Received: July 2023
Accepted: December 2023
DOI: 10.7862/rz.2023.mmr.23

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POST-PANDEMIC INNOVATION PRACTICES IN MICRO, SMALL, AND MEDIUM-SIZED FIRMS IN THE STATE OF GUANAJUATO

The pandemic caused by the spread of the SARS-CoV-2 virus has compelled many companies to prioritize innovation strategies in order to survive. Consequently, this cross-sectional empirical study employed a quantitative approach to assess the level of innovation achieved through frugal innovation practices by micro, small, and medium-sized enterprises (MSMEs) in the post-pandemic era in the state of Guanajuato, Mexico. A survey-type questionnaire was randomly administered to a sample of 58 companies. Stepwise discriminant analysis, utilizing Wilks' Lambda method, was applied to analyze the data. The results demonstrate that, during the crisis, the most influential variables in explaining the level of innovation are the significant reduction in the price of products or services and their durability, both regarded as frugal innovation practices. Consequently, decision-makers should establish frugal ecosystems that enable cost reduction while emphasizing the functionality and performance of their products or services.

Keywords: innovation, frugal innovation practices, cost reduction, MSMEs, discriminant analysis.

1. INTRODUCTION

In today's rapidly changing and competitive business landscape, innovation has become a crucial driver of success, particularly for micro, small, and medium-sized enterprises (MSMEs). However, in recent years, there has been a significant surge in innovation

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occurring within settings where resources are limited, particularly in emerging economies (Agarwal et al., 2017). These enterprises not only face unique challenges, including limited resources, constrained budgets, and the need to adapt quickly to market dynamics but also their consumers are identified by their notably reduced buying capacity and unique purchasing preferences, making them a novel opportunity for multinational corporations (Hossain, 2021; Mutlu et al., 2015). In such circumstances, embracing frugal innovation practices has emerged as a promising approach to foster innovation and enhance the level of competitiveness for SMEs (Cuevas-Vargas, Camarena, et al., 2022; Hossain, 2021; Hossain et al., 2022).

Frugal innovation, characterized by its emphasis on simplicity, cost-effectiveness, and resource optimization, offers SMEs a practical and sustainable pathway to innovation (Cuevas-Vargas, Parga-Montoya, et al., 2022). It encourages entrepreneurs and decision-makers to think creatively and find inventive solutions within the constraints they face (Mishra, 2021). By focusing on affordability and value creation, frugal innovation enables SMEs to deliver high-quality products or services while maintaining competitive pricing. The importance of frugal innovation practices in driving SMEs' innovation cannot be overstated. In the aftermath of the pandemic, businesses across the globe experienced unprecedented disruptions, necessitating adaptive strategies to survive and thrive. SMEs, in particular, confronted immense challenges, requiring them to rethink their operations, business models, and approaches to innovation (Cuevas-Vargas, Parga-Montoya, 2022).

Through the lens of frugal innovation, SMEs can overcome these challenges by leveraging their inherent agility and resourcefulness. By adopting a frugal mindset, SMEs can identify innovative ways to reduce costs, optimize processes, and improve the functionality and performance of their offerings (Rossetto et al., 2017). This approach allows them to meet evolving customer demands while maintaining a competitive edge in the marketplace. Understanding the level of frugal innovation practices employed by SMEs and their impact on fostering innovation is of paramount importance (Cuevas-Vargas, Parga-Montoya et al., 2022). Not only does it shed light on the strategies that have enabled SMEs to survive and thrive during turbulent times, but it also provides valuable insights for policymakers, business support organizations, and SMEs themselves to develop effective frameworks, programs, and initiatives that foster innovation-driven growth.

Frugal innovation (FI) has received increased attention in academic literature due to the growing need for efficient resource utilization in the face of mounting challenges (Pisoni et al., 2018). Few studies have been conducted on frugal innovation practices (Cuevas--Vargas, Parga-Montoya et al., 2022). The term “frugal” denotes the economical use of resources without wastage, as applied in FI practices (Bhatti, Ventresca, 2013). The effectuation approach suggests that organizations utilize existing resources to generate new ideas and successfully achieve their objectives (Iqbal et al., 2020). Four principles, namely experimentation, flexibility, affordable loss, and prior commitment, are utilized to assess a firm’s capacity to exploit new opportunities through FI (Sarasvathy et al., 2014). Research in the field of FI focuses on attributes such as ease of use, cost reduction, limited features, and low environmental impact. However, the evolving definition of FI has incorporated elements of sophistication, sustainability, functionality, and performance optimization (Weyrauch, Herstatt, 2017).

