



Informal SMEs with e-commerce platforms in the state of Oaxaca, Mexico.

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Abstract. The informal economy is a structural phenomenon in developing countries, particularly in the context of economic and health crises that have intensified labor market vulnerabilities and accelerated changes in entrepreneurial behavior. This research aims to analyze the behavior of the informal sector in the state of Oaxaca during the period 2021–2025, as well as the emergence of informal micro, small, and medium-sized enterprises (MSMEs) that incorporated e-commerce platforms as an adaptation strategy following the COVID-19 pandemic. The study employed a quantitative approach, with a descriptive-analytical scope and a non-experimental, retrospective longitudinal design, utilizing secondary sources such as the National Statistical Directory of Economic Units (DENUE) and data from the National Institute of Statistics and Geography (INEGI). Spatial analysis using QGIS software was conducted to identify territorial patterns and the geographic distribution of informal economic activities across the state. The results reveal an increase in the number of informal MSMEs during the analyzed period, accompanied by a growing adoption of digital marketing strategies and online commercial channels, particularly in retail trade and service activities. Although these economic units continue to exhibit structural limitations associated with informality, including restricted access to institutional support, financing, and social protection, they also demonstrate a significant capacity for adaptation through the incorporation of digital technologies into their business operations. The findings indicate that digital transformation has strengthened the resilience and commercial reach of informal enterprises without necessarily promoting their transition toward formality. It is concluded that informality, rather than disappearing, is being reconfigured through digitalization processes, generating new challenges and opportunities for public policy, business formalization, regional development, and the long-term sustainability of MSMEs in emerging economies.

Keywords: Informality, MSMEs, e-commerce, digitization, Oaxaca.

1 Introduction

According to statistical data, the state of Oaxaca ranks among the top states with the highest number of informal jobs; eight out of ten workers lack economic benefits because they work in the informal sector. The states reporting the highest percentages of their population living in working poverty in 2025 are Chiapas (59.2%), Oaxaca (56.6%), and Guerrero (51.3%), while the states with the lowest percentages are Baja California Sur (14.2%), Colima (17.3%), and Baja California (18.2%), according to data provided by the National Institute of Statistics and Geography (INEGI). [1] It asserts that the informal economy constitutes a persistent structural phenomenon in developing economies, particularly in contexts characterized by inequality, precarious employment, and limitations in the generation of formal employment. In Mexico, this phenomenon is particularly relevant, given that a considerable proportion of the economically active population participates in activities outside the legal and regulatory framework. In this regard, the state of Oaxaca stands out as one of the entities with the highest incidence of informal employment, where a significant portion of the employed population lacks access to social benefits and job security.

From a theoretical perspective, informality has been addressed from various approaches. On the one hand, the structuralist view maintains that this sector arises as a result of the inability of the formal economic system to absorb the entirety of the available workforce, thus generating a “refuge sector” for the excluded population ([2] & [3]).

In contrast, more recent approaches suggest that informality not only responds to conditions of exclusion but can also constitute an adaptive strategy in the face of uncertain economic environments, where economic agents seek flexible alternatives for subsistence [4].

In this context, the COVID-19 pandemic represented a turning point in the dynamics of micro, small, and medium-sized enterprises (MSMEs), particularly those operating in the informal sector. As the Organization for Economic Co-operation and Development points out [5], the health crisis accelerated digital transformation processes, prompting numerous economic units to incorporate information and communication technologies to remain active in the market. This process gave rise to new forms of operation, where informality is linked to the use of digital platforms, shaping what some authors call “digital informality”.

According to [6], the analysis of contemporary social phenomena requires considering both their structural dimensions and their processes of transformation, particularly in contexts of crisis. In this sense, the study of informal micro, small, and medium-sized enterprises (MSMEs) that adopt e-commerce platforms allows us to understand not only the persistence of informality but also its evolution toward hybrid models that combine traditional practices with digital tools. This transformation reflects the growing capacity of small businesses to adapt to changing market conditions by incorporating digital resources that improve communication with customers, facilitate commercialization, and expand market reach, even under conditions of economic

informality [7]. In line with this, recent research has demonstrated that digitalization significantly impacts the transformation of economic dynamics by modifying business models, production processes, and forms of interaction in markets, especially in emerging economies [8]. Furthermore, digital technologies have become an important mechanism for strengthening the competitiveness and resilience of MSMEs by enabling greater flexibility and access to new business opportunities [9].

