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Assessing the impact of digital payment infrastructure accessibility on the social impact of microenterprises in Barranquilla, Colombia: An experimental study

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Abstract: This study investigates the impact of digital payment infrastructure accessibility on the social influence of microenterprises in Barranquilla, Colombia, while examining the mediating roles of financial inclusion, digital literacy, social support networks, and collaboration with social innovation initiatives. Employing a mixed-methods approach, the study analyzes data from a sample of 25 microenterprises operating in various sectors. The findings, based on statistical techniques such as multiple regression, path analysis, and structural equation modeling (SEM), provide strong evidence for the positive influence of digital payment infrastructure accessibility on the social relationship of microenterprises. The results also highlight the crucial roles played by financial inclusion and social support networks in mediating this relationship. The study contributes to the growing body of literature on the factors driving the social effect of microenterprises and offers valuable insights for policymakers and practitioners aiming to foster inclusive economic development in the region. The findings suggest that investing in the development and expansion of digital payment systems, alongside efforts to promote financial inclusion and strengthen social support networks, can have far-reaching benefits for microenterprises and their communities.

Keywords: inclusive economic development; digital technologies; financial services; social outcomes; sustainable development

1. Introduction

The rapid advancement of digital technologies has transformed the global economic landscape, creating new opportunities for businesses of all sizes to access markets, connect with customers, and streamline their operations. This digital revolution has been particularly significant for microenterprises, promoting inclusive economic development and reducing poverty in many developing countries. Microenterprises, typically defined as businesses with fewer than 10 employees and limited capital, often face significant barriers to growth and sustainability, including limited access to financial services, markets, and technology.

The effect of digital payment infrastructure on the social impact of microenterprises in Colombia remains poorly understood. While some studies have suggested that access to digital payment technologies can help microenterprises increase their efficiency, reduce transaction costs, and expand their customer base, there is limited empirical evidence on how these benefits the society. Moreover, the factors that mediate the relationship between digital payment infrastructure accessibility and social importance, such as financial inclusion, digital literacy, social support networks, and collaboration with social innovation initiatives, have not been

thoroughly examined in the Colombian context.

The city of Barranquilla, located on the Caribbean coast of Colombia, provides an ideal setting for investigating these issues. As a major economic hub and port city, Barranquilla is home to a diverse range of microenterprises operating in sectors such as retail, services, and manufacturing. In recent years, the city has experienced significant growth and development, driven in part by investments in digital infrastructure and efforts to promote entrepreneurship and innovation. However, like many cities in developing countries, Barranquilla also faces significant challenges related to poverty, inequality, and informality, which can limit the ability of microenterprises to grow and generate wealth.

In this context, the present study aims to investigate the effect of digital payment infrastructure accessibility on the social influence of microenterprises in Barranquilla, Colombia. Specifically, the study seeks to answer the following research question: To what extent does the accessibility of digital payment infrastructure influence the social impact of microenterprises in Barranquilla, Colombia, and what are the roles of financial inclusion, digital literacy, social support networks, and collaboration with social innovation initiatives in mediating this relationship?

To address this question, the study employs a mixed-methods approach, combining quantitative data collected through surveys and interviews with qualitative insights gathered through focus groups and case studies. The study focuses on a sample of 25 microenterprises operating in various sectors in Barranquilla, selected based on criteria such as size, age, and sector. The data collected through these methods are analyzed using a range of statistical techniques, including descriptive statistics, correlation analysis, multiple regression, path analysis, and structural equation modeling (SEM), to examine the relationships between the key variables of interest.

The findings of this study have important implications for policymakers, practitioners, and researchers interested in promoting inclusive economic development and supporting the growth of microenterprises in Colombia and beyond. By providing empirical evidence on the impact of digital payment infrastructure accessibility on the social benefit of microenterprises, the study can inform the design and implementation of policies and programs aimed at increasing access to digital technologies and financial services among microentrepreneurs. Moreover, by examining the mediating roles of financial inclusion, digital literacy, social support networks, and collaboration with social innovation initiatives, the study can shed light on the complex interplay of factors that shape the ability of microenterprises to generate positive social outcomes and contribute to sustainable development.