Based on empirical findings, it has been shown that entrepreneurs encountered a significant barrier during the pandemic, which was the limited availability of resources. This prompted them to employ frugal innovation as a means to enhance their innovation

levels (Mishra, 2021). Therefore, in this study, we aim to contribute to the growing body of knowledge surrounding frugal innovation practices in the context of SMEs. Specifically, we focus on exploring the level of frugal innovation practices employed by micro, small, and medium-sized enterprises (MSMEs) in the state of Guanajuato, Mexico in the post-pandemic era. By conducting a cross-sectional empirical study with a quantitative approach, we seek to identify the impact of frugal innovation practices on the level of innovation achieved by these MSMEs.

The findings of this study are expected to provide valuable insights and practical implications for decision-makers, entrepreneurs, and other stakeholders invested in promoting innovation among SMEs. By understanding the significance of frugal innovation practices, strategies can be formulated to create frugal ecosystems that facilitate cost reduction, enhance functionality, and drive SMEs' innovation in a sustainable manner. Ultimately, this research aims to contribute to the growth and resilience of SMEs in the face of evolving business landscapes and foster their ability to thrive in an innovation-driven economy.

2. METHOD

An empirical study was conducted with a quantitative, cross-sectional, non-experimental approach, through the statistical technique of multivariate stepwise discriminant analysis, using Wilks' Lambda method, through the IBM SPSS 26 statistical software. For this study, the database of the National Statistical Directory of Economic Units (Instituto Nacional de Estadística y Geografía (INEGI), 2021), was used as a reference, considering as the universe the economic units in the southwest of Guanajuato, Mexico, which have from five to 250 workers. A sample of 58 MSMEs was used for this study. The simple random sampling technique was used and an equal number of companies were visited to be answered by the managers or owners of the companies chosen from the sample through a google form, during the period September-October 2021, which represent the sample for this study.

To measure FI, the second-order scale proposed by Rossetto et al. (2017) was used, which consists of three reflective dimensions: (1) substantial cost reduction, measured with three indicators; (2) creation of a frugal ecosystem, measured with three indicators; and (3) focus on core functionalities and performance, measured with three indicators. All of them measured with a five-point Likert-type scale, where 1 was determined for “Strongly Disagree” and 5 for “Strongly Agree”.

Innovation was measured using the first-order reflective scale used by García-Morales et al. (2008), which consists of three indicators that allow measuring the innovative level of the companies. All of them were measured with a five-point Likert-type scale, where 1 was determined for “Strongly disagree” and 5 for “Strongly agree”.

In order to evaluate the reliability of the scales, Cronbach's Alpha coefficient was estimated for each of the scales. The results presented in Table 1 show the high internal consistency of the four first-order reflective constructs, since the Cronbach's Alpha reliability for each of the constructs is greater than 0.7 as suggested by Nunnally and Bernstein (1994).

Table 1. Reliability of the constructs

Construct	Cronbach's Alpha
Substantial costs reduction	0.885
Creation of a frugal ecosystem	0.769
Focus on core functionalities and performance	0.755
Innovation	0.760

Source: Own calculations from results obtained with software IBM SPSS Statistics v26.

3. RESULTS

First, a descriptive analysis of the manifest variables was conducted using the mean and standard deviation (SD). Table 2 illustrates the findings, indicating that managers or owners of MSMEs in Guanajuato are assigning limited importance to forming alliances with local companies for enhancing their operational processes (mean = 3.37). This overlooks the potential to strengthen the development of frugal ecosystems, which could lead to significant cost reduction in their operations (Rossetto et al., 2017). Additionally, the study reveals that they are attaching insufficient importance to both the adoption of new production methods or services (mean = 3.45) and the introduction of new products or services (mean = 3.60) to enhance their level of innovation during the pandemic. Despite perceiving themselves as more innovative than their competitors in the pandemic era, they fail to prioritize these aspects to attain sustainable competitive advantages.