Despite the relevance of this phenomenon, there is still limited empirical evidence analyzing the relationship between informality and digitalization from a territorial perspective, especially in regional contexts such as the state of Oaxaca. Most existing studies have examined informality or digital transformation separately, while relatively few have analyzed how both processes interact within specific regional economies characterized by high levels of labor informality and unequal access to digital infrastructure [10]. Therefore, this research aims to analyze the behavior of the informal sector in this state during the period 2021–2025, as well as to identify the emergence of informal micro, small, and medium-sized enterprises (MSMEs) that incorporate e-commerce platforms as an adaptation strategy in a post-pandemic environment.

In accordance with the above, the research question that guides this study is: What type of MSMEs emerged in the informal sector of the economy of the state of Oaxaca during the period 2021–2025, and how have they incorporated digital tools into their operating strategies?

2 Research Method

This research was conducted using a quantitative approach with a descriptive-analytical scope and a non-experimental retrospective longitudinal design. According to [6], this methodological design is appropriate when phenomena are examined in their natural context without manipulating the variables under study, allowing the researcher to describe and analyze their behavior over a defined period. Accordingly, the study focused on examining the evolution of informal micro, small, and medium-sized enterprises (MSMEs) in the state of Oaxaca between 2021 and 2025, emphasizing the incorporation of e-commerce platforms as an adaptive business strategy. This approach also facilitates the identification of temporal changes and emerging patterns associated with business digitalization, providing evidence of how informal economic units respond to changing socioeconomic conditions over time [7]. The analysis relied exclusively on secondary information obtained from official statistical sources. The primary source was the National Statistical Directory of Economic Units (DENUE) developed by the National Institute of Statistics and Geography (INEGI), which provides georeferenced information on economic units according to business size, economic activity, and territorial location [11]. Complementary statistical information was also considered to characterize the socioeconomic conditions associated with informality in Oaxaca and to contextualize the evolution of the sector during the post-pandemic period. The use of official databases contributes to the reliability and consistency of the analysis, allowing for the

identification of territorial and sectoral trends through standardized and periodically updated information.

The unit of analysis comprised economic units employing between zero and ten workers, as this segment represents the largest proportion of MSMEs operating in the informal economy. This selection is consistent with evidence indicating that microenterprises usually face lower barriers to market entry, limited access to financing, scarce technological capabilities, and reduced administrative structures, characteristics that make them particularly vulnerable to economic shocks while simultaneously encouraging the adoption of flexible business practices ([5] & [4]).

Consequently, particular attention was given to identifying businesses that incorporated digital communication channels, social media, and e-commerce platforms into their commercial activities. These technologies have become increasingly important for microenterprises because they facilitate customer interaction, reduce operating costs, and improve market visibility, even among businesses with limited financial and technological resources [7].

The methodological procedure was implemented in four sequential stages. First, the DENUe database was filtered to identify all economic units located in Oaxaca with between zero and ten employees. Second, these establishments were classified according to their principal economic activity, emphasizing sectors characterized by a high incidence of informality, including retail trade, personal services, and administrative support activities. Third, descriptive statistical techniques were applied to determine the distribution and relative concentration of informal MSMEs across the state. Finally, a geospatial analysis was performed using QGIS software, enabling the visualization of territorial patterns, spatial concentrations, and the relationship between business location and urban as well as semi-urban environments. The integration of geospatial analysis with official statistical information facilitates the identification of spatial disparities and territorial concentrations that support a more comprehensive interpretation of the distribution of informal economic activities.

Since the research was based on existing official records, no variables were manipulated during the investigation, which confirms its non-experimental nature [6]. the retrospective longitudinal perspective facilitated the identification of changes in the behavior of informal MSMEs throughout the 2021–2025 period, making it possible to observe the progressive incorporation of digital technologies following the COVID-19 pandemic. This methodological approach is particularly useful for examining temporal trends and understanding how external events influence business adaptation processes without directly intervening in the study environment [6].

Five principal variables guided the analysis: informality, business size, economic activity, territorial distribution, and digital adaptation. Informality was conceptualized as the operation of economic units outside comprehensive legal, fiscal, or social protection frameworks. Business size was determined according to the number of employees registered in DENUe, while economic activity was classified following the official categories established by INEGI. Territorial distribution was examined through

georeferenced information, whereas digital adaptation was assessed by identifying the incorporation of digital marketing tools and e-commerce platforms into business operations, reflecting recent transformations in informal entrepreneurial practices ([12] & [9]). Recent studies indicate that digital readiness and the adoption of digital technologies have become relevant indicators for evaluating the capacity of MSMEs to respond to changing market conditions, particularly in emerging economies where technological adoption has accelerated in recent years [7].

