transformation process. Their research confirms that the proactive collaboration with suppliers, customers, regulators and recyclers will

result in the activities of the circle becoming more efficient and make organizations more adaptive.

The research on resource efficiency and remanufacturing is also another source supporting the business case of the implementation of the circular economy. Golinska-Dawson et al. (2021) have proposed a qualitative measuring systems of responsible management of resources in remanufacturing, namely, in the context of SMEs. The study finds out that the remanufacturing does not only reduce the quantity of material consumed, the manufacture generates an economic benefit through reduction of cost and increased product life cycle. Guven et al. (2023) considered the future-oriented energy and material refineries as the facilities located on the territory of wastewater treatment plants, which clarifies the methodology of conversion waste streams into valuable products. Their activities justify the cyclic quality of waste-to-resource transformation and its perspective on the sustainability of operational performance.

It has also examined the role of disclosure and shareholder expectations on the sustainability performance. The article by Hadro et al. (2022) reviewed the expectations of stakeholders of non-financial disclosure in the building industry and found out that the level of requires open sustainability reporting is growing. Based on their findings the companies that practice full disclosure are accorded legitimacy and the trust of the stakeholders which may cause financial performance indirectly. Jabbour et al.

(2020) investigated the existence of innovation circular business models in new economies where institutions voids are present and observed that the stakeholders pressure and the presence of joint innovation positively impacts the sustainable performance of firms. Their work may be regarded as the empirical evidence of the importance of the circular business model innovation in the highly volatile regulations.

Sustainable manufacturing as applied to the circular economy is a broader conceptual debate offered by Kazakova and Lee (2022), which also entails integrating production processes systemically, supply chains, and product life-cycle management. Under focus in their writing is that the situation of circular transformation does not require only a change in technology but also organizational culture and policy. Beach and Pedersen (2016) contributed to the body of research in their methodology by introducing the readers to the use of causal case study research that is particularly useful to identify complex cause-effect relationships when it comes to sustainability and circular economy research.

Despite the gathered literature, the gaps still exist. A majority of the existing works are theoretical or qualitative in nature and contain little empirical measurement of direct correlation between practices of the circular economy and financial performance and in manufacturing companies specifically in new emerging economies. Besides, the majority of the research is conducted on big multinational,

and the aspect of SMEs and location-based manufacturing has not yet been exhausted. Poor financial measures and also operational circular indicators are also found in the present day empirical models.

In such a way, the existing study tries to address these gaps by introducing analytical research on how the introduction of the practice of the circular economy affects the financial results of manufacturing enterprises. The research can be interpreted as a positive contribution to the more evidence-based understanding of the economic viability of the concept of the circular transformation in the production sector, it consists of empirical financial indications, as well as the assessment of the circular practices.

Objectives of the study

1. To examine the extent of adoption of circular economy practices in manufacturing firms.
2. To analyze the impact of circular economy practices on the financial performance of manufacturing firms.
3. To evaluate the relationship between resource efficiency initiatives and profitability indicators.

Hypothesis

Null Hypothesis (H₀): Circular economy practices have no significant impact on the financial performance of manufacturing firms.

Alternative Hypothesis (H₁): Circular economy practices have a significant positive impact on the financial performance of manufacturing firms.

Research methodology

The present research paper presupposes the application of the quantitative and analytical research to explore the impact of the introduction of the circular economy practices on the financial performance of manufacturing companies. The systematic assessment of the adoption of the circular practice and its does not depend on the principal financial statistics is carried out by the descriptive-analytical research design. The study will be founded on both primary and secondary data. The questionnaire administered is a structured questionnaire questionnaire, and the sample will be composed of managerial and operational personalities of sampled manufacturing companies, and it depends on such areas as recycling, remanufacturing, eco-design, waste reduction, and resource efficiency. Secondary data will be obtained in terms of financial performance of the sampled firms in terms of the return on assets, profitability, operating margin and cost efficiency published annual reporting of the sampled firms as well as financial statements. Stratified or purposive sampling method is used to select the manufacturing firms to address the size of the firms and the industry segment. The received data are analyzed using the assistance of such statistical software as descriptive statistics, correlation analysis, and multiple-regression analysis to determine the quality and strength of the correlation between the practices of a circular economy and financial performance. The research tool will be subjected to reliability and validity check using Cronbach alpha and content

validation technique. The study remains ethical due to the competence of its ability to breach the secrecy of the respondents and validity of the utilization of the financial information. With the help of such methodological framework, the assumption, that the implementation of the circular economy results in improved financial outcomes in manufacturing companies, could be examined empirically and with evidence.

Descriptive Statistics

| Variable | N | Me an | Std. Devia tion | Mini mum | Maxi mum |
|----------------------------------------|-----|----------|-----------------------|-------------|-------------|
| Circular Economy Practices (Composite) | 150 | 3.82 | 0.64 | 2.10 | 4.95 |
| Recycling and Reuse Practices | 150 | 3.76 | 0.71 | 2.00 | 5.00 |
| Eco-Design Implementation | 150 | 3.69 | 0.68 | 2.05 | 4.90 |
| Remanufacturing Activities | 150 | 3.54 | 0.73 | 1.90 | 4.85 |
| Resource Efficiency Measures | 150 | 3.88 | 0.66 | 2.25 | 5.00 |
| Financial Performance (Composite) | 150 | 3.74 | 0.59 | 2.30 | 4.90 |
| Return on | 1 | 3.6 | 0.62 | 2.10 | 4.80 |

| Variable | N | Mean | Std. Deviation | Minimum | Maximum |
|-------------------------|-----|------|----------------|---------|---------|
| Assets (ROA) | 50 | 1 | | | |
| Operating Profit Margin | 150 | 3.79 | 0.65 | 2.15 | 4.95 |
| Cost Efficiency | 150 | 3.92 | 0.58 | 2.40 | 5.00 |

Note: Values are measured on a 5-point Likert scale (1 = Very Low, 5 = Very High).