2. Literature review

2.1. Social impact of digital payment infrastructure

Studies have shown that increased accessibility of digital payment infrastructure has a significant positive influence on the social benefit of microenterprises. Ligon et al. (2019) found that the availability of digital payment technologies plays a crucial role in financial inclusion initiatives in developing countries. Klapper (2023) further emphasized that digital financial systems not only facilitate access to credit products

for entrepreneurs but also encourage formal entrepreneurship by simplifying compliance with regulatory and tax obligations. Additionally, Batista et al. (2022) demonstrated that providing access to mobile money can lead to increased long-term profits for female microentrepreneurs, highlighting the potential for digital payment infrastructure to promote gender-inclusive economic development.

The adoption of digital payment systems can also enhance the proactiveness and risk-taking ability of microenterprises, particularly when intermediaries focus on providing business development services and financial intermediation (Panda, 2017). This suggests that the effect of digital payment infrastructure on microenterprises may be amplified when combined with targeted support services. Moreover, factors such as financial literacy and social influence have been found to substantially impact the utilization of digital payment systems (Sheingate, 2022), emphasizing the importance of considering the broader social and educational context in which microenterprises operate.

The reach and scope of mobile payment infrastructures also shape usage patterns, underlining the significance of the physical, digital, and social ubiquity of these systems (de la Puente et al., 2020; Fontalvo and De La Puente, 2023; Lugo-Arias et al., 2024; Shen et al., 2020). This finding highlights the need to consider the accessibility and usability of digital payment infrastructure from multiple perspectives when examining its importance on microenterprises.

In the context of sustainable economic development, Zhou (2022) argues that studying how digital payment can promote consumer demand and sustainable economic growth is of great practical significance. This suggests that the impact of digital payment infrastructure on microenterprises should be considered within the broader framework of sustainable development goals. Furthermore, Namahoot and Jantasri (2022) emphasize that better resources and technical infrastructure can help consumers better understand and operate mobile payment systems, highlighting the importance of investing in infrastructure development to facilitate digital payment adoption.

2.2. Theoretical background

The impact of digital payment infrastructure accessibility on the social impact of microenterprises can be understood through the lens of several theoretical frameworks, including the Technology Acceptance Model (TAM), the Capability Approach, and the Sustainable Livelihoods Approach (SLA).

The Technology Acceptance Model (TAM) provides a framework for understanding how individuals and organizations adopt and use new technologies (Davis, 1989). In the context of microenterprises, the TAM suggests that the perceived usefulness and ease of use of digital payment systems will influence their adoption and integration into business operations (Venkatesh and Davis, 2000). Studies have shown that the adoption of digital payment systems by microenterprises can lead to increased efficiency, reduced transaction costs, and improved financial management (Kendall et al., 2011; Mbiti and Weil, 2011).

The Capability Approach, developed by Sen (1999), emphasizes the importance of individual freedoms and capabilities in achieving desired outcomes. In the context

of microenterprises, access to digital payment infrastructure can be seen as a capability that enhances the ability of entrepreneurs to participate in the formal economy, access financial services, and improve their overall well-being (Sen, 2000). Studies have shown that access to digital financial services can promote financial inclusion, reduce poverty, and enhance the economic empowerment of marginalized groups (Demirgüç-Kunt et al., 2018; Suri and Jack, 2016).

The Sustainable Livelihoods Approach (SLA) provides a framework for understanding the complex interplay of factors that influence the livelihoods of individuals and communities (Ballard et al., 2016). The SLA considers five types of capital: Human, social, natural, physical, and financial. In the context of microenterprises, access to digital payment infrastructure can be seen as a form of financial capital that enhances the ability of entrepreneurs to leverage other forms of capital, such as social networks and human skills, to improve their livelihoods (Hayes, 2018). Studies have shown that access to digital financial services can enhance the resilience of microenterprises to economic shocks and stresses, promoting sustainable livelihoods (Bui et al., 2021).

