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Modeling the Impact of Inventory Management on Sales Performance in Peruvian Nano-Stores: Evidence from Structural Equation Modeling

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Abstract

Nanostores are a vital segment of the Peruvian retail ecosystem; however, their operational inefficiencies, particularly in inventory management, limit their commercial development. This study investigates the causal Relationship between inventory management and sales performance in nanostores in Lima, using Structural Equation Models (SEM). A quantitative and explanatory design was employed, with data collected from 220 store owners through validated surveys. The analysis, conducted with SPSS and ADANCO, revealed that inventory management has a significant influence on sales results. Additionally, supplier management has direct and indirect effects through inventory and procurement practices. Although some indicators showed low factor loads, the overall model demonstrated an acceptable fit and explanatory power ($R^2 = 0.526$ for the Impact on sales). The findings suggest that bolstering supplier and inventory management strategies can improve sales performance and competitiveness in small-scale retail. This study is novel in its application of SEM to nanostores in a Latin American context, making methodological and practical contributions to the literature on supply chain efficiency in microenterprises.

Keywords
Inventory management, nanostores, internal logistics, structural equation model (SEM), Impact on sales

1. Introduction
Small businesses called bodegas are essential for meeting the daily needs of families in Peru and most of Latin America. People like these nano stores, which are often in neighborhoods, because they are easy to get to and offer personalized customer service. Their strong presence in retail is mostly because they are close to customers and can be flexible (Mora-Quiñones, & C, 2021), (Acuña, & E, 2021). Most of the time, these businesses are owned by families and have few employees, small budgets, and limited access to technology (Acuña, & E, 2021), (Ortega-Jiménez, & C, 2022). Many of them are run by people who, despite their dedication, don't have the right training or management tools (Salinas, & D, 2024). Some of these stores are financially stable, but they can't grow because they still use old methods, don't have a wide range of products, and don't come up with new ideas. Because of this, they often depend on a loyal but unchanging customer base and have a hard time adjusting to changes in the market (Salinas, & D, 2024), (Escobar, & H, 2023).

Nano stores are everywhere, but they still have a lot of problems with how they run. They often can't compete as well because they don't have structured inventory control, don't use technology enough, and have informal relationships

with suppliers. These facts make us ask an important question: How much do nanostores' inventory, supplier, and purchasing management practices affect their sales in developing economies like Peru?

To be competitive in today's market, you need more than just determination. It is important to have a better understanding of operational factors, especially those that have to do with making money (Salinas-Navarro, D., Velazquez, M., Garcia, P., Martinez, R., & Experiential learning for sustainability in supply chain management education, 2022). We need new ways of looking at things to understand how micro and small businesses (SMEs) deal with environments that are always full of problems (Chacón, & E, 2022). Small and medium-sized businesses (SMEs) often have to use simple, low-cost strategies because of money and technology issues. These strategies may not always work as well as those of larger companies (Teerasoponpong, S., Sopadang, A., & Decision support system for adaptive supply and inventory management in small and medium-sized enterprises, 2022). Previous research has shown that managing inventory directly helps a business by lowering costs, meeting customer demand, and making the value chain better (Chen, L., et al, 2023). Keeping the right amount of stock on hand and avoiding shortages and overstocking can have a real impact on both short-term and long-term profitability. On the other hand, bad inventory management, which is often caused by bad buying and monitoring choices, can be a major cause of inefficiency (Bellido Mantilla, R., et al., 2021).

Also, there isn't enough research in the supply chain literature about strategic decisions about inventory holding costs, especially when it comes to small retailers (Bolaños-Zúñiga, L., Holguín, & C, 2021). This gap underscores the importance of examining which variables most influence inventory control and, by extension, business outcomes in nano stores. For this reason, the present study focuses on inventory management, purchasing management, and supplier management as central elements linked to sales performance.

Although inventory practices have been studied in various SME settings, research applying structural equation modeling (SEM) to nano stores remains limited. In addition, few studies have integrated supplier and purchasing management as mediators in the Relationship between inventory and sales. This study addresses neglect by proposing a theoretical model and validating it with empirical data from nano stores in Lima. In doing so, it brings new insights to the literature on micro-retailer supply chains. It provides actionable findings for small businesses looking to strengthen their operations in highly competitive markets.

1.1 Variables

This research aims to analyze the variables that are believed to have a greater impact on inventory management and investigate how inventory management predominates over other variables in the profitability of the aforementioned business models. The dimensions of each variable and their Impact on the proposed model will also be observed. This way, highlight the key points to work on to maximize profits.

1.1.1 Vendor Management

Distributors play a vital role in supplying small independent retailers, who remain key hotspots for households, particularly those at the base of the socio-economic pyramid, defined as individuals living on less than $5 a day, representing approximately 65% of the world's population (Fransoo, & J, 2022). In this context, recent studies have examined the Impact of the product mix on consumer behavior and sales performance in this retail segment. Specifically, three dimensions of the product mix (breadth of range, presence of perishable products, and recommended variety) have been identified as important factors affecting purchasing and sales decisions for group consumer goods (CGBs) (Xin, T., Hailiang, J., Xuan, Z., & Product assortment and online sales in the community group purchasing channel: evidence from a convenience store chain, 2024).

The primary measure of CGB's sales success is the total revenue generated from group purchases made at each store (Xu, S., Chen, T., & Research on the optimal threshold of group purchasing and the pricing strategy of community group purchasing, 2023). Two other useful measures for looking at how people shop are the average number of items per transaction (basket size) and the average price per item in each order (Zhang, H., Wang, Z. & Li, M, 2022), (Malik, & T, 2023).

Supplier management is also a strategic part of making retail operations run more smoothly, in addition to product strategy. When nano store owners negotiate effectively and select their suppliers wisely, they can secure better business terms, such as volume discounts and extended payment terms (Du, S., Sun, X., Hu, L., & Choi, & T, 2024),

(Hidalgo-Carvajal, D., Rodriguez, M., Sanchez, J., Lopez, K., & Out of the box: exploring the returnability of cardboard in nanostore supply chains, 2023). These benefits lower operating costs and increase financial liquidity, allowing the business to reinvest in key areas (Sun, S., Zhang, B., & Operation strategies for nanostores in community group purchases, 2022). Additionally, strategic supplier management directly leads to increased sales by making it easier for customers to find a wider range of products that meet their needs, which helps attract Additionally, strategic supplier management directly leads to increased sales by making it easier for customers to find a broader range of products that meet their needs, which helps attract new customers and encourages repeat purchases (Fransoo, & J, 2022).