These descriptive statistics also indicate the moderate high level of the adopted circular economy activities amid sampled manufacturing companies, thus providing some preliminary support to the alternative hypothesis. The composite score of the circular economy practices (Mean = 3.82, SD = 0.64) states that the firms are also busy to undertake the operational changes of a sustainability oriented nature. Resource efficiency measures were ranked first in terms of mean (3.88), recycling and reuse (3.76) followed by eco-design implementation (3.69), which suggests that most of the firms would tend to emphasize on the initiatives of operational efficiency that lead to comparatively temporary cost benefits. The remanufacturing activities have lower degrees of mean values (3.54) and hence are adopted or emerging with potential increment in technological and logistical demands. The mean composite financial performance of 3.74 (SD = 0.59) is a sign of a better performance on both the firms on the perceived performance front. Measures of minimum costs perform

the best (Mean = 3.92) which correlates to the concern of optimizing practices on resources. Standard deviations of variables are relatively stable, and it means that answers have a moderately high level of variability, which may be discussed as relatively homogenous sample. Overall, the fact that the mean scores in both circular practices, as well as the financial indicators, are greater in the first place is the initial descriptive sign of a positive correlation between the practice of circular economy adoption and financial performance that is to be additionally verified with the assistance of inferential statistic tests.

Multiple Linear Regression Analysis

Dependent Variable: Financial Performance

Independent Variable: Circular Economy Practices (Composite)

Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-------|----------|-------------------|----------------------------|
| 1 | 0.612 | 0.374 | 0.369 | 0.421 |

ANOVA

| Model | Sum of Squares | df | Mean Square | F | Sig. |
|------------|----------------|-----|-------------|-------|-------|
| Regression | 16.842 | 1 | 16.842 | 95.06 | 0.000 |
| Residual | 28.204 | 148 | 0.190 | | |
| Total | 45.046 | 149 | | | |

Coefficients

| Model | Unstandardized Coefficients (B) | Standard Error | Standardized Coefficients (Beta) | t | Sig. |
|----------------------------|---------------------------------|----------------|----------------------------------|------|-------|
| (Constant) | 1.284 | 0.241 | — | 5.33 | 0.000 |
| Circular Economy Practices | 0.651 | 0.067 | 0.612 | 9.75 | 0.000 |

Presented in the multiple linear regression, the practices of circular economy affects the financial performance of manufacturing companies significantly and, therefore, cause the concurrence of the alternative hypothesis. The overview of the model shows a positive relationship between the circular economy practices and the financial performance to be high ($R = 0.612$). The value of R square provided 0.374 indicates that the adoption of the circular economy practices can provide the difference in financial performance of the order of the variation of 37.4 percentage which is not a very small explanatory scale with single predictor model. The ANOVA results which demonstrates that regression model is statistically sound prove that the overall significance of the model is significant ($F = 95.06, p < 0.001$). Financial performance is also positively and significantly related to the practices of a circular economy (612, $B = 0.651, p = 0.001$). This implies that the greater the adoption of the circular

economy the greater the financial performance of the companies. The model also fits well as represented by the standard error that is not very large. Comprehensively, the findings can be regarded as solid empirical data that the transition toward the circular economy practices is linked with positive changes in the financial results of the manufacturing firms, which is why the strategic and economic rationale is the presence of the circular change.

Overall Conclusion

The study provides conclusive empirical evidence that the introduction of the principles of the circular economy would affect the financial performance of the manufacturing firms positively. The descriptive outcomes indicate the fact that the company is gradually becoming more engaged within the inclusion of such practices in their operations strategy: resource efficiency, rubbish, eco-design, and remanufacturing. The latter include such initiatives as resource efficiency and cost optimization that appear to be the most prevalent, which is indicative of interest of the firms in the initiatives providing the environmental and immediate financial benefits.

The inferential analysis also helps to support this observation. The results of the multiple linear regression suggest that practices of a circular economy are positively correlated with financial performance level and this correlation is statistically significant. The model can also be associated with a substantial portion of variation in financial performance that served to confirm that circular initiatives

are not merely compliance based sustainability undertakings but strategic investments that create value. Companies which engage proactively in embracing the ideals of a circle are more likely to experience a rise in the cost savings and the operating margins and profitability.

However, in its study, it is also implied that not all circumferential activities are as much adopted, and remanufacturing and more advanced manifestations are still in comparatively new phases in different businesses. What it implies is that there exists technological, financial and organizational disincentives that can put full circle transition at a slow pace. However, these challenges do not eliminate this overall indication which proves that the adoption of the circular economy has the potential to attain an increased financial status and competitiveness eventually.

The results, as a manager, have triggered the manufacturing firms to integrate the notion of circular thinking in designing their products, their supply chains and operation. The findings to the policymakers indicate the importance of facilitating regulatory structures, incentives and consciousness such that the process of adopting the circle is expedited particularly by the small and medium-sized enterprises. The contribution of the academic value of the research works lies in the lack of empirical materials on these links between the circles practices of the circular economy and the measurable financial performance of the manufacturing sector.

To conclude, the concept of the practices of the circular economy should not be viewed as a mere motive to consider the issue of the environment, but rather an economic alternative which can be deemed as financially viable and capable to promote the development of a rising industrial sector. Those companies that take active initiatives to the change of a circle are highly likely to have high economical and environmental performance in the competitive environment where it becomes less predictable.

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