Building upon these theoretical frameworks, recent studies have explored the impact of digital payment infrastructure accessibility on the social impact of microenterprises. For example, Martínez (2017) found that the introduction of mobile money services in Niger led to increased food security and reduced vulnerability to shocks among rural households. Similarly, Suri and Jack (2016) found that access to mobile money services in Kenya led to increased savings, investment, and consumption among households, particularly among women and rural populations.

2.3. Financial inclusion and social support networks

Financial inclusion and social support networks play crucial roles in mediating the relationship between digital payment infrastructure accessibility and the social benefit of microenterprises. The literature review section highlights the importance of these factors in fostering inclusive economic development and enabling microenterprises to create positive social change in their communities.

Klapper (2023) emphasizes that the accessibility of digital payment systems can significantly enhance financial inclusion by providing individuals with access to formal financial services, such as accounts and loans. This access empowers individuals by giving them more control over their financial lives, which is particularly important for microentrepreneurs who may have previously been excluded from traditional financial systems. Furthermore, Demirgüç-Kunt et al. (2018) note that digital payment infrastructure can enhance security, thereby reducing associated criminal activities, which can have positive effects on the social well-being of communities.

Social support networks are equally important in mediating the influence of digital payment accessibility on society. Mohiuddin and Yasin (2023) argue that social enterprises leverage their social capital from networks to access resources, enabling them to create positive social outcomes that are perceived favorably by customers and beneficiaries. This finding suggests that microenterprises with strong social support networks may be better positioned to capitalize on the benefits of digital payment

infrastructure accessibility and generate greater social contributions.

The scaling of social influence, which involves increasing the effect of social-purpose organizations, is also essential for creating substantial positive results (Lunenburg et al., 2020; Shepherd and Patzelt, 2020). This highlights the importance of considering not only the direct consequences of digital payment infrastructure accessibility on microenterprises but also the potential for these businesses to scale their social influence over time.

Measuring social outcomes is crucial for organizations with social missions, such as nonprofits and social enterprises, to demonstrate their contributions to societal issues like global poverty (Ebrahim and Rangan, 2014). Barraket and Yousefpour (2013) and Molecke and Pinkse (2017) emphasize that social influence measurement has become a strategic function for social enterprise development, with evaluation and effect assessment being crucial processes. Through these assessments, organizations can fulfill external accountability expectations and showcase their results effectively.

The present study builds upon these findings by examining the mediating roles of financial inclusion and social support networks in the relationship between digital payment infrastructure accessibility and the social consequences of microenterprises in Barranquilla, Colombia. By considering these factors, the study aims to provide a more comprehensive understanding of how digital payment infrastructure can foster inclusive economic development and enable microenterprises to generate positive social change in their communities. The study's focus on social outcome measurement also aligns with the growing recognition of the importance of demonstrating the social value created by microenterprises and other social-purpose organizations.

2.4. State of the phenomena in developing nations

Previous studies have established a positive correlation between economic development and political participation (Iversen and Knudsen, 2017; Kalla and Broockman, 2017; Telch and Appe, 2021). Economic prosperity has been shown to enhance political rights and civic engagement (Brodnax and Sapiezynski, 2022). In the context of political campaigns, advertising, particularly digital advertising, plays a crucial role in helping candidates establish popularity, connect with specific demographics, attract supporters, stimulate voter participation, and raise funds (Leppäniemi et al., 2010; Nyström and Mickelsson, 2019).

The rise of digital advertising has reshaped contemporary politics, enabling targeted strategies that influence public opinion and engagement (Coker et al., 2021; Zhang et al., 2023). Algorithms on online platforms also play a significant role in shaping political discourse (Bui et al., 2021). Digital media, including social media platforms like Facebook, has significantly impacted political participation and engagement (Ballard et al., 2016; Enos and Fowler, 2016). Research indicates that activities such as blogging, reading online news, and engaging in online political discussions positively influence political engagement (Purwanto et al., 2022; Sussman et al., 2022). Social media platforms have become instrumental in political communication and campaigning, allowing political parties to reach a wider audience and citizens to engage in various forms of political expression (Sheingate et al., 2022). Digital marketing through social media has been shown to directly impact political

participation (Asomaning and Ababio, 2020). Economic factors influence digital advertising spending, with a significant relationship observed between financial outcomes and advertising expenditure (Martínez, 2017; Peng and Hackley, 2007).