However, in many nano store settings, suppliers are viewed as passive players who have little say in the buying process, as store owners typically make all the key decisions (Albors-Garrigos, & J, 2020). This situation often leads to poor purchasing practices, which makes it harder for the company to respond to market changes. Building stronger, more cooperative relationships with suppliers can significantly enhance operational efficiency by ensuring that products are consistently available, reducing lead times, and minimizing the risk of stockouts significantly enhance operational efficiency by ensuring that products are consistently available, reducing lead times, and minimizing the risk of stockouts (Xu, S., Chen, T., & Research on the optimal threshold of group purchasing and the pricing strategy of community group purchasing, 2023).

1.1.2 Purchasing management

In small businesses like nano stores, managing purchases is very important and is usually done by the owners or managers of the stores. Purchases make up about 50% of total operating costs, and inventory-related costs make up another 14% (Alam, & Md, 2024), (Xu, S., Chen, T., & Research on the optimal threshold of group purchasing and the pricing strategy of community group purchasing, 2023). This means that businesses need to have good procurement strategies in place to stay in business. If not handled properly, these high costs can make it hard to make money and grow.

Over the past four years, these businesses have consistently made about 25,000 PEN a month in sales. The actual average monthly revenue collected, on the other hand, has been closer to 23,000 PEN, which shows that there is a persistent gap between expected and actual sales. This difference shows that there are problems with operational efficiency, especially when it comes to planning purchases and inventory.

Even though these problems exist, nano stores are still the best place for low-income people who cannot afford to shop at supermarkets or hypermarkets. One of the main reasons people stay loyal to these stores is that they are flexible, like letting regular customers borrow money without having to pay it back right away (Ventura, & J, 2023). This dynamic strengthens consumer preference, but it also highlights the importance of developing skills that can predict market behavior and provide highlights the importance of developing skills that can predict market behavior and provide long-lasting competitive advantages (Yuan, & Z, 2024).

Nano stores face a significant challenge due to their limited liquidity, resulting in purchases that are often reactive and driven by demand, without any structured face a significant challenge due to their limited liquidity, resulting in purchases that are often reactive and driven by demand, without any structured planning (Xu, S. & Chen, T., 2023), (Zhang, H., Wang & Z., Li, M., 2022), (Malik, & T, 2023). These uncoordinated buying habits make it more likely that you will have too much or too little stock, which will affect service levels and sales. Also, the quality of service tends to go down because of two common issues: orders that are only partially filled and customers who do not want the products. These problems are often caused by inefficient inventory management, like low stock turnover or delayed replenishment cycles, which in the end hurt profits (Quiroz-Flores, & J, 2022).

In this situation, it is important to learn how to manage things like predicting the market and getting the best deals when buying. Nano stores can become more competitive and improve their overall financial performance by using more structured purchasing methods that are in line with customer demand.

1.1.3 Investment Management

Good inventory management is very important for the long-term success of nano stores because it keeps the right amount of stock on hand and stops both product shortages and the buildup of slow-moving items (Wang, G.-Y., Fransoo, & J, 2025). Store owners can keep their inventory in check so that supply matches actual demand. This keeps money from sitting around in unsold goods. Also, nano stores can better predict what customers will need by looking

at past sales data and studying trends in consumption. They can then change how much they buy based on these predictions (Farida, & I, 2022).

Overstocking, on the other hand, is still a big problem because it raises storage and transportation costs, lowers available working capital, and lowers the overall return on investment (Collao-Díaz, & M, 2024), (Immadisetty, A., & Real-time inventory management: restock outs and overstocks in retail, 2025). So, managing inventory not only affects how a business runs daily, but it also affects its long-term viability and overall financial health.

1.1.4 Impact on sales

Nano stores have had to rethink and change how they are organized internally in the last few years because of more uncertainty in the market and more competition for workers (Alam, & Md, 2024). In this situation, it is becoming more and more important to know what makes people buy things in these types of stores. It is important to not only find out which factors have the biggest Impact on consumers' choices, but also to look at how these factors interact with and affect each other (Purnamasari, & D, 2023).

Previous research has stressed the importance of looking into how these behavioral factors are related, especially since they affect loyalty and repeat purchases in low-income markets (Sharma, R., Patel, D., & A comprehensive analysis of inventory management and its impact on operational efficiency, 2024), (Costa Filho, M. C., & Falcão, R. P. Q, 2021). To make marketing and buying decisions in nano stores more effective, it is important to understand these dynamics so that inventory planning matches actual sales behavior.

1.2 Causal relationships

When managing inventory well in nano stores, you need to think about a lot of different things, like how much space you have to store things, how much demand there is from customers, and how available your suppliers are. One of the biggest problems is that the supply chains these stores use are very complicated. More complicated systems often mean more uncertainty, which means that businesses need to come up with ways to adapt to stay competitive (Kraude, R., Narayanan, S. & Talluri, S., 2022).

Despite this, pre-purchase supplier management is often overlooked, even though it can be a deciding factor in procurement performance. Establishing relationships with suppliers with flexible contractual terms can generate mutual benefits, provided that a proper prior analysis is carried out (Soni, & H, 2018), (Hidalgo-Carvajal, D., Rodriguez, M., Sanchez, J., Lopez, K., & Out of the box: exploring the returnability of cardboard in nanostore supply chains, 2023), (Sun, S. & Zhang, B., 2022), (Albors-Garrigos, & J, 2020), (Alam, & Md, 2024), (Wang, G.-Y., Fransoo, & J, 2025). Poor inventory control is often linked to errors in batch sizes and inadequate purchasing decisions, often exacerbated by poor supplier management (Bellido Mantilla, R., et al., 2021). Several authors suggest that inventory outcomes are not determined solely by the decisions of the warehouse manager, but by a combination of factors, including procurement strategy, administrative capabilities, and supplier reliability (Fransoo, & J, 2022), (Sun, S., Zhang, B., 2022), (Malik, & T, 2023).

In many small businesses, inventory control is poorly implemented or completely absent. As a result, owners lack accurate records of product values, fail to protect their investment, and are unable to meet customer demand effectively (Boulaksil, Y., van Wijk, & A, 2018). These weaknesses become especially problematic in scenarios characterized by high volatility, such as simultaneous stockouts and sudden increases in demand, or the opposite: high inventory and weak sales. Delivery delays and unpredictable supply conditions further complicate the situation (Lashgari, M., Sadjadi, & S, 2019), (Sharma, R., Patel, D., & A comprehensive analysis of inventory management and its impact on operational efficiency, 2024), (Fransoo, & J, 2022).