Table 2. Descriptive statistics – Mean and standard deviation

Construct	Indicators description	Mean	SD
Substantial costs reduction	Solutions offering "good and cheap" products/services	3.76	1.08
	Significant cost reduction in the operational process.	3.62	1.09
	Significant reduction of the final price of the product / service	3.66	1.09
Creation of a frugal ecosystem	Environmental sustainability in the operational process	3.70	1.08
	Partnerships with local companies in the operational process	3.37	1.21
	Efficient and effective solutions to the social/environmental needs of customers	3.77	1.01
Focus on core functionnalities and performance	The core functionality of the product/service rather than additional functionality	3.84	1.03
	Ease of use of the product/service	4.12	0.95
	The issue of the durability of the product / service (not easily damaged)	3.99	1.00
Innovation level	The rate of introduction of new products or services has been growing rapidly in our company.	3.60	1.04
	The rate of introduction of new production methods or services rendered has grown rapidly in our company	3.45	1.12
	Compared to the competition, our company has become much more innovative.	3.82	1.00

Source: Own calculations from results obtained with software IBM SPSS Statistics v26.

With regard to the results of the discriminant analysis, firstly, the assumption of equality of variance-covariance matrices was verified through Box's M test. The results

obtained from the contrast statistic M = 13.926 and a value of F = 4.461, with an associated probability p = 0.004, prevent the acceptance of the null hypothesis of equality of covariances of the discrimination groups; that is, the explanatory capacity of separation of the groups is appropriate. In addition, we proceeded to determine which variables could generate greater discrimination in the analysis. To assess this, a test of equality of means was performed, allowing us to determine whether the mean value of a variable differs significantly across the groups. Table 3 presents the results, indicating that the p-values of the performed tests are less than 0.05, thereby rejecting the null hypothesis. These findings suggest that all the variables considered in the analysis contribute to accurately classifying a firm as a company with high or low innovation level.

Table 3. Equality tests of group means

Indicators description	Wilks' Lambda	F	df 1	df 2	Sig.
Solutions offering “good and cheap” products/services	0.782	15.567	1	56	0.000
Significant cost reduction in the operational process.	0.846	10.222	1	56	0.002
Significant reduction in the final price of the product/service	0.744	19.237	1	56	0.000
Environmental sustainability in the operational process	0.857	9.363	1	56	0.003
Partnerships with local companies in the operational process	0.917	5.043	1	56	0.029
Efficient and effective solutions to the social/environmental needs of customers	0.843	10.429	1	56	0.002
The core functionality of the product/service rather than additional functionality	0.866	8.681	1	56	0.005
Ease of use of the product/service	0.849	9.953	1	56	0.003
The issue of the durability of the product/service (not easily damaged)	0.835	11.098	1	56	0.002

Source: Own calculations from results obtained with software IBM SPSS Statistics v26.

To verify the statistical significance of the variables and their ability to provide adequate discrimination, Wilks' Lambda was analyzed. Table 4 presents the results, indicating that the p-value is less than 0.05 at a significance level of 0.05. Therefore, the assumption is validated.

Table 4. Wilks' Lambda

Step	Introduced	F exact			
		Lambda’s statistic	df 1	df 2	Sig.
1	Significant reduction in the final price of the product/service	19.237	1	56.000	0.000
2	The issue of the durability of the product/service (not easily damaged)	13.130	2	55.000	0.000

Source: Own calculations from results obtained with software IBM SPSS Statistics v26.

The discriminant functions are shown in Table 5, enabling forecasts to determine the level of innovation of SMEs. Therefore, the discriminant functions are as follows.

For low innovation level:

$$Z1 = -16.342 + RSPF*3.112 + DP*5.447 \quad (1)$$

For high innovation level:

$$Z2 = -24.330 + RSPF*4.320 + DP*6.358 \quad (2)$$

Table 5. Classification Function Coefficients

Variable	Low innovation level	High innovation level
Significant reduction in the final price of the product/service	3.112	4.320
The issue of the durability of the product/service (not easily damaged)	5.447	6.358
(Constant)	-16.342	-24.330

Source: Own calculations from results obtained with software IBM SPSS Statistics v26.

