

Analysis of technological innovation in micro and small industries in Cascavel/PR

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Abstract

Adopting innovative practices is important for companies seeking to compete in the market. The manufacturing industries are perhaps the ones with the greatest capacity for generating innovation, given that their activities involve a significant production process for manufacturing products. The aim of this study was to assess the perception of entrepreneurs in Cascavel/PR about the level of innovation in their industries. A descriptive statistical analysis was carried out. The database used was a primary survey of 60 manufacturing companies in Cascavel/PR. The information was collected using a questionnaire adapted from the Industrial Technological Innovation Survey (PINTEC). The results show a low level of innovation and, above all, a lack of new products and processes introduced to the market by the industries, which, according to theory, can negatively influence competitiveness and even threaten the survival of these industries in the market.

Keywords | Cascavel/PR; competitiveness; industry; market; micro and small companies; technological innovation.

JEL Classification | L22 O32 R11

Análise da inovação tecnológica em micro e pequenas indústrias de Cascavel/PR

Resumo

A adoção de práticas inovadoras é importante para empresas que buscam competitividade no mercado. As indústrias de transformação talvez sejam as que tem maior capacidade de geração de inovação, dado que suas atividades implicam num significativo processo de produção para a fabricação de produtos. O objetivo deste trabalho é avaliar a percepção dos empresários de Cascavel/PR sobre o nível de inovação em suas indústrias. Efetuou-se uma análise estatística de caráter descritivo. A base de dados utilizada foi uma pesquisa primária com 60 indústrias de transformação de Cascavel/PR. As informações foram coletadas a partir de uma adaptação do questionário da Pesquisa Industrial de Inovação Tecnológica (PINTEC). Os resultados encontrados demonstram um baixo nível de inovação e, principalmente, a carência de novos produtos e processos introduzidos no mercado pelas indústrias, o que, segundo a teoria, pode

influenciar negativamente a competitividade e até mesmo ameaçar a sobrevivência dessas indústrias no mercado.

Palavras-chave | Cascavel/PR; competitividade; indústria; inovação tecnológica; mercado; micro e pequenas empresas.

Classificação JEL | L22 O32 R11

Análisis de innovación tecnológica en micro y pequeñas industrias de Cascavel/PR

Resumen

La adopción de prácticas innovadoras es importante para las empresas que buscan competitividad en el mercado. Las industrias manufactureras son quizás las que tienen mayor capacidad de generación de innovación, dado que sus actividades implican un proceso productivo significativo para la fabricación de productos. El objetivo de este trabajo fue evaluar la percepción de los empresarios de Cascavel/PR sobre el nivel de innovación en sus industrias. Se realizó un análisis estadístico descriptivo. La base de datos utilizada fue una investigación primaria con 60 industrias manufactureras de Cascavel/PR. La información se obtuvo de una adaptación del cuestionario de la Investigación Industrial de Innovación y Tecnología (PINTEC). Los resultados encontrados demuestran un bajo nivel de innovación y principalmente, la falta de nuevos productos y procesos introducidos en el mercado por las industrias, lo que según la teoría, puede dañar la competitividad e incluso la supervivencia de estas industrias en el mercado.

Palabras clave | Cascavel/PR; competitividad; industria; innovación tecnológica; mercado; micro y pequeñas empresas.

Clasificación JEL | L22 O32 R11

Introduction

Micro and small-sized enterprises (MSEs) have played a significant role in the Brazilian economy. Particularly, the performance of MSEs in the manufacturing sector has contributed to increased employment concentration and supported economic growth in various activities (IBGE, 2017). Transformation industries, which consist of micro or small-sized enterprises, hold a market share of 9.97% of all enterprises in Brazil. In terms of the comprehensive industrial sector income, transformation industries account for at least 60%. In 2015, these enterprises accounted for 15.7% of all formal labor in Brazil, with an average wage ranging from 1 to 5 Brazilian minimum wages for 82.96% of the sector's employees (MTE, 2017).

According to Néto and Teixeira (2011), there are several factors that may lead to the failure of MSEs in the industrial sector. Implementing strategies, such as policies that foster innovation, can mitigate these factors. Josef Schumpeter was one of the first economists to consider and research the potential of innovation in firms. His research has highlighted innovation as one of the primary drivers of economic development.

Schumpeter (1982) defined innovation as the creation of new goods and services, production techniques, market openings, raw materials, and organizational methods. These types of innovation strategies can make a significant difference in enhancing competitiveness. Innovations elevate enterprises above their market competitors, at least until these innovations are surpassed or replicated. This phenomenon is often referred to as provisional monopolies.