Given this, the analysis of the interactions between these variables is essential. By better understanding their causal relationships, future research can propose actionable tools and models to strengthen warehouse management and reduce uncertainty in micro-retail environments.

2. Methodology

This study employs an explanatory research design based on a positivist paradigm, with the aim of identifying causal relationships between variables through objective measurement and analysis. The research adopts a quantitative approach and employs an appropriate experimental design, in which the researcher deliberately manipulates

independent variables to observe their effect on the dependent variable under controlled conditions (Ge, J., Honhon, D., Fransoo, & J, 2020).

Experimental methods are particularly suitable for hypothesis testing because they allow researchers to establish cause-and-effect relationships. When a statistically significant change in the dependent variable occurs as a result of a controlled variation in the independent variable, the underlying hypothesis is confirmed (Dai, Z., Gao, K. & Zheng, X., 2022). In this case, the study aims to assess the causal Impact of supplier management, purchasing management, and inventory management on sales performance in nanostores. By testing these relationships experimentally, the study not only describes, but also explains the magnitude and direction of each effect, offering insights into which variables most influence sales outcomes in this segment of the retail sector.

2.1. Hypothesis

According to data from the Association of Merchants of Peru, approximately 70% of new small businesses fail within their first year of operation, and 90% of those that survive beyond this period enter a subsistence phase, with a high risk of eventual closure (Mora-Quiñones, & C, 2021). These figures highlight the fragility of nanostores, commonly referred to as "bodegas" in Peru, which face unique operational challenges, such as limited inventory space and low volume of products per transaction (Alam, & Md, 2024).

Despite these limitations, this study proposes that effective inventory management can play a critical role in improving sales performance and ensuring business sustainability. The research, therefore, aims to test the causal Relationship between inventory management (independent variable) and sales (dependent variable) in the context of Peruvian nano stores. Figure 1 illustrates the conceptual framework and hypotheses that guide this research.

By empirically evaluating this Relationship, the study seeks to identify key areas for operational improvement and measure their Impact on performance outcomes. In addition, the interactions between other relevant variables, such as supplier management and purchasing management, will also be examined to provide a more complete understanding of their influence on sales. These hypotheses were developed based on predictive analysis and were based on both empirical evidence and contextual business realities.

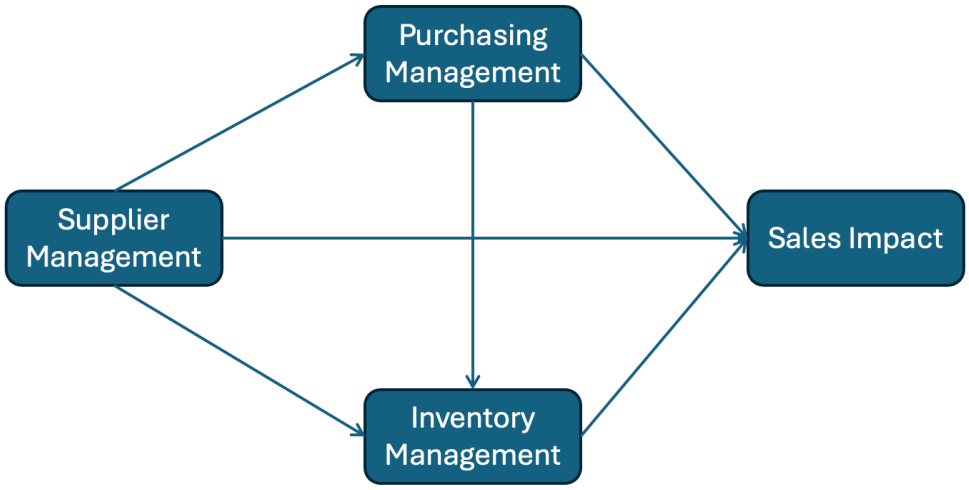

Figure 1. Conceptual diagram

Note. Adapted from Ortega-Jiménez (2022); Teerasoponpong and Sopadang (2021); Quiroz-Flores, Valverde-Huamán, and Romero-Vega (2022); Dai, Gao, and Zheng (2022); Kraude, Narayanan and Talluri (2022); Ortega et al. (2024); and Kang (2021). Some elements were modified for the purposes of this study.

To support the formulation of hypotheses, a predictive analysis was performed based on the causal relationships identified in the literature and contextual business practices. A critical element influencing these relationships is the

complexity of the supply chains in which nano stores operate. Increased supply chain complexity is often linked to increased uncertainty, forcing these companies to develop adaptive strategies to remain competitive (Salinas-Navarro, D. et al., 2022).

Ensuring the availability of high-demand products has a direct and positive impact on sales. When customers are confident that they will find what they need, the likelihood of repeat purchases increases (Chaniago, H., 2021). In line with the above, the following hypotheses were established:

- **H1**: Inventory management has a positive effect on sales performance.
- **H2**: Purchasing management has a positive effect on sales performance.

Despite its importance, pre-purchase supplier management is often undervalued in the decision-making process. Several studies report that deficiencies in inventory control, such as incorrect size of purchase batches and poor supervision, are frequently associated with inadequate supplier management (Ventura, & J, 2023). Therefore, the following relationships are also proposed:

- **H3:** Vendor management has a positive effect on inventory management.
- **H4:** Supplier management has a positive effect on purchasing management.

This perspective is widely supported in the literature, which emphasizes that a firm's profitability depends not only on purchasing decisions, but also on the quality of supplier relationships, (Costa Filho, M. C., & Falcão, R. P. Q, 2021). Working with suppliers that offer flexible contract terms can benefit both parties, especially when proposals are evaluated jointly and strategically (Kraude, R., Narayanan, S. & Talluri, S., 2022).

In addition, there is expected to be a direct relationship between supplier quality and business performance:

- **H5:** Vendor management has a positive effect on sales performance.

Effective inventory practices also contribute to cost reduction, particularly by minimizing overstocking and associated storage and spoilage expenses, an issue of great relevance in nanostores that handle perishable products (Soni, & H, 2018). Therefore, the final hypothesis postulates that:

- **H6:** Purchasing management has a positive effect on inventory management.