Finally, integrating descriptive statistical techniques with geographic information systems (GIS) strengthened the analytical capacity of the research by revealing spatial dynamics that cannot be identified through conventional statistical analysis alone. As recent international studies indicate, combining territorial analysis with digitalization indicators provides a more comprehensive understanding of how informal enterprises adapt to changing economic conditions and technological transformations, particularly in developing regions characterized by structural issues ([12] & [9]). Likewise, integrating spatial information with business digitalization indicators allows researchers to identify territorial patterns that can support the formulation of public policies aimed at promoting regional economic development and digital inclusion among MSMEs [7]. This methodological strategy therefore offers a robust framework for examining the relationship between informality, territorial development, and digital transformation in Oaxaca.

3 Results

To analyze the behavior of the informal sector in the state of Oaxaca during the period 2021–2025 and the emergence of informal MSMEs using e-commerce platforms, the first step consisted of identifying the number of economic units employing between zero and ten workers, as well as their principal economic activity. This classification made it possible to characterize the segment of businesses that represents the largest proportion of MSMEs in the state and to identify the sectors where informality is most prevalent.

The analysis of the information obtained from the National Statistical Directory of Economic Units (DENUE), prepared by the National Institute of Statistics and Geography [11], and processed using QGIS software, allowed the identification of the distribution and characteristics of economic units in the state of Oaxaca, particularly those with between 0 and 10 employees, which represent the base of MSMEs. The use of geospatial information facilitated the visualization of territorial patterns and provided a more detailed understanding of the spatial distribution of informal economic activities across the state.

An estimated 12,068 economic units were identified under this classification, primarily concentrated in commercial and service activities. Sectors such as retail trade and administrative support activities stand out, which aligns with recent literature indicating that informal MSMEs tend to concentrate in activities characterized by low barriers to entry, limited capital requirements, and rapid capital turnover [5]. Similar findings have been reported in studies on emerging economies, where microenterprises

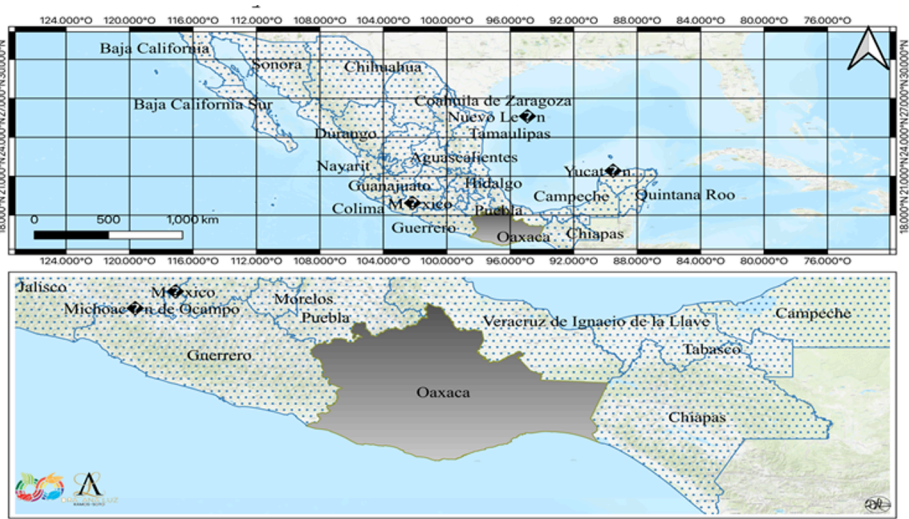
are predominantly established in service-oriented activities due to their operational flexibility and lower investment requirements [13].

From a territorial perspective, the geospatial analysis revealed a high concentration of these units in urban and semi-urban areas, suggesting a direct relationship between population density, commercial activity, and the growth of informality. This spatial concentration may also be associated with greater access to customers, transportation networks, and digital infrastructure, factors that facilitate the operation of small businesses in competitive local markets [14].

Likewise, it was identified that during the post-pandemic period there was an increase in the presence of economic units that incorporated digital tools, such as social media and e-commerce platforms, as a mechanism to maintain their operations in the market. These findings coincide with those of the Economic Commission for Latin America and the Caribbean, which indicates that digitalization has allowed MSMEs to cope with the restrictions stemming from the health crisis, although with limitations in terms of formalization and access to financing [4].