The choice of technology strategies related to different types of innovation, such as products, processes, markets, raw material sources, or organizational methods, is determined by firms' awareness of business technology and market trends. Technology strategies can be categorized into six groups: Aggressive: Aimed at technical and market leadership. Defensive: Involves Research, Development, and Innovation (R, D&I) and is more frequently used by oligopolistic firms. Imitative: Pursues market leaders with already available technologies. Dependent: Relies on other firms' technology and does not have any innovation projects. Traditional: Suitable for a stable market where products are not affected by shifts. Opportunistic: Takes advantage of dynamic market shifts (MALAQUIAS; MEIRELLES, 2009; GONZAGA; RIBEIRO, 2015; PAULA; BIGUETTI, 2003; SEREIA; STAL; CÂMARA, 2015; STAL, 2010).

According to Jensen, Menezes-Filho, and Sbragia (2004), wealthy and developed nations include technological innovation projects supported by more aggressive market strategies in their development agenda. Access to financial support and government investments can enhance competitiveness in the industrial sector, ultimately reducing social inequality.

In Brazil, efforts have been made to improve competitiveness conditions through the "Lei da Inovação Tecnológica" (LIT), which was decreed in December 2004. This legislation acts as a mechanism for promoting innovation, scientific research, and technology development. The incentives for technological improvements foster competition in the goods and services market, contributing to increased employment levels, income, and development (MATIAS-PEREIRA, 2013).

Barboza, Fonseca, and Ramalheiro (2015) argue that MSEs need to be stimulated to innovate because they often lack the resources and infrastructure for in-house Research, Development, and Innovation (R, D&I) departments, which are more common in larger enterprises. According to Stal, Nohara, and Chagas Jr. (2014), establishing an independent R, D&I department may not be affordable or feasible for MSEs and could jeopardize their survival in the market.

Therefore, the most viable path towards innovation for MSEs is through forming partnerships. The theoretical framework of this study suggests that the transformation industry, due to its vastness, requires partnerships, resources, and investments in innovation the most. This topic is chosen because this sector encompasses various activities aimed at modernizing their machinery, tools, and updating their products and production processes. Additionally, the sector contributes 11.7% to Brazilian GDP in 2014 (IBGE, 2017).

In this context, the paper explores the debates about the innovative efforts made by small industrial firms in the transformation industry sector. The guiding question for this study is: considering the different types of innovation, how do entrepreneurs perceive the innovation levels of their industrial enterprises? The primary focus is on the various paths available for achieving innovation. The importance of this topic has grown over the years with extensive discussions on entrepreneurial behavior. Therefore, the main objective of this study is to estimate the entrepreneurs' perception of the level of innovation in micro and small industries located in Cascavel-PR between 2015 and 2016.

Innovations by micro and small businesses are crucial for local development because, in the industrial sphere, innovations can lead to improvements in machinery and equipment, thereby increasing production. According to Welter et al. (2020), each region has its unique socio-economic and productive characteristics, leading to economic growth occurring in diverse ways and intensities, rather than uniformly.

This paper consists of four additional sections following this introduction. The second section presents the methods and tools used in the research. The results and discussions are presented in the third section, while the fourth section provides the final considerations.

Tools and methods

In consonance with the main objective of this paper, a descriptive statistical analysis was taken. As defined by Gil (2002), this research method is suitable for characterizing a sample and establishing connections among variables.

Data collection was carried out using an adapted questionnaire from the Research of Innovation and Technology (IBGE, 2016). The PINTEC survey is conducted by the Brazilian Institute of Geography and Statistics (IBGE) with support from the Studies and Projects Supporter (FINEP) and the Ministry of Science and Technology. The primary objective of PINTEC is to identify innovative activities within enterprises and analyze the trends they have followed over time. For this study, we utilized the 2016 PINTEC survey, which covers the period from 2012 to

2014. The survey's key questions focus on the types of innovations implemented by enterprises in the market.

The original survey does not provide regionalized data. Hence, the use of the PINTEC data serves as an appropriate means to comprehensively understand the dynamics of innovation in a specific municipality or region while adhering to the original survey's guidelines. Interviews were conducted between January 2017 and March 2017, focusing on the 2015-2016 period.