In summary, exploring the interrelationships between these six variables not only supports the theoretical framework of this study but also lays the groundwork for future research focused on operational improvements in small-scale retail. The findings are expected to provide practical tools and strategies for more effective inventory, purchasing, and supplier management in nanostores.

2.2. Sample size

According to the latest projection of the number of corner stores made by the Association of Merchants in Peru, it is estimated that there are a total of 113,000 units in Metropolitan Lima. Sample size selection varies depending on study design and statistical method. Therefore, the sample values, as suggested by Cohen, are automatically provided by the G-power software (Boulaksil, Y., van Wijk, & A, 2018). A margin of safety with a high percentage (Fransoo, & J, 2022) and a margin of error of 5% were considered, as the results of the mean of the sample are likely to vary from those of the actual sample (Lashgari, M., Sadjadi, & S, 2019). The result obtained by the program is 210 corner stores, but a total of 220 corner stores were surveyed.

To obtain the value of our sample, we used the GPower tool, which gave us a sample of 210 people as an answer. In theory, this number would be optimal to obtain the answers to our hypotheses without deviations or errors due to data that could bias the results. It was decided to use this tool because it is reliable and easy to use, not only statisticians can use it, but it has been implemented in several fields of study with positive results (Ge, J., Honhon, D., Fransoo, & J, 2020). When working with techniques such as CB-SEM (Covariance-Based Structural Equation Modeling) or PLS-

SEM (Partial Least Squares Structural Equation Modeling), the theoretical sample size obtained through tools such as GPower is a reliable method to determine the correct sample size needed for the (Covariance-Based Structural Equation Modeling) or PLS-SEM (Partial Least Squares Structural Equation Modeling). Theoretical sample size obtained through tools such as GPower is a reliable method for determining the correct sample size needed for the data (Dai, Z., Gao, K., Zheng, X., & Optimization of two multi-tier inventory systems for perishables with price- and stock-dependent demand in the supply chain, 2022). But it is important to remember that the values you get with the Gpower might not be enough because things that affect the quality of the data could also affect them. One problem is that even though 210 people responded, not all of them are valid because some of them did not answer fully or correctly. This can make the sample size smaller because it means getting rid of wrong or inconsistent answers. So, it is better to have a lot of people respond so that any wrong answers do not count and the final sample is big enough (Guevara Jara, 2019), (Ben-Ammar, O., Bettayeb & B., Dolgui, A., 2019). This method is very important because the right sample size is necessary for CB-SEM or PLS-SEM models to give results that are accurate and trustworthy. The sample size has a direct effect on the model's reliability and validity, and it also makes the results more important. The right sample size is important for getting accurate and reliable results in CB-SEM or PLS-SEM models because it affects the model's validity and reliability and makes the analysis more statistically powerful (Guevara Jara, 2019). In short, GPower gives a good estimate (Ge, J., Honhon, D., Fransoo, & J, 2020), (Dai, Z., Gao, K. & Zheng, X., 2022), but it is important to keep these things in mind when deciding on the final sample size to make sure that there are enough valid responses and strong results (Guevara Jara, 2019), (Ben-Ammar, O., Bettayeb & B., Dolgui, A., 2019).

2.3. Survey Design

The survey instrument was designed based on the dimensions of the variables identified in the theoretical framework. To ensure the validity of its content, the initial version was revised and refined with input from experts in the field. Specifically, four supply chain management specialists and one experienced store owner participated in the validation process, providing feedback to improve the clarity and relevance of the questions.

The final version of the instrument consisted of a total of 27 questions: 4 items for the collection of demographic and segmentation data, and 23 items corresponding to the dimensions of the three main variables: inventory management, purchasing management, and supplier management.

Survey responses were structured using a Likert scale format to assess the perceptions of store representatives. This scaling method allowed the identification of response patterns and hierarchies, thus facilitating the Evaluation of how respondents prioritized various operational aspects (Liao, W. et al., 2014), (Yuksel, H., 2008).

Table 1 presents the Likert scales used in the questionnaire, which included different formats depending on the nature of the question:

Table 1. Likert scale

1	2	3	4	5
Never	Rarely	Sometimes	Frequently	Always
Very bad	Bad	Regular	Good	Very good
Strongly disagree	Disagree	Neutral	Agree	Totally agree

The survey was administered through Google Forms and distributed through three channels: (i) shared through Messenger, (ii) sent through WhatsApp, or (iii) completed orally with the help of the researcher, who used a mobile device to record the responses in real time while the interviewee responded verbally.

This flexible, multi-channel approach made it easier for store owners with different levels of digital literacy to participate, ensuring wider coverage of the target population.

2.4. Research Method: Structural Equation Model (SEM)

This study follows an explanatory research design within a positivist paradigm, adopting a quantitative and experimental approach. In experimental research, the researcher intentionally manipulates one or more independent variables to observe and control their Impact on the dependent variables, thereby minimizing bias (Arias, 2012). Such designs are carried out under controlled conditions and are particularly useful for testing causal hypotheses. When a measurable variation in the dependent variable occurs because of the manipulation of an independent variable, the objective of the research is considered fulfilled (Guevara Albán, G., et al., 2020).

In this sense, this study seeks to evaluate the causal relationships between the independent variables (supplier management, purchasing management, and inventory management) and the dependent variable, sales performance. This approach allows for a detailed explanation of how these operational practices influence the business outcomes of nanostores.

To make the construct validity better, the survey used both reflective (latent) and formative (relational) constructs, depending on the type of question. Latent constructs are ideas that are measured indirectly through a number of observable indicators. This means that there is always some measurement error that needs to be taken into account during the analysis (Congress of the Republic of Peru, 2021). On the other hand, relational constructs are made up of several dimensions or indicators that work together to help define the whole idea (Kang, H, 2021).

The Structural Equation Model (SEM) is the analytical method chosen because it is a strong way to explain and test causal relationships based on theoretical assumptions (Liao, W. et al., 2014). Surveys were used to gather data for analysis, and sales records from several nanostores were used to confirm the results. This made it possible to fully evaluate how decisions about inventory affect business performance (Santabárbara, J., 2022).

SEM is especially good for quantitative, cross-sectional, and experimental studies because it lets you estimate the size and direction of multiple causal paths at the same time (Arancibia, H. & Cárdenas, M., 2014). One of SEM's biggest benefits is that it can consider measurement errors in both independent and dependent variables (Badillo Badillo, & P, 2020). This makes it easier to understand how constructs are related to each other in a more accurate way (Kline, 2023).