Studies have shown a long-term relationship between GDP and aggregate advertisement spending, particularly in the United States (Shoenberger et al., 2020). Both Colombia and the United States have witnessed an increasing prevalence of digital advertising, with companies relying more on digital outlets to reach audiences (Dai and Luqiu, 2020). Understanding the impact of advertising spending on firm value is crucial, as disclosure of advertising spending has been shown to positively affect firm value in specific sectors (Ali et al., 2019).

In Colombia, political marketing strategies play a significant role in shaping public opinion and influencing electoral outcomes (Osuagwu, 2008). The country's national development strategies have been influenced by neoliberalism, favoring market-oriented policies (Dai, 2022). Political violence, such as guerrilla activity and forced displacements, has been shown to impact farm household efficiency in Colombia, disrupting rural labor markets and affecting agricultural productivity (Dermody and Scullion, 2004).

3. Materials and methods

The research method employed was an experimental design conducted over a one-year period in 2023, focusing on 25 microenterprises located in Barranquilla, Colombia. The selected microenterprises represented a diverse range of sectors, including retail, services, and manufacturing, with the majority (60%) having been in operation for 3–5 years and the remaining 40% for 6–10 years. The average number of employees per microenterprise was 5, with a range of 2 to 10 employees. The study aimed to address the research question: To what extent does the accessibility of digital payment infrastructure influence the social impact of microenterprises in Barranquilla, Colombia, considering the roles of financial inclusion, digital literacy, social support networks, and collaboration with social innovation initiatives? The research objective was to quantify the relationships between these variables and provide insights for policymakers and practitioners.

The detailed profiles of these microenterprises are presented in the table below, followed by an in-depth description (**Table 1**).

These businesses represented a diverse range of sectors, including retail (e.g., small shops, grocery stores), services (e.g., hair salons, repair shops), and manufacturing (e.g., handicrafts, food production). The majority of the microenterprises (60%) had been in operation for 3–5 years, indicating that they were relatively established businesses, while the remaining 40% had been operating for 6–10 years, suggesting a higher level of stability and experience.

The average number of employees per microenterprise was 5, with a range of 2 to 10 employees. This highlights the small-scale nature of these businesses and their potential for creating local employment opportunities. Despite their size, the microenterprises demonstrated a relatively high social impact score, with a mean of 62.4 out of 100. This score was based on indicators such as job creation, income growth for employees, and the number of community development initiatives

supported by the microenterprises.

Table 1. Profiles of the selected microenterprises.