The sample for this study consisted of 60 micro and small transformation industry enterprises, randomly selected in the municipality of Cascavel, located in the State of Paraná. Among these enterprises, 13 (21.7%) were classified as micro-sized, while 47 (78.3%) were considered small-sized. Of the 60 enterprises, 33 (55%) were situated in the industrial districts of the municipality. The survey covered various industrial sectors, including food, construction, metal mechanics, furniture, plastics, chemicals, and textiles. The data were analyzed using basic statistical methods.

Results and discussions

According to the Instituto Paranaense de Desenvolvimento Econômico e Social (IPARDES), the municipality of Cascavel was home to 1,177 established firms in the transformation industry sector. In the same year, these industries generated 18,642 formal jobs (IPARDES, 2017).

The sample of 60 enterprises in this study represents approximately 5% of all businesses in the sector. These enterprises accounted for a total of 894 formal jobs, constituting around 4.7% of all employment within the transformation industry in Cascavel, Paraná. The subsectors of the industrial activities surveyed are detailed in the first table below:

Table 1 – Subsector of the industrial activities

Sector	%
Mechanic Metal	33.33
Building	21.67
Plastic	11.67
Food	10.00
Furniture	8.33
Chemistry	6.67

Textile	5.00
Other sorts: boards and kayaks factory	3.33
Total	100.00

Source: Prepared by the authors.

The diversity of subsectors underscores the significance of innovative activities across various industries. This study delves into the innovative behavior of these firms and the strategies they employ to enhance their competitiveness relative to their market competitors, with a particular focus on four main types of innovations: products, processes, organizations, and markets.

According to Terra, Barboza, and Bouzada (2015), the introduction of new products can expand a firm's sales and, consequently, its revenue. Product innovation is, in essence, one of the most pivotal means for industries to maintain their market share and outperform their competitors.

However, in this competitive environment driven by the desire for differentiation from competitors, such a proactive stance was not universally observed among the firms within the sample. The survey revealed that 43.3% of the entrepreneurs indicated that they neither introduced new products nor updated existing ones in 2015 and 2016, whereas 56.7% did engage in such activities. This suggests that even for products available in the national market, a significant number of industries did not employ imitative innovation practices.

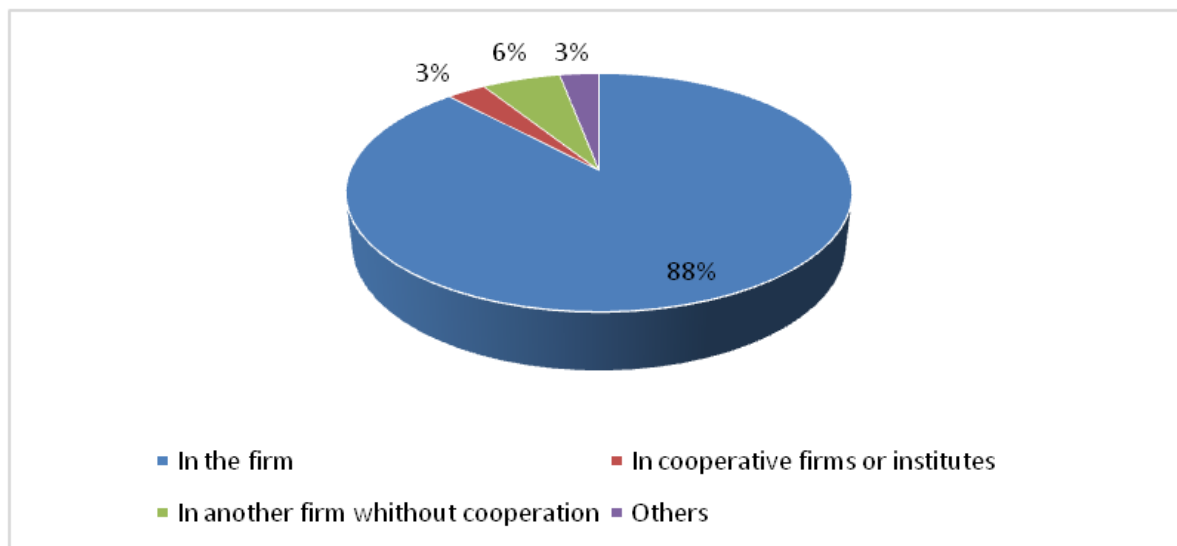
When asked about innovations in the form of new products or significant updates for the national market, 81.6% of entrepreneurs reported that they did not engage in these types of innovations, which are considered genuine innovations. Consequently, these industries appeared to lack an aggressive innovation strategy, and the micro and small industrial enterprises in Cascavel did not seem inclined to take risks associated with the costs of innovation. Only 18.4% of the sample innovated by creating new products or significantly updating existing ones for the national market.