The Partial Least Squares Structural Equation Modeling (PLS-SEM) method was used in this study. This method has become more popular in recent years because it works well for predictive modeling, especially when there are a lot of variables and small sample sizes. Many people use PLS-SEM to test hypotheses and solve hard problems with lots of different types of data (Gamboa Graus, 2023), (Tyumeneva, Y. et al., 2022), (Sabol, M. et al., 2024).

At the same time, Excel was used to prepare the data. Before the last analysis, statistical software like SPSS, Excel, or SAS was used to review the data that had been collected and fix any problems, outliers, or inconsistencies that could make the model less reliable.
Finally, Table 2 shows the variables and the identification codes that were used to create the mathematical model.

Table 2. Variables and identification codes

Variable			Dimension	Code
Independent	Inventory Management	(GI)	Inventory Policy	PI
			Control of expired products	PVD
			Expired product management	GPV
			Products out of the portfolio	PFP
			Contingency Plan	PC
			Store Size	TT
			Purchasing Management System	GC
	Purchasing Management	(GC)	Product Assortment	CLC
			Purchase quantity	CPC
			When orders are placed	HP
	Supplier management	(GP)	Vendor Approval	AP
			Supplier selection	SP
			Supplier Evaluation	EP
			Supplier Purchasing Policy	PCP
			Negotiation with suppliers	NP
Dependent	Impact on sales	(IV)	New customers	NI
			New lines	NL
			Product Assortment	OP
			Stockout control	YES
			Sales growth	CV
			In-store promotions	PT
			Return Policy	PC
			Customer satisfaction	SC
			Loyalty	FC
			In-store promotions	PT

To assess the reliability of the measurement instrument, the study employed Cronbach's alpha coefficient, a widely accepted metric for assessing the internal consistency of survey items. According to Oviedo and Campo-Arias (Vizcaíno Zúñiga, & P, 2023), a Cronbach's alpha of 0.70 is considered the minimum acceptable threshold; Scores below this level suggest low reliability of the scale. Conversely, values greater than 0.90 may indicate redundancy or duplication of elements. In general, alpha values between 0.80 and 0.90 are considered optimal, indicating a high level of internal consistency without redundancy. In practice, a value greater than 0.70 is usually sufficient to confirm the reliability of a construct (López-Fernández, O. & Fernández-Cano, A., 2021).

For this analysis, the researchers used SPSS software to calculate Cronbach's alpha coefficient for each item related to the study's key variables. The results are summarized in the following tables. As presented in **Table 3**, all variables showed alpha values ranging from 0.876 to 0.884, while the overall alpha value for the complete set of 23 items was 0.885. These results confirm that the scale exhibits an acceptable level of internal consistency, which supports the reliability of the proposed measurement model.

Table 3. Reliability Analysis

Variables	Medium scale if the item has been deleted	Scale variation if the item has been deleted	Corrected Total Correlation of Elements	Multiple correlation squared	Cronbach's alpha if the object has been removed
NI	69.265	177.975	.613	.618	.876
GN	69.352	177.036	.630	.698	.876
R	69.324	177.798	.611	.645	.876
OP	68.840	176.841	.577	.407	.877
MP	68.192	186.358	.292	.265	.884
PNC	69.781	190.521	.159	.297	.886
P.S.	69.470	171.232	.590	.517	.876
SC	68.443	184.349	.383	.300	.882
FC	69.511	181.260	.389	.366	.882
PT	69.712	179.132	.444	.368	.880
HP	70.046	177.539	.472	.528	.880
SP	69.863	172.137	.614	.724	.875
EP	69.767	175.326	.490	.607	.879
PCP	69.196	179.159	.484	.381	.879
QMS	69.059	182.340	.327	.332	.884
CLC	68.735	183.388	.384	.455	.882
CPC	68.612	182.358	.422	.449	.881
PI	69.315	177.391	.514	.386	.878
RRP	68.986	180.050	.450	.307	.880
GPV	69.128	174.121	.580	.465	.876
PFP	69.598	187.627	.269	.320	.884
PC	69.680	177.163	.539	.393	.878
TT	68.963	179.081	.519	.365	.878

These findings confirm that the survey items used to measure the constructs have strong internal consistency. Validated reliability supports the subsequent analysis of structural relationships presented in the next section.

3. Results

3.1 Demographic Information

The demographic analysis provides a detailed view of the profiles of the respondents who participated in the study. As shown in Table 4, a slightly higher proportion of participants were women (52.3%), while men accounted for 47.7%. This reflects a relatively balanced gender distribution among nano store owners.

Regarding educational level, most participants (64.1%) reported having completed secondary education. University education was the second most common level (18.2%), followed by primary education (10.5%). A smaller proportion reported having postgraduate studies (5.5%) or technical training (1.8%). These figures suggest that most nanostore owners have an average level of education, and relatively few have advanced academic qualifications.

In terms of geographical distribution, the highest concentration of respondents (40.5%) was in Zone 6, which includes districts such as Jesús María, Lince, Pueblo Libre, Magdalena, and San Miguel. It was followed by zone 7 (Miraflores, San Isidro, San Borja, Surco, and La Molina) with 24.5%. Other relevant areas were Zone 8 (Surquillo, Barranco, Chorrillos, San Juan de Miraflores) with 12.7%, and Zone 4 (Cercado, Rímac, Breña, La Victoria) with 10%. The selection of several areas was intentional, with the aim of ensuring diversity in the sample and avoiding grouping responses from a single district. This approach allowed for a broader representation of the reality of Lima's nano stores.

Table 4. Store Owner Characteristics [Total N=220]

Features		Frequency (n)	Percentage (%)
Gender	Male	105	47.7%
	Female	115	52.3%
Level of Education	Primary	141	64.1%
	Secondary	23	10.5%
	University	40	18.2%
	Graduate	12	5.5%
	Technical	4	1.8%
Location of the nano store	**Zone 1:** Window, Stone Bridge, Comas, Carabayllo.	3	1.4%
	Zone 2: Independencia, Los Olivos, San Martín de Porres.	8	3.6%
	Zone 3: San Juan de Lurigancho	1	0.5%
	Zone 4: Cercado, Rímac, Breña, La Victoria.	22	10%
	Zone 5: Ate, Chaclacayo, Lurigacho, Santa Anita, San Luis, El Agustino.	15	6.8%
	Zone 6: Jesús María, Lince, Pueblo Libre, Magdalena, San Miguel.	89	40.5%
	Zone 7: Miraflores, Saín Isidro, San Borja, Surco, La Molina.	54	24.5%
	Zone 8: Surquillo, Barranco, Chorrillos, San Juan de Miraflores.	28	12.7%

3.2 Hypothesis testing based on the multivariable structural equation model

3.2.1 Relationship between inventory management and the Impact of sales.

The SEM approach was used to explore the Relationship between inventory management and its effect on sales performance. Inventory management was modeled as an exogenous latent construct composed of two dimensions: purchasing management and supplier management. The purchasing dimension was represented by three observed variables, while supplier management consisted of four indicators.