On the other hand, Table 6 shows that, overall, the correct classification is 74.1%. Furthermore, the model demonstrates better classification performance for companies with a high level of innovation (83.9%) compared to those with low level of innovation (63%). The high classification percentage indicates that the results are favorable, supporting the conclusion that the classification is accurate and appropriate.

Table 6. Classification results

			Group membership prediction		Total
		Level of innovation	Low innovation level	High innovation level	
Original	Count	Low innovation level	17	10	27
		High innovation level	5	26	31
	%	Low innovation level	63.0%	37.0%	100%
		High innovation level	16.1%	83.9%	100%
NOTE: 74.1% of the original grouped cases were classified correctly.					

Source: Own calculations from results obtained with software IBM SPSS Statistics v26.

4. CONCLUSIONS

In conclusion, this study has explored the importance of frugal innovation practices in fostering the level of innovation among micro, small, and medium-sized enterprises (MSMEs). By adopting a frugal mindset and leveraging limited resources, SMEs can navigate challenges, adapt to changing market dynamics, and deliver high-quality products or services at competitive prices. Through our empirical study conducted in the post-pandemic era, we investigated the level of frugal innovation practices employed by micro, small, and medium-sized enterprises (MSMEs) in the state of Guanajuato. The findings have shed light on the impact of frugal innovation practices on the level of innovation

achieved by these MSMEs, with a particular focus on the significant reduction in product or service prices and the durability of offerings.

The results emphasize the need for decision-makers to create frugal ecosystems that allow MSMEs to reduce costs while maintaining the functionality and performance of their products or services. By embracing frugal innovation principles, such as simplicity, cost-effectiveness, and resource optimization, MSMEs can not only survive but thrive in today's competitive business landscape. Additionally, promoting alliances with local companies in the operational process is recommended to strengthen their frugal ecosystems. Furthermore, a greater emphasis should be placed on the integration of ICTs and new production methods or services that contribute to process innovation improvement.

Furthermore, this study contributes to the growing body of knowledge surrounding frugal innovation practices in the context of MSMEs. The insights gained from this research have practical implications for policymakers, business support organizations, and MSMEs themselves. It provides a foundation for developing effective frameworks, programs, and initiatives that foster innovation-driven growth and enhance the resilience of MSMEs.

Limitations and directions for future research

As every study has its limitations, this one is no exception. Firstly, a limitation of this research is the relatively small sample size of 58 companies. This may raise concerns about the generalizability of our findings to a larger population of MSMEs in Guanajuato or beyond. Future research should consider expanding the sample size to enable a more representative analysis. Second, this study specifically focuses on MSMEs in the state of Guanajuato. While it provides valuable insights into a specific context, it may limit the applicability of our findings to MSMEs in other regions or countries. Future research could explore variations in frugal innovation practices across different regions or compare practices in various states or countries. Third, our study only focuses on the post-pandemic era. Thus, it might be useful to consider conducting longitudinal research to capture how frugal innovation practices evolve over time. Finally, while our study identifies significant variables related to frugal innovation, it is essential to consider that other unmeasured variables may also impact innovation levels. Future research could explore additional variables that might influence frugal innovation in MSMEs.

Moving forward, further research should investigate the long-term effects of frugal innovation practices on the performance and sustainability of MSMEs to determine whether sustained frugal innovation leads to long-lasting competitive advantages or if there are diminishing returns over time. Furthermore, it is suggested to perform industry-specific studies to examine frugal innovation practices in different industries and understand how they vary across sectors. Certain industries may benefit more from frugal innovations than others, and this could inform targeted strategies.

Moreover, future studies should explore the role of external factors such as government policies, regulatory frameworks, and market conditions in facilitating or hindering frugal innovation in MSMEs. This could provide insights into how policymakers can support these practices. Additionally, future research should assess the environmental and sustainability implications of frugal innovation to determine if frugal practices are more environmentally friendly and can contribute to sustainable development goals.

Addressing these limitations and exploring these research directions can contribute further to the understanding of frugal innovation practices in MSMEs and their potential

for driving economic development and resilience. By continuously refining our understanding of frugal innovation and its application in MSMEs, we can pave the way for sustainable growth, increased competitiveness, and economic development. Ultimately, this research aims to inspire and empower MSMEs to harness the power of frugal innovation and thrive in an ever-evolving business landscape.

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