Another noteworthy observation from the survey pertains to whether the industries that innovated did so by introducing products that were already available or by creating entirely new products, as defined by the OECD (2005). It turns out that 42.4% of the firms that innovated did so by improving upon existing products, while 57.6% introduced entirely new products to their portfolio.

This survey found that only 31.6% of the industries innovated by introducing new products to their business. It is uncertain whether the firms that innovated are entirely safeguarded against competition, let alone those that did not innovate, making their competitiveness more susceptible to threats.

As such, it is imperative to examine the factors that can stimulate innovation within these firms. Therefore, one of the key questions posed to the firms that engaged in the creation of new products or significant updates to existing ones was: "Where did the innovation for these products come from?" The responses are presented in the first chart:

Graphic 1 – Where the person who developed the products innovation is from?



Source: Prepared by the authors.

The majority of firms that developed product innovations sought to implement internal ideas, particularly those conceived and developed by their owners. These findings reinforce the concept of an emerging institutional network, which, despite being an essential factor for innovations, is not fully established, as defined in the neo-Schumpeterian research (NELSON; WINTER, 2005).

However, it's worth noting that even though most product innovations are generated internally by the firms, it doesn't necessarily imply that these firms have formalized management structures for innovation. In fact, only 11.7% of the firms engaged in any internal Research, Development, and Innovation (R, D & I) activities. As a result, innovations primarily occurred due to occasional changes rather than a sustained effort towards continuous product innovation.

Among all the types of innovation, product and process innovations are closely intertwined since one often depends directly on the other to materialize. In many cases, the development of a new product necessitates the improvement of machinery, tools, software, and production methods. It is vital to scrutinize the distinctive aspects of process innovations within the surveyed enterprises.

Numerous studies have explored the correlations between innovations and firms' revenue trends. In the case of process innovations, they can enhance business profitability, primarily because this type of innovation leads to cost reductions in the production process (TERRA; BARBOZA; BOUZADA, 2015).

With regard to process innovation, the adapted PINTEC questionnaire used in this survey includes three key questions to assess whether any process innovations occurred. The first question pertains to new or updated production methods, revealing that 45% of the firms did not introduce any innovations in this area. This percentage underscores the idea of a correlation and influence of product innovations on process innovations since it closely resembles the proportion of firms that innovated in their products (43.3%).

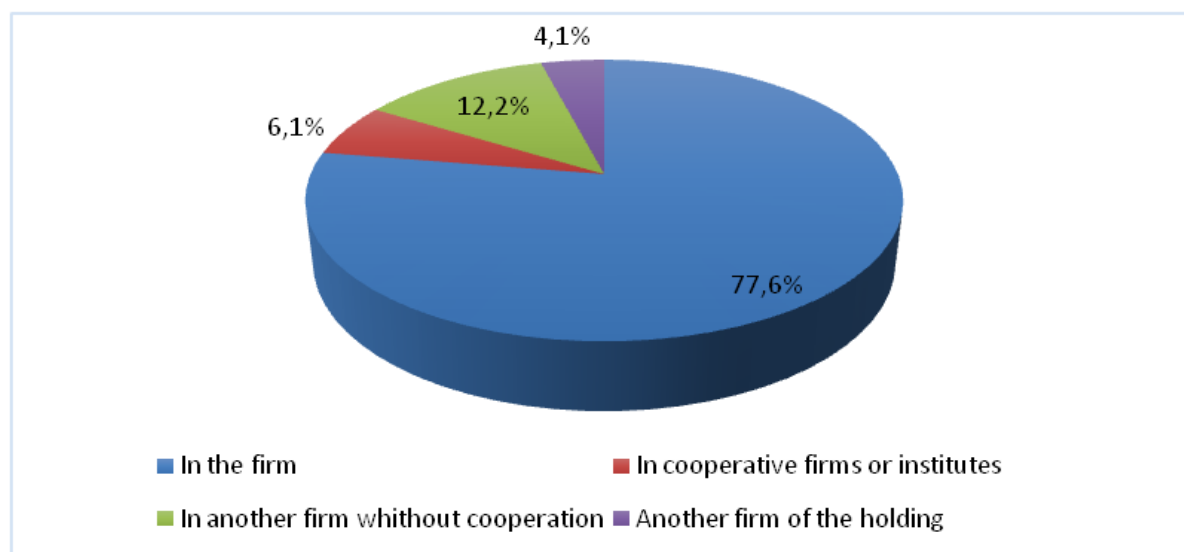
The second question relates to innovations in logistics, such as the implementation of new delivery systems or improvements to existing ones. The percentage of firms that did not innovate in this area was even higher, reaching 71.7%. Reducing transportation costs could be a strategic option for these firms, and potential solutions mentioned in the literature include logistics software, sourcing delivery, partnerships, and more. However, the survey indicated that 66.7% of the firms did not establish any partnerships, agreements, or sourcing arrangements during 2015 and 2016.