The Impact on sales was defined as an endogenous latent variable, conceptualized through indicators such as profitability, net profit, revenue, payment methods, customer satisfaction, return policies, loyalty, and promotional strategies. Figure 2. The Initial Mathematical Model visually illustrates this structure, with four ellipses (latent variables) and 23 rectangles (observed variables) forming the conceptual framework

3.2.2. Evaluation of the structural equation model (SEM)

Confirmatory factor analysis (CFA) was performed to assess model reliability, convergent and discriminant validity, and overall fit. As reported in Table 5, the initial model showed some deviations from the accepted thresholds. The GFI, AGFI, CFI, IFI, and TLI values were below the recommended threshold of 0.90, and the RMSEA slightly exceeded the acceptable limit of 0.08. These results suggest that the initial specification of the relationships between the variables required refinement to better represent the empirical data.

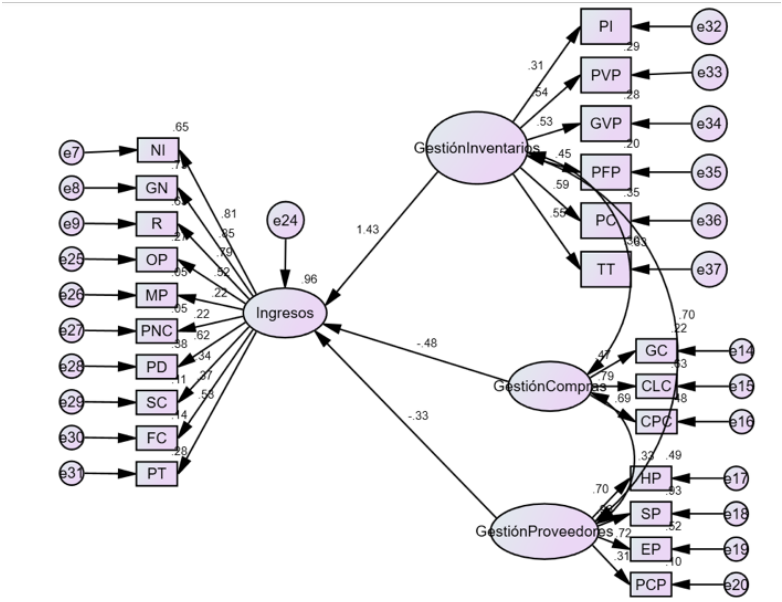

Figure 2. Initial mathematical model

Confirmatory factor analysis (CFA) measures model reliability, convergent and discriminant validity, and fit statistics [57]. Key metrics of the goodness-of-fit index include chi-square (χ2), degrees of freedom (DOF), and mean-squared approximation error (RMSEA) [58]. In addition, there are the Standard Fit Index (NFI), the Comparative Fit Index (CFI), the Incremental Fit Index (IFI), and the Tucker Lewis Index (TLI).

Table 5. SEM Criteria Results

Statistical estimator	**Adjustment rate**	**Goodness of Fit Index**	**Comparative Fit Index**	**Incremental adjustment rate**	**Tuc-Ker-lewis Index**	**Mean square error**
Indexes	GFI	AGFI	IFC	IFI	TLI	RMSEA
Value estimator	0.784	0.734	0.787	0.791	0.76	0.88
Measurement Method	>0.9	>0.9	>0.9	>0.9	>0.9	<0.8
Independent variables	Y1: Inventory Management Y1: Vendor Management Y3: Purchasing Management					

3.2.3 Model optimization

To improve the model's performance, modifications were made based on the software's suggestions. Specifically, relationships with standardized coefficients below 0.30 were eliminated to retain only those that contributed significantly to the structure. The revised version is shown in Figure 3. Optimized Mathematical Model, which reflects a more parsimonious and statistically sound representation of the theoretical framework.

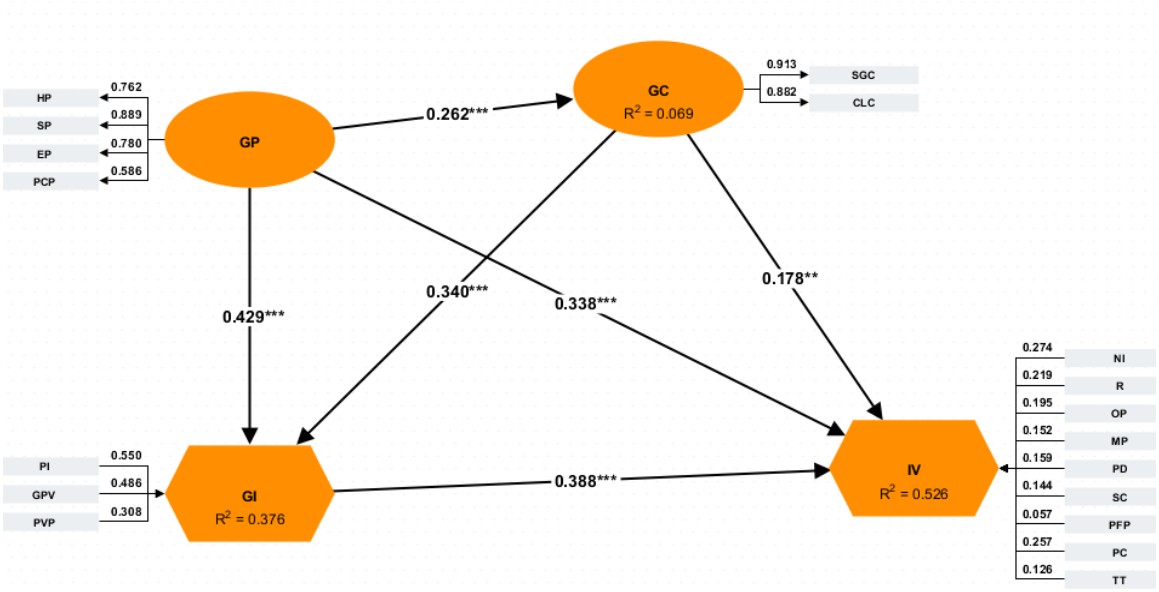

Figure 3. Optimized mathematical model

Table 6 summarizes the standardized beta coefficients (β), which represent the strength and direction of the relationships between constructs in the structural model. These coefficients indicate the intensity with which one latent variable influence another, while the associated p-values reflect the statistical significance of those relationships. A p-value less than 0.001 indicates a highly significant effect, while a p-value less than 0.01 suggests a moderately significant effect.