Similarly, recent studies suggest that the adoption of digital technologies has enabled many small businesses to improve customer interaction, expand their market reach, and strengthen business resilience despite operating under conditions of informality [7].

In this sense, the results not only show a quantitative growth of the informal sector but also a qualitative transformation in its forms of operation. The incorporation of digital communication channels and e-commerce platforms suggests that informal MSMEs are gradually adopting business practices traditionally associated with formal enterprises, giving rise to hybrid operating models that combine informality with digital commercialization strategies (See Image 1).



Note. ADIS UABJO, using the QGIS program (2024).

Figure 1. Macro and micro location map of Oaxaca.

As can be seen, Image 1 shows the macro and micro-location of the state of Oaxaca, allowing for the spatial contextualization of the study area within the national territory and, in turn, the identification of its internal distribution. From an analytical perspective, this cartographic representation is fundamental to understanding the territorial heterogeneity that characterizes the state, which is distinguished by a high population dispersion, the presence of rural areas, and limitations in economic infrastructure. These territorial characteristics have historically influenced regional economic development by generating significant disparities in productive opportunities, access to public services, and business competitiveness. Moreover, spatial analysis contributes to identifying geographic patterns associated with the concentration of productive activities and provides a broader understanding of the relationship between territorial conditions and local economic dynamics [14].

In interpretive terms, Oaxaca's geographic location largely conditions the development of formal economic activities, contributing to the persistence of informality as a subsistence strategy. Territorial dispersion and connectivity gaps affect unequal access to markets, financing, and technology—factors that, according to recent literature, directly influence the proliferation of informal economic units [4]. In addition, deficiencies in transportation infrastructure, digital connectivity, and institutional support reduce the capacity of many microenterprises to integrate into formal value chains, reinforcing dependence on informal commercial practices. Recent evidence suggests that institutional quality and territorial conditions play a decisive role in explaining the persistence of informality, particularly in emerging economies characterized by structural inequalities [10].

This territorial configuration also helps explain why informal MSMEs tend to concentrate in urban and semi-urban areas, where there is greater population density and commercial activity. These locations provide businesses with improved access to consumers, suppliers, financial services, and communication networks, thereby increasing commercial opportunities despite operating under informal conditions. However, the presence of these businesses in peripheral areas also demonstrates the informal sector's capacity to adapt to contexts with structural limitations. In many cases, digital technologies and social media platforms have partially reduced geographical barriers by facilitating communication with customers and expanding market access beyond local boundaries, although important challenges related to digital inclusion and technological capabilities remain ([7] & [14]).

On the other hand, in Oaxaca, approximately 12,068 economic units operate with workforces ranging from 0 to 10 employees, reflecting the predominance of microenterprises within the state's productive structure. Among these establishments, 1,159 are engaged in administrative activities of social welfare institutions, four correspond to national security services, 67 are dedicated to the administration of public cemeteries, 262 operate in general public administration, one belongs to

advertising agencies, five provide collection agency services, two are placement agencies, one operates as a temporary employment agency, and an additional 262 correspond to other public administration activities. This composition illustrates the diversity of small-scale economic activities present in Oaxaca while highlighting the importance of service-oriented sectors within the regional economy. According to recent studies, microenterprises represent the backbone of productive systems in developing economies because of their capacity to generate employment opportunities despite operating under conditions of limited productivity and institutional constraints ([10] & [15]).