The last question focuses on the creation or update of equipment or software supporting production, such as control tools, performance measurement, and quality control. Innovations in this aspect were more common, with 71.7% of firms updating these processes. However, it is important to note that many of these innovations involved the maintenance or replacement of older equipment rather than entirely new developments.

Entrepreneurs were also asked about entirely new innovations introduced by their firms for their respective sectors in Brazil. Only 6.7% claimed to have introduced such innovations. Once again, it becomes apparent that the firms in the sample did not engage in aggressive innovation practices, as discussed in Malachias and Meirelles' paper (2009).

Similar to product innovations, process innovations had a high degree of internal development, indicating a low demand for innovations from external sources, as shown in the second chart. The data revealed that the majority of innovations were occasional, with 88.3% of the firms lacking a dedicated Research, Development, and Innovation (R, D & I) department.

Graphic 2 – Where the developers of the process innovations are from



Source: Prepared by the authors.

Another aspect explored in the research was the impact of innovations on increasing production and reducing costs. The second table displays the proportion of entrepreneurs who reported some significance regarding the impact of process innovations in each area.

Table 2 – Relevance of the process innovations

Impacts over	Relevance		
	High	Medium	Low
Increase in the production capacity	48,9%	42,8%	8,3%
Lowering of costs of production	14,4%	38,7%	46,9%
Lowering of labor costs	18,3%	30,6%	51,1%
Lowering of raw-material costs	10,2%	16,3%	73,5%
Lowering electricity costs	8,1%	26,5%	63,4%

Source: Prepared by the authors.

The second table indicates that 91.7% of the firms that innovated in production processes claimed that, to some extent, it increased production. However, most of these innovations did not lead to a reduction in labor, raw material, and electricity costs for the majority of the firms. Only 14.4% of the entrepreneurs affirmed that process innovations significantly reduced production costs in all cases.

This inverse correlation between increased production capacity and production costs is expected since changes in the industry structure that lead to increased production also tend to result in cost increases. One notable characteristic observed about process innovations is that entrepreneurs primarily aimed to boost profits by increasing production, thus driving innovations in this direction rather than focusing on cost reduction.

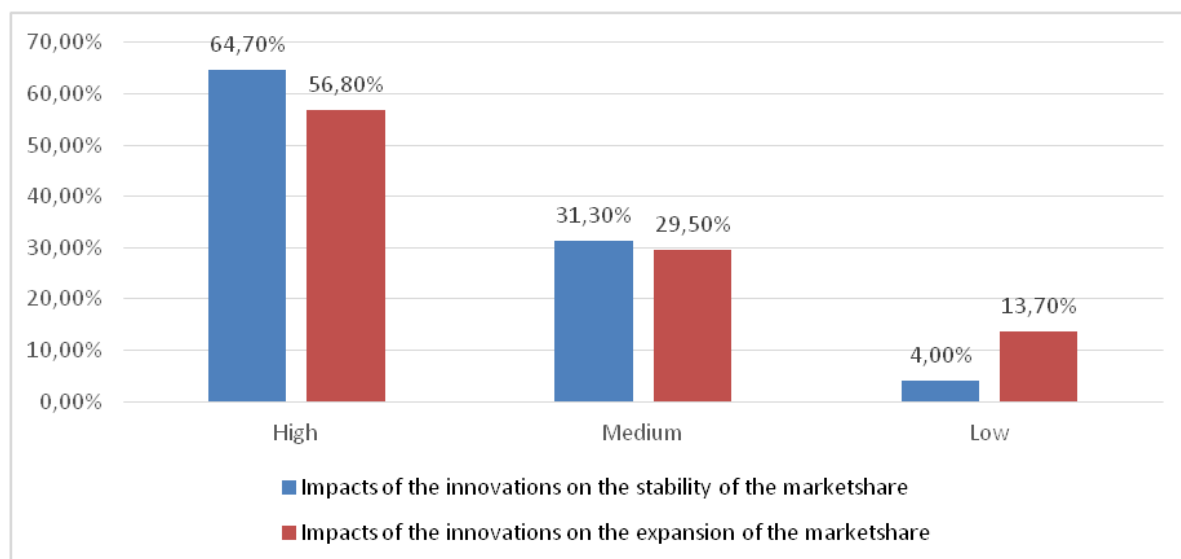
A significant portion of the literature on innovation emphasizes technological changes as catalysts for innovation in firms, often making the innovation processes more complex. Typically, innovation is limited to changes occurring in the creation of new products and processes. Consequently, the literature frequently attributes less relevance to organizational and market innovations (BARBOZA, FONSECA; RAMALHEIRO, 2015).