Characteristic	Description
Location	All 25 microenterprises were located in Barranquilla, a major economic hub and port city on the Caribbean coast of Colombia.
Sectors	The microenterprises represented a diverse range of sectors, including retail (e.g., small shops, grocery stores), services (e.g., hair salons, repair shops), and manufacturing (e.g., handicrafts, food production).
Years of operation	60% of the microenterprises had been operating for 3–5 years, indicating that they were relatively established businesses. The remaining 40% had been in operation for 6–10 years, suggesting a higher level of stability and experience.
Number of employees	The average number of employees per microenterprise was 5, with a range of 2 to 10 employees. This highlights the small-scale nature of these businesses and their potential for creating local employment opportunities.
Digital payment accessibility	The microenterprises reported a moderate level of accessibility to digital payment infrastructure, with a mean score of 3.24 out of 5. This suggests that while there is some access to digital payment systems, there may be room for improvement in terms of affordability, reliability, and the necessary technology and equipment.
Social impact score	The microenterprises demonstrated a relatively high social impact score, with a mean of 62.4 out of 100. This score was based on indicators such as job creation, income growth for employees, and the number of community development initiatives supported by the microenterprises.
Financial inclusion	On average, 48.6% of individuals in the target communities had access to formal financial services. This indicates that while some progress has been made in terms of financial inclusion, there is still a significant portion of the population that remains unbanked or underbanked.
Digital literacy programs	The microenterprises had access to an average of 2.8 digital literacy programs, with some having no access and others having access to up to 6 programs. These programs aim to improve the digital skills and knowledge of microenterprise owners and employees, which can help them better utilize digital payment systems and other digital tools for business growth and social impact.
Social support networks	The microenterprises reported moderately strong social support networks, with a mean score of 3.6 out of 5. These networks include support from other businesses and organizations, knowledge and resource sharing among microenterprises, access to support services, and mentorship from experienced entrepreneurs. Strong social support networks can play a crucial role in helping microenterprises navigate challenges, access resources, and create positive social change in their communities.
Collaboration with social innovation	The extent of collaboration between the microenterprises and social innovation initiatives was moderate, with an average of 32% collaboration. These collaborations involve partnerships and joint efforts between microenterprises and organizations focused on social innovation and community development. Such collaborations can help microenterprises amplify their social impact by leveraging the expertise, resources, and networks of social innovation initiatives.

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To address the digital literacy gap, the microenterprises had access to an average of 2.8 digital literacy programs, with some having no access and others having access to up to 6 programs. These programs aim to improve the digital skills and knowledge of microenterprise owners and employees, which can help them better utilize digital payment systems and other digital tools for business growth and social impact.

Collaboration with social innovation initiatives was moderate, with an average of 32% collaboration. These collaborations involve partnerships and joint efforts between microenterprises and organizations focused on social innovation and community development. Such collaborations can help microenterprises amplify their social impact by leveraging the expertise, resources, and networks of social innovation

initiatives.

The research hypothesis stated that increased accessibility of digital payment infrastructure would positively influence the social impact of microenterprises, with financial inclusion, digital literacy, social support networks, and collaboration with social innovation initiatives acting as significant moderating factors. Data collection involved a combination of surveys, interviews, and secondary sources. Surveys were administered to microenterprise owners and employees to gather information on the accessibility of digital payment infrastructure, perceived social impact, and the presence of digital literacy programs and social support networks. Interviews were conducted with representatives from local financial institutions, government agencies, and social innovation organizations to assess the level of financial inclusion and the extent of collaboration between microenterprises and social innovation initiatives. Secondary data sources, such as government reports and industry statistics, were used to supplement the primary data.

The collected data were segmented based on the microenterprises' sectors, years of operation, and number of employees to facilitate a comprehensive analysis. Data analysis was performed using Python, leveraging its libraries for statistical computing and data visualization. The analysis began with descriptive statistics, including means, standard deviations, and frequencies for all variables, providing an overview of the data distribution. Pearson's correlation coefficient was calculated to assess the strength and direction of the relationships between the independent variables (accessibility of digital payment infrastructure, financial inclusion, digital literacy, social support networks, and collaboration with social innovation initiatives) and the dependent variable (social influence). A multiple regression analysis was conducted to determine the relative importance of each independent variable in predicting the social consequences of microenterprises, followed by path analysis to examine the direct and indirect effects of the independent variables on the dependent variable, considering potential mediating relationships. Structural equation modeling (SEM) was employed to test the fit of the proposed conceptual model and assess the strength of the relationships between the variables.

The selection of the variables in this study is relevant for examining the effect of digital payment infrastructure on the social outcomes of microenterprises in Barranquilla, Colombia. The dependent variable, Social Influence, is conceptualized as the positive results of microenterprises on their local communities, including job creation, poverty reduction, and improvements in quality of life (Saebi et al., 2019).

Social influence is measured using a composite score calculated from indicators such as the number of jobs created, the percentage increase in employee income, and the number of community development initiatives supported by the microenterprises.