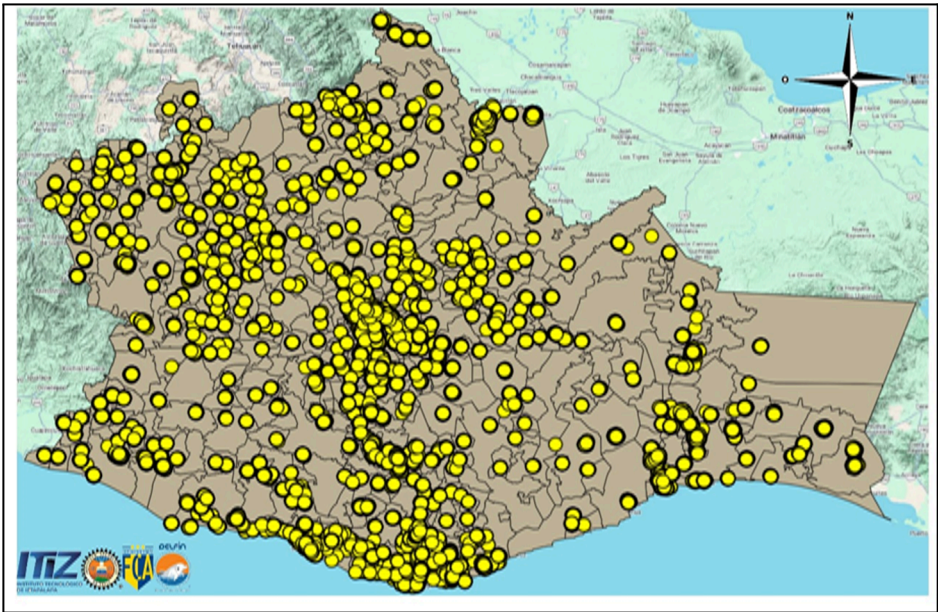
Figure 2 illustrates the spatial distribution of micro, small, and medium-sized enterprises (MSMEs) in the state of Oaxaca, specifically those employing between 0 and 10 workers, allowing the identification of territorial patterns associated with business concentration and economic specialization. The analysis reveals a marked concentration of economic units in urban and semi-urban areas, particularly in activities related to retail trade, wholesale trade, and administrative services. This distribution suggests that informal MSMEs preferentially develop in territories characterized by higher population density, stronger commercial interaction, and greater availability of public and private services, which is consistent with the findings of the Organization for Economic Co-operation and Development [5], indicating that small businesses tend to locate in markets with greater consumer demand and relatively lower barriers to market entry. Likewise, recent research has demonstrated that urban agglomeration generates positive externalities for small firms by facilitating access to suppliers, labor markets, knowledge exchange, and commercial networks, thereby strengthening entrepreneurial activity even under conditions of informality [16].

Additionally, the observed distribution suggests that the growth of these economic units during the analyzed period is closely associated with the need to generate immediate income, particularly in the economic recovery following the COVID-19 pandemic. The expansion of informal entrepreneurial activities reflects the adaptive responses of households and small business owners facing labor market uncertainty, reduced formal employment opportunities, and changing consumer behavior. Similar dynamics have been documented across Latin America, where informal entrepreneurship became an important mechanism for economic resilience during and after the health crisis ([9] & [15]).

In this sense, the cartographic evidence supports the quantitative findings by demonstrating not only an increase in the number of MSMEs but also their territorial expansion throughout different municipalities of Oaxaca. Furthermore, the incorporation of digital platforms as commercial and marketing tools has enabled many of these enterprises to expand their customer base beyond their immediate geographic location, modifying traditional commercial interactions and creating new opportunities for market participation. Recent evidence suggests that digital technologies improve the visibility, adaptability, and competitiveness of small businesses by facilitating online communication, electronic transactions, and customer engagement, even among firms operating in the informal economy ([17] & [7]).

However, the adoption of digital technologies does not eliminate the structural limitations traditionally associated with informality; rather, both phenomena coexist, giving rise to new hybrid business models that combine informal operating practices with digital commercialization strategies. These transformations illustrate that digitalization is reshaping entrepreneurial ecosystems without necessarily promoting business formalization, particularly in regions characterized by institutional weaknesses and socioeconomic disparities [18].

Finally, the analysis confirms that Oaxaca has experienced sustained growth in MSMEs dedicated to administrative services, wholesale trade, and retail commerce, sectors that continue to represent the principal drivers of informal entrepreneurial activity within the state.



Note. Information taken from DENUE (2024) via the software.

Figure 2. Map of SMEs in Oaxaca.

4 Discussion

Micro, small, and medium-sized enterprises (MSMEs) constitute one of the principal drivers of employment generation, local economic development, innovation, and business adaptation. Their contribution extends beyond job creation by stimulating productive linkages, strengthening local supply chains, and generating aggregate demand through commercial interactions between retail businesses and wholesale suppliers. In addition, MSMEs play a fundamental role in fostering entrepreneurship, promoting income generation, and supporting regional economic resilience,

particularly in developing economies where they account for a substantial share of productive activity [14].

In the state of Oaxaca, these dynamics are particularly relevant because MSMEs represent the productive base of the regional economy despite operating under structural conditions characterized by poverty, marginalization, limited access to financing, and high levels of labor informality. These structural constraints often reduce business productivity while simultaneously encouraging entrepreneurial adaptability and the search for alternative commercial strategies [10].