Table 6. The relationships presented in the model with their significance value

Hypothesis	Route Listing	Beta coefficient (β)	P value
H1	Supplier management	**0.262**	<0.001
	Purchasing Management		
H2	Supplier management	**0.429**	<0.001
	Inventory Management		
H3	Supplier management	**0.338**	<0.001
	Impact on sales		
H4:	Purchasing Management	**0.178**	<0.001
	Impact on sales		
H5:	Inventory Management	**0.388**	<0.001
	Impact on sales		

The results reveal that Supplier Management (GP) exerts direct and indirect influences on the Impact on Sales (IV). Directly, GP shows a significant effect on IV, and indirectly, its influence is mediated by Purchasing Management

(KM) and Inventory Management (IG). This highlights the central role of vendor-related strategies in shaping sales results.

In terms of measurement structure, reflective constructs, where indicators are effects of the latent variable, exhibited strong psychometric properties. For Supplier Management, the observed variables HP (0.762), SP (0.889), EP (0.780), and PCP (0.586) reported factor loads above the recommended threshold of 0.50, which confirms the internal consistency and reliability of this construct. Similarly, Purchasing Management was well defined by the QMS (0.913) and CLC (0.882) indicators, both demonstrating strong correlations with the underlying construct and high convergent validity.

In contrast, the formative constructs, in which the indicators contribute in a unique way to form the latent variable, showed varying levels of influence. For Inventory Management, the PI (0.550), GPV (0.486), and RRP (0.308) indicators revealed heterogeneous contributions. In particular, the relatively low factor load of PVP suggests limited explanatory strength and may warrant a re-evaluation in future model refinements.

The Sales Impact (IV) construct, comprising nine indicators (NI, R, OP, MP, PD, SC, PFP, PC, TT), also exhibited a wide range of factor loads, most of which fell below the ideal threshold. The values ranged from 0.057 (PFP) to 0.274 (NI), indicating considerable variability in the relevance of individual indicators. This heterogeneity suggests that some items may be weakly associated with the overall latent construct and could reduce the robustness of the measurement model if left unrevised.

Overall, the analysis confirms that supplier and inventory management are the most influential drivers of sales performance in the context of nanostores, while some measurement components, particularly within construct IV, require refinement to improve the validity and interpretability of the model.

3.1. Model Quality Assessment

The overall quality of the structural equation model was evaluated through its fit indices and the explanatory capacity of the latent constructs. One of the main indicators considered was the Standardized Mean Quadratic Residual (SRMR), which measures the discrepancy between observed and predicted correlations. According to the established criteria, values below 0.08 are indicative of an acceptable fit. As shown in Table 7, the SRMR value obtained was 0.0765, thus satisfying the threshold for a well-tuned model.

Table 7. Model Quality Assessment

SMRS		
Standardized mean square residual		.0765
Explanatory capacity (R^2):	Purchasing Management	.069
	Inventory Management	.376
	Impact on sales	.526

In addition, the table presents the coefficient of determination (R^2) for the three key endogenous constructs. The explanatory capacity of Purchasing Management (KM) is 0.069, indicating a weak contribution to the model. In contrast, Inventory Management (GI) demonstrates a moderate level of explanatory power, with an R^2 value of 0.376. It should be noted that the Sales Impact (IV) construct reaches an R^2 of 0.526, which implies that the model is able to explain 52.6% of the variance of this outcome variable based on exogenous predictors (Supplier Management, Purchasing Management, and Inventory Management).

3.2. Interpretation of the model

The interpretation of the structural relationships established in the model reveals that Supplier Management (PM) exerts a direct and statistically significant effect on the Impact on Sales (IV), as well as an indirect effect mediated through Inventory Management (IM) and Purchasing Management (PM). This two-track reinforces the strategic importance of efficient supplier coordination as a determinant of sales performance.

In particular, the Inventory Management (GI) construct demonstrates a direct and significant influence on Sales Impact, suggesting that optimized inventory processes tangibly contribute to improving business outcomes. While purchasing management (KM) also has a positive effect on sales, the lower β coefficient indicates that its influence is relatively less substantial compared to supplier and inventory management.

Overall, the model highlights supplier management and inventory management as the main drivers of sales impact, both through direct relationships and indirect interactions. In terms of measurement quality, the reflective indicators associated with Supplier Management and Purchasing Management exhibit strong factor loads and structural consistency. In contrast, indicators related to Inventory Management and Sales Impact show greater variability, suggesting heterogeneity in their contribution to constructs and pointing to potential areas for refinement in future research.

3.3. Model Analysis

A thorough check of the model's reliability and construct validity was done to make sure it was strong. This meant checking how well the constructs met the criteria for internal consistency, convergent validity, and discriminant validity. All of these are important for making sure the results are correct and trustworthy.

As shown in Table 8**,** the reliability coefficients (ρA and ρC) for both Vendor Management (GP) and Purchasing Management (KM) were higher than the minimum level of 0.7, which means that the internal consistency was acceptable. Also, the Mean Extracted Variance (EAV) for both constructs was higher than 0.5, which shows that convergent validity is present. The Heterotrait-Monotrait ratio (HTMT) for Supplier Management was much lower than the important level of 0.85, which showed that it was valid. All these results show that the constructs used in the structural model are good at measuring what they are supposed to.

Table 8. Result of the SEM criteria

Statistical estimator	**Construct reliability**		**Convergent validity**	**Discriminant validity**
Table of Contents	ρ A	ρ C	AVE	HTMT
GP	.7549	.8445	.5808	.3342
GC	.7708	.8923	.8055	
Measurement Method	>0.7	>0.7	>0.5	<0.85

3.4. Model limitations and recommendations for the model

Even though the proposed model has a strong structure, some problems were found that need more attention. For example, in the Sales Impact (IV) construct, a few indicators had factor loads below the 0.5 threshold, which could make the construct less valid and reliable overall. This means that the indicators used might not fully show how complicated or different sales outcomes can be in nano store settings.