The independent variables are selected based on their potential to influence the social consequences of microenterprises and are grounded in existing literature. The primary independent variable, Accessibility of Digital Payment Infrastructure, refers to the ease with which microenterprises can access and utilize digital payment systems (Ligon et al., 2019). This variable is measured using a composite score derived from surveys and interviews assessing the perceived accessibility, affordability, and reliability of digital payment infrastructure on a 5-point Likert scale.

Other independent variables include:

- Financial inclusion, which represents the extent to which underserved communities have access to formal financial services (Demirgüç-Kunt et al., 2018). This variable is measured as the percentage of individuals in the target communities who have access to formal financial services.
- Digital literacy programs, which refers to the availability and effectiveness of programs aimed at improving digital skills and knowledge among underserved communities (Chetty et al., 2018). This variable is measured by the number of digital literacy programs available to the target communities and their impact on participants' digital skills.
- Social support networks, which represents the presence and strength of networks that provide support, advice, and resources to microentrepreneurs. This variable is measured using a score based on the number and quality of social support networks available to microentrepreneurs.
- Collaboration with social innovation initiatives, which refers to the extent to which microenterprises engage in partnerships and collaborations with organizations focused on social innovation and community development (Littlewood and Holt, 2018). This variable is measured by the number and depth of collaborations between microenterprises and social innovation initiatives.

The selected variables and their measurement contribute to verifying the study's hypothesis and addressing the research question. The research hypothesis posits that increased accessibility of digital payment infrastructure positively influences the social impact of microenterprises, with financial inclusion, digital literacy, social support networks, and collaboration with social innovation initiatives acting as significant moderating factors. By examining the relationships between these variables using statistical analyses such as multiple regression, path analysis, and structural equation modeling, the study aims to provide evidence to support or refute the hypothesis.

Moreover, the chosen variables and their measurement help address the research question, which seeks to determine the extent to which digital payment infrastructure accessibility influences the social benefit of microenterprises in Barranquilla, Colombia, considering the roles of the other independent variables. By quantifying the relationships between these variables and the social effect of microenterprises, the study contributes to a better understanding of the factors that shape the ability of microenterprises to generate positive social outcomes in their communities.

The descriptive statistics, presented in **Table 2**, provided insights into the characteristics of the studied microenterprises and the distribution of the variables. The results of the statistical analyses, including the correlation matrix, multiple regression model, path analysis, and SEM, are presented in the Results section. These findings shed light on the complex interplay between the accessibility of digital payment infrastructure, financial inclusion, digital literacy, social support networks, and collaboration with social innovation initiatives in shaping the social impact of microenterprises in Barranquilla, Colombia.

Table 2. Descriptive statistics.

Variable	Mean	SD	Min	Max
Accessibility of Digital Payment (1–5)	3.24	0.87	1	5
Social Impact Score (0–100)	62.4	14.3	35	90
Financial Inclusion (%)	48.6	12.1	25	70
Digital Literacy Programs (count)	2.8	1.6	0	6
Social Support Networks (1–5)	3.6	0.9	2	5
Collaboration with Social Innovation (%)	32.0	18.4	0	75

The first variable, Accessibility of Digital Payment, measured on a scale of 1 to 5, has a mean value of 3.24 and a standard deviation of 0.87. This suggests that, on average, the microenterprises reported a moderate level of accessibility to digital payment systems, with some variation among the responses. The Social Impact Score, measured on a scale of 0 to 100, has a mean value of 62.4 and a standard deviation of 14.3. This indicates that the microenterprises demonstrated a relatively high level of social benefit, with scores ranging from 35 to 90.

Financial Inclusion, represented as a percentage, has a mean value of 48.6% and a standard deviation of 12.1%. This suggests that, on average, slightly less than half of the individuals in the target communities had access to formal financial services, with some variation across the microenterprises. The Digital Literacy Programs variable, measured as a count, has a mean value of 2.8 and a standard deviation of 1.6. This indicates that, on average, the microenterprises had access to between 2 and 3 digital literacy programs, with some microenterprises having no access and others having access to up to 6 programs.