The findings of this study demonstrate that the informal economy continues to represent one of the principal productive structures in Oaxaca. However, beyond its quantitative persistence, the results reveal a significant qualitative transformation characterized by the progressive incorporation of digital technologies into the commercial practices of informal MSMEs. Although many of these businesses exhibit relatively short business life cycles due to economic vulnerability, scarce financial resources, and limited access to productive assets, they have demonstrated a remarkable capacity for adaptation, allowing them to remain active within the informal economy while progressively integrating digital tools into their business operations. This adaptive behavior reflects broader entrepreneurial responses observed in emerging economies, where business flexibility and digital readiness have become essential mechanisms for coping with uncertain economic environments ([7] & [17]).

These findings are consistent with the Organization for Economic Co-operation and Development [12], which argues that digital technologies have become a strategic resource for enhancing the resilience and competitiveness of SMEs, particularly under conditions of economic uncertainty. While digital transformation is commonly associated with productivity improvements, innovation, and market expansion, the present study demonstrates that these benefits are also observable among informal enterprises, where digital tools function primarily as mechanisms for business continuity rather than as direct drivers of business formalization. Similar conclusions have been reported by the International Labour Organization [15], which emphasizes that digital technologies have increasingly enabled small enterprises to maintain employment, strengthen commercial relationships, and improve operational flexibility despite persistent institutional and financial constraints.

Similarly, the evidence obtained supports the observations of the Economic Commission for Latin America and the Caribbean [12], which highlights that the COVID-19 pandemic accelerated digital transformation processes throughout Latin America [5].

Nevertheless, whereas ECLAC emphasizes digitalization as an opportunity for productive modernization, the results of this research indicate that technological adoption has not necessarily translated into greater compliance with formal institutional or regulatory frameworks. Consequently, digitalization and formalization should be understood as complementary, yet independent, processes. This distinction has also been highlighted in recent studies on digital entrepreneurship, which argue

that firms may successfully adopt digital technologies without simultaneously modifying their institutional status or transitioning toward formality [18]. Consequently, digital transformation should not be interpreted as an automatic pathway to business formalization but rather as a strategic resource that enables informal enterprises to improve competitiveness, expand market access, and strengthen organizational resilience while continuing to operate under informal institutional arrangements.

From a theoretical perspective, the findings may be interpreted through the structuralist approach to informality, which explains the emergence of this sector as a consequence of the formal economy's limited capacity to absorb the available labor force [2]. This perspective has traditionally emphasized structural inequalities, labor market segmentation, and institutional deficiencies as the principal determinants of informal employment. However, the empirical evidence obtained in Oaxaca suggests that informality can no longer be explained exclusively by economic exclusion. Consistent with the arguments proposed by [3], informal entrepreneurship increasingly reflects adaptive survival strategies that combine flexibility, innovation, and technological adoption in response to changing market conditions. Recent institutional research further argues that informality should be understood as a dynamic socioeconomic phenomenon shaped by both structural constraints and entrepreneurial decision-making processes, particularly in emerging economies characterized by institutional asymmetries [10].

This evolution is particularly evident in the growing use of social media, electronic marketplaces, and digital communication platforms among informal MSMEs. Rather than replacing traditional commercial practices, these technologies complement existing business models by expanding customer reach, facilitating commercial transactions, improving customer engagement, and increasing business visibility. Similar conclusions have been reported by Rodríguez-Ruiz [8], who argues that digitalization contributes to business growth by strengthening operational flexibility and improving firms' capacity to respond to changing market environments. Likewise, recent studies indicate that digital capabilities have become strategic resources for improving organizational resilience, customer relationship management, and long-term business competitiveness, particularly among small enterprises operating under resource constraints ([17] & [19]).

The territorial analysis also provides relevant evidence regarding the relationship between geography and business informality. The spatial concentration of informal MSMEs in urban and semi-urban municipalities indicates that proximity to consumers, transportation infrastructure, commercial networks, and digital connectivity continues to determine entrepreneurial activity. Although digital technologies reduce certain geographical barriers by facilitating remote commercial interactions, the findings suggest that territorial characteristics remain fundamental in explaining the location, expansion, and sustainability of informal economic units throughout Oaxaca. Similar territorial patterns have been documented in regional development studies, where urban agglomeration generates competitive advantages by concentrating economic

resources, infrastructure, and business services that stimulate entrepreneurial activity [16].