It was observed that the firms that pursued innovations in this manner did not necessarily rely on high levels of technology for these innovations. In the context of organizational innovations, questions were raised about the firm's participation and involvement in cooperative arrangements, clusters, and partnerships with the aim of driving innovations. Surprisingly, 63.3% claimed not to have been involved in these strategies.

A few organizational innovation efforts within the firms were related to changes made in management. It was noted that 58.3% of the industries introduced new techniques to enhance their management routines (e.g., human resources, accounting, and financial departments), and 73.3% implemented new methods of work organization, including the distribution of functions, decision-making authority, and the establishment of teamwork. Additionally, 45% indicated that they modified their environmental management techniques. While this can be seen as a positive step for environmental preservation, most firms cited compliance with environmental laws as their primary motivation.

Market innovations were evaluated in terms of their relevance to the firms' market share trends, as illustrated in the third chart.

Graphic 3 – Impact of the innovations in the market share trends.



Source: Prepared by the authors.

The majority of firms that had implemented innovations managed to either maintain or significantly improve their market share as a result of these innovations. While the number of enterprises that expanded their market share is smaller than those that maintained it, it still represents a substantial proportion. This indicates that the gains in productivity resulting from innovations were effectively absorbed by the market.

The final two questions in this survey pertained to marketing strategies. Despite marketing being a powerful tool for promoting products and firms to the public, 40% of the sample had not improved their marketing strategies, including the adoption of new media, techniques for promoting their products, and new sales channels, even though they had initiated such strategies in the past two years.

Lastly, respondents were questioned about changes in product designs, whether any alterations were made in this regard. A notable 43.3% of the firms reported no changes in product designs. However, the absence of innovation in design can be justified by the high number of firms that have successfully maintained their market shares without the need for design changes, thus keeping costs in check.

It is important to acknowledge that regional circumstances play a pivotal role in the diffusion of innovations among micro and small businesses. According to Ferrera de Lima and Bidarra (2019), the regional environment is influenced by the unique growth patterns in each location. Alves (2022) emphasizes that the regional environment is shaped by geographical, historical, and economic factors, which, in turn, influence the region's productive structures. In his study, Ribeiro (2022) argues that government policies targeting the business sector (machinery and equipment)

and socio-economic development aid in expanding and solidifying the economy by boosting production.

Final considerations

Technological innovation can be defined as the application of ideas to create products, processes, and services that can be offered in the market. The primary objective of this survey was to analyze entrepreneurs' perceptions of the level of innovation in Micro and Small Enterprises (MSEs) located in the municipality of Cascavel, Paraná, between 2015 and 2016.

The survey underscored the critical role of innovation in the development of the industrial sector, manifesting in the quality of products, production processes, firm organization, and market competitiveness. However, the results revealed a deficiency in the introduction of new products and processes, leading to a relatively low level of innovation within the industries in Cascavel, Paraná, during 2015 and 2016. The theoretical framework posits that this limited innovation has a detrimental impact on firms' competitiveness and their ability to thrive in the market.

The results further indicated that the innovations that occurred during the 2015-2016 period in these firms were largely sporadic rather than representing genuine improvements in the production process. Consequently, the dearth of innovative processes in micro and small companies has repercussions for the local productive structure and the overall development of the municipality.

Numerous authors have already explored innovations within micro and small industries, yet there remains substantial room for new research. Therefore, additional research and surveys examining the dynamics of innovation within firms are invaluable, especially those seeking to analyze the main factors that hinder innovation, thereby facilitating the identification of these challenges and offering potential solutions for their elimination. New research that analyzes each sector separately is also encouraged to uncover common threads and areas of convergence among the information.

In conclusion, fostering a culture of innovation and addressing the challenges that impede it within MSEs is paramount for the sustained growth and competitiveness of these enterprises and the regions they operate in.

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