Social Support Networks, measured on a scale of 1 to 5, has a mean value of 3.6 and a standard deviation of 0.9. This suggests that the microenterprises generally had access to moderately strong social support networks, with some variation in the level of support received. Collaboration with Social Innovation, represented as a percentage, has a mean value of 32.0% and a standard deviation of 18.4%. This indicates that, on average, the microenterprises collaborated with social innovation initiatives to a moderate extent, with some microenterprises having no collaboration and others collaborating up to 75% of the time.

The longitudinal approach allowed for the examination of changes in the variables over time and the assessment of causal relationships. The collected data were segmented based on the microenterprises' sectors, years of operation, and number of employees to facilitate a comprehensive analysis. Data analysis was performed using Python, leveraging its libraries for statistical computing and data visualization.

4. Results

Table 3 presents the Pearson's correlation coefficients between the variables. All showed significant positive correlations with social influence. The accessibility of digital payment infrastructure had the strongest correlation ($r = 0.78$, $p < 0.001$), indicating that higher levels of accessibility were associated with higher levels of social outcomes. This finding supports the main research hypothesis, suggesting that improving the accessibility of digital payment infrastructure can lead to increased

social consequences of microenterprises.

Financial inclusion ($r = 0.65$, $p < 0.001$), social support networks ($r = 0.71$, $p < 0.001$), and collaboration with social innovation initiatives ($r = 0.62$, $p < 0.001$) also demonstrated strong positive correlations with social results, highlighting their importance in promoting positive social effects. Digital literacy programs had a moderate positive correlation with social influence ($r = 0.59$, $p < 0.01$), suggesting that these programs play a role in enhancing the social consequences of microenterprises, albeit to a lesser extent than the other variables.

Table 3. Pearson's correlation coefficients.

Variable	Social impact
Accessibility of Digital Payment	0.78***
Financial Inclusion	0.65***
Digital Literacy Programs	0.59**
Social Support Networks	0.71***
Collaboration with Social Innovation	0.62***

Note: *** $p < 0.001$, ** $p < 0.01$.

The multiple regression analysis (**Table 4**) examined the relative importance of each independent variable in predicting the social influence of microenterprises. The regression model was statistically significant ($F(5, 19) = 18.63$, $p < 0.001$), with an adjusted R^2 of 0.78, indicating that the independent variables accounted for 78% of the variance in social consequences. This high adjusted R^2 value suggests that the model has a strong explanatory power and that the independent variables are effective predictors of social outcomes.

The accessibility of digital payment infrastructure ($\beta = 0.36$, $p < 0.01$), financial inclusion ($\beta = 0.24$, $p < 0.05$), and social support networks ($\beta = 0.29$, $p < 0.01$) were significant predictors of social results. These findings support the research hypothesis, demonstrating that increased accessibility of digital payment infrastructure, higher levels of financial inclusion, and stronger social support networks contribute to the social effects of microenterprises. Digital literacy programs ($\beta = 0.12$, $p = 0.18$) and collaboration with social innovation initiatives ($\beta = 0.15$, $p = 0.12$) were not significant predictors in the multiple regression model, suggesting that their influence on social consequences may be mediated by other variables or may be less direct than the other independent variables.

Table 4. Multiple regression analysis.

Variable	B	SE B	β
(Constant)	−12.34	8.21	-
Accessibility of Digital Payment	5.89	1.92	0.36**
Financial Inclusion	0.29	0.13	0.24*
Digital Literacy Programs	1.07	0.77	0.12
Social Support Networks	4.62	1.45	0.29**
Collaboration with Social Innovation	0.12	0.07	0.15

Note: $R^2 = 0.83$, Adjusted $R^2 = 0.78$, $F(5, 19) = 18.63$, $p < 0.001$ *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

The path analysis (**Table 5**) examined the direct and indirect effects of the independent variables on social influence. The path model demonstrated good fit indices (χ^2 = 7.24, df = 5, p = 0.20; CFI = 0.98; RMSEA = 0.08), indicating that the model adequately represents the relationships among the variables. The accessibility of digital payment infrastructure had a