Furthermore, the empirical evidence indicates that the incorporation of digital platforms does not necessarily imply business formalization. This finding coincides with recent international studies warning about the emergence of digital informality, a phenomenon characterized by the use of digital technologies without full compliance with legal, fiscal, or labor regulations [4].

Consequently, the coexistence of technological innovation and institutional informality reflects the emergence of hybrid business models that challenge traditional approaches to entrepreneurship and economic regulation. Rather than eliminating informality, digital technologies frequently enable informal firms to improve operational efficiency, expand market access, and strengthen commercial relationships while remaining outside formal regulatory frameworks, a trend increasingly observed across developing economies ([18] & [15]).

From a public policy perspective, these findings suggest the need to rethink formalization strategies beyond traditional regulatory mechanisms. Policies promoting digital transformation should be accompanied by initiatives aimed at improving financial inclusion, technological capabilities, entrepreneurial training, administrative simplification, and access to digital infrastructure. As highlighted by the World Bank [14], digital inclusion generates greater economic impact when combined with institutional support mechanisms that facilitate the gradual transition of MSMEs toward the formal economy. Likewise, recent evidence suggests that effective public policies should simultaneously strengthen innovation ecosystems, entrepreneurial competencies, and digital skills to ensure that technological adoption contributes not only to business competitiveness but also to long-term productive development and inclusive economic growth [20].

Overall, this research contributes to the current literature by integrating three dimensions that have generally been analyzed independently: business informality, digital transformation, and territorial dynamics. By combining these analytical perspectives, the study provides a broader understanding of how informal MSMEs respond to structural economic challenges through the adoption of digital technologies. The evidence demonstrates that technological innovation does not eliminate informality; instead, it reshapes the ways in which informal MSMEs organize, compete, and survive in increasingly digital markets. In this regard, digital technologies should be understood not only as operational tools but also as strategic resources that enable informal enterprises to improve adaptability, strengthen customer relationships, and expand commercial opportunities despite persistent institutional constraints [17].

Consequently, understanding the evolution of contemporary informal economies requires recognizing that digital transformation is redefining—rather than replacing—the traditional characteristics of business informality. These findings contribute to the growing body of literature emphasizing that technological change and

institutional transformation evolve at different speeds, giving rise to increasingly complex entrepreneurial ecosystems in developing economies [19].

5 Conclusions

The present study examined the evolution of the informal sector in the state of Oaxaca between 2021 and 2025, focusing on the emergence of informal micro, small, and medium-sized enterprises (MSMEs) that incorporated e-commerce platforms as part of their business strategies following the COVID-19 pandemic. The empirical evidence confirms that the proposed objective was successfully achieved while providing a comprehensive understanding of the research problem addressed in this study. Furthermore, the integration of official statistical information with territorial analysis enabled the identification of spatial and economic patterns that contribute to a more comprehensive understanding of the interaction between informality, entrepreneurship, and digital transformation within the regional context.

The findings indicate that the informal economy continues to play a fundamental role in Oaxaca's productive system. Nevertheless, the results also reveal that this sector is undergoing a gradual transformation driven by the increasing adoption of digital technologies. Rather than remaining limited to conventional informal activities, many MSMEs have incorporated digital communication channels and e-commerce platforms into their commercial operations, giving rise to new organizational practices that combine traditional informality with digital business models. This transformation demonstrates that digital technologies have become valuable instruments for improving business adaptability, commercial visibility, and customer interaction, even among enterprises operating outside formal institutional frameworks. Similar trends have been documented in emerging economies, where digital transformation has strengthened the resilience and competitiveness of small enterprises while simultaneously generating new challenges related to regulation, digital inclusion, and productive development ([20] & [18]).

An important contribution of this research lies in demonstrating that digitalization has enhanced the adaptive capacity of informal enterprises without necessarily encouraging their transition toward formality. Although digital technologies have facilitated broader market access, improved commercial interaction with customers, and strengthened business visibility, they have not substantially modified the structural conditions associated with informality, including limited regulatory compliance, restricted access to institutional support, constrained financial inclusion, and the absence of comprehensive social protection mechanisms. These findings suggest that technological adoption and business formalization evolve through different, although complementary, processes. In this regard, digital transformation should be understood as an enabling mechanism that strengthens business resilience and operational efficiency rather than as an automatic pathway toward institutional formalization. This conclusion is consistent with recent studies emphasizing that digital capabilities improve organizational performance without necessarily altering the institutional status of small enterprises ([19] & [20]).