The Purchasing Management (KM) construct also had a low explanatory power, with an R^2 value of 0.069. This means that this variable by itself does not explain the changes in the dependent constructs very well. This limitation shows how important it is to include complementary variables or outside factors, like digital procurement tools, the ability to negotiate with suppliers, or contextual constraints, that can affect how well purchases work in nano stores.

Future studies should work on improving the choice of measurement indicators for sales impact and think about adding more constructs to the model to make it more accurate at predicting outcomes. Longitudinal or mixed-method approaches could also help us understand causal mechanisms better and help us test our models over time and in different retail settings.

4. Discussion

The results of this study show that managing inventory is a key factor in the sales performance of nano stores that have limited resources. Inventory management had the biggest direct effect on sales results of the three variables

studied. Supplier management also had a big effect, both directly and indirectly, through its interaction with inventory and purchasing practices. Even though procurement management did not have a big impact, it was still important in the bigger picture of the supply chain that helps small retailers make sales.

These results are in line with what other research has found about the operational and strategic benefits of good inventory management. For instance, Rodríguez et al. (Mora-Quiñones, & C, 2021) talked about how planning inventory can help keep costs down and make customers happy. Ortega-Jiménez (Salinas-Navarro, D. et al., 2022) said that small retailers need to be able to adapt by coordinating with suppliers to do better in business. Chacón (Chacón, & E, 2022) also talked about how working with suppliers can help small businesses become more resilient and last longer, which is in line with what this study found. Other research, like Bellido Mantilla et al. (Bolaños-Zúñiga, L., Holguín, & C, 2021), has also shown that structured methods like DDMRP and 5S can make small businesses run better when they are used to manage inventory.

In addition to confirming what we already know, this study fills a gap in the literature by using Structural Equation Modeling (SEM) in a micro-retail setting that has not been studied much in the past. Many big companies and other industrial settings have used SEM, but it has not been used as much in smaller, less formal businesses like nano stores. Previous studies have often overlooked the combined influence of supplier and purchasing management on inventory decisions and, ultimately, sales performance. By modeling these interrelationships using SEM, this study offers a more nuanced understanding of how internal logistics and supplier dynamics shape business outcomes in small-scale retail.

This methodological contribution is supported by previous work that validates the suitability of SEM to analyze complex and multivariate relationships in business environments (Santabárbara, J, 2022), (Arancibia, H. & Cárdenas, M., 2014), (Badillo Badillo, & P, 2020), (Gamboa Graus, 2023), (Tyumeneva, Y. et al., 2022). The approach used here not only confirms its relevance for academic exploration but also provides a practical tool for business owners and policymakers seeking to improve the competitiveness of micro-retail in emerging economies.

On a practical level, the results suggest that nanostore managers should prioritize implementing simple but effective inventory control systems, whether manual or digital, and adopt more structured approaches to supplier selection and purchase planning. Even in low-resource environments, having basic replenishment, expiry control, and purchase volume policies in place can improve inventory turnover and product availability, which are critical to maximizing customer satisfaction and, ultimately, sales.

Beyond the context of nanostores, the implications of these findings may extend to other types of microenterprises operating under similar conditions, such as local bakeries, pharmacies, or convenience stores. These companies often face comparable challenges related to procurement, inventory space, and vendor lock-in. Therefore, implementing inventory-focused management strategies can help improve your operational efficiency and profitability.

Another important aspect to consider is the potential contribution of these practices to sustainability. By avoiding product shortages and excess inventory, companies can minimize food waste, reduce unnecessary storage costs, and optimize the use of financial resources—factors that contribute not only to profitability but also to environmental and economic sustainability. In this regard, the study highlights how better inventory decisions and greater supplier coordination can serve both economic and social objectives.

Despite the strengths of this research, certain limitations must be recognized. One of them lies in the measurement of the sales performance construct, where some indicators showed low factor loads. This can be attributed to the way respondents interpreted certain survey items or to a mismatch between indicators and the realities of informal retail. In addition, the geographic focus of the study, limited to nanostores in Lima, means that the findings may not fully represent other regional markets with different customer behaviors and operational limitations.

Future research could address these limitations by refining the design of the survey instrument, particularly indicators related to sales impact. In addition, the inclusion of complementary variables such as logistics coordination, the accuracy of demand forecasts, or the level of digitalisation could provide a more complete view of how micro-retailers

can improve performance. Extending the study to rural areas or other Latin American cities could also improve the external validity of the model and lead to broader policy recommendations.

Overall, the study reinforces the idea that inventory management and supplier coordination are not just operational needs but strategic levers that can drive performance improvements in small businesses. By focusing on these areas, nanostores and similar microenterprises can strengthen their competitiveness and move towards more sustainable and resilient business models in an increasingly demanding market.

5. Conclusions

This study looked at how nano stores in Lima's inventory management, supplier coordination, and buying habits affect their sales. The results made it clear that managing inventory has the biggest direct effect on sales, while managing suppliers has a dual effect, affecting results both directly and indirectly by affecting purchases and inventory control. Even though purchasing management did not help sales as much, it is still an important part of the overall supply chain structure in small retail businesses.

These results show how important it is for retailers with limited resources to formalize their inventory policies, build better relationships with suppliers, and start basic procurement planning. Even small changes in these areas can help you keep better track of your stock, have fewer shortages, and make your customers happier, all of which can help you sell more and make more money.

From a methodological point of view, the study shows that Structural Equation Modeling (SEM) is a useful way to look at complicated cause-and-effect relationships in informal retail settings. It also fills a gap in the literature by extending the application of SEM to a type of business that is often overlooked in empirical research, thus contributing both theoretically and practically to the study of microenterprise logistics.

However, there are some limitations to consider. The measurement of sales performance included indicators with relatively low factor loads, suggesting the need to refine the survey design in future studies. In addition, the geographical focus in Lima may limit the generalization of results to other contexts with different market dynamics.

Future research could build on these findings by incorporating additional variables such as logistics coordination, digital inventory systems, or forecasting customer demand. Replicating the model in different regions or sectors would also improve the robustness and external validity of the conclusions.

In summary, evidence suggests that enhancing inventory and supplier management practices can be a powerful strategy to improve suggests that enhancing inventory and supplier management practices can be a powerful strategy to improve the performance of nano stores. These improvements not only improve business outcomes but also contribute to more sustainable and resilient micro selling systems in emerging economies.

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