The territorial analysis further highlights that the spatial distribution of informal MSMEs remains closely associated with demographic concentration, commercial accessibility, transportation infrastructure, and local economic activity. While digital technologies contribute to expanding market opportunities beyond traditional physical boundaries by facilitating online communication and electronic commerce, territorial characteristics continue to influence the establishment, concentration, and long-term development of informal entrepreneurial initiatives throughout the state of Oaxaca. These findings reinforce the importance of considering geographical, institutional, and socioeconomic conditions when designing policies aimed at promoting inclusive regional development and strengthening entrepreneurial ecosystems ([14] & [16]).

From an academic perspective, this study contributes to the understanding of digital informality by integrating three analytical dimensions that have generally been examined independently in previous research: business informality, digital transformation, and territorial dynamics. The results provide evidence that technological innovation is not replacing informal economic structures; instead, it is reshaping the way informal enterprises operate, compete, and respond to increasingly digital market environments. By combining territorial analysis with evidence on digital adoption among informal MSMEs, this research broadens the existing literature on entrepreneurial adaptation in developing economies and provides a framework for future studies examining the interaction between institutional conditions, technological innovation, and regional economic development. Furthermore, the findings highlight the need for interdisciplinary approaches capable of integrating perspectives from economics, business management, geography, and information systems to better understand the evolving nature of digital informality ([21] & [17]).

Finally, the findings emphasize the importance of designing public policies capable of simultaneously promoting digital transformation and progressive business formalization. Rather than relying exclusively on regulatory mechanisms, policy initiatives should incorporate financial inclusion, digital skills development, entrepreneurial training, administrative simplification, and improved access to digital infrastructure to strengthen the competitiveness and long-term sustainability of informal MSMEs. In addition, coordinated public-private initiatives should encourage innovation ecosystems that facilitate knowledge transfer, technological adoption, and access to financing, thereby creating more favorable conditions for the gradual integration of informal enterprises into the formal economy. Recent international evidence indicates that digital transformation policies generate greater economic and social impact when they are accompanied by institutional reforms that promote inclusive entrepreneurship and strengthen the productive capacities of small businesses ([20] & [14]).

Although this research contributes to the understanding of digital informality among MSMEs in Oaxaca, several limitations should be acknowledged. First, the study was based exclusively on secondary information obtained from official statistical databases, which restricted the possibility of directly exploring entrepreneurs' perceptions, motivations, and levels of digital capability. Second, the analysis was geographically limited to the state of Oaxaca; consequently, caution should be exercised when

extrapolating the findings to other regions with different institutional and socioeconomic characteristics. Finally, while the research identified the incorporation of digital technologies into business activities, the available information did not allow for measuring the intensity, frequency, or degree of sophistication of digital adoption among informal enterprises. Future studies incorporating mixed-methods approaches could provide a more comprehensive understanding of the behavioral, organizational, and technological factors influencing the digital transformation of informal businesses [6].

Future investigations should expand this line of research by incorporating primary information collected directly from informal entrepreneurs in order to better understand the determinants and implications of digital adoption. Comparative studies involving different Mexican states or other Latin American countries would also contribute to identifying regional differences in the interaction between informality and digital transformation. Such comparative analyses could facilitate the identification of best practices and institutional factors that promote digital inclusion while simultaneously encouraging productive development and business formalization across diverse socioeconomic contexts [9].

Likewise, subsequent research could examine the effects of digital technologies on business performance by evaluating variables such as productivity, competitiveness, sales growth, customer diversification, business resilience, innovation capacity, and long-term sustainability. Particular attention should be devoted to understanding how digital capabilities, financial inclusion, entrepreneurial competencies, and institutional support mechanisms influence the successful implementation of digital business strategies. Recent research has shown that these factors significantly affect the digital maturity of SMEs and their capacity to sustain competitive advantages over time [22].

Finally, further theoretical and empirical development of the concept of digital informality would enrich the current literature by providing a more comprehensive explanation of how technological innovation is transforming informal economic activities in developing countries. Integrating perspectives from economics, business management, geography, and information systems may contribute to a deeper understanding of the structural changes currently affecting informal entrepreneurial ecosystems. Moreover, future research should explore how emerging digital technologies—including artificial intelligence, digital payment systems, cloud computing, and platform-based commerce—are reshaping entrepreneurial behavior and redefining the relationship between technological innovation, institutional development, and economic informality in developing countries ([21] & [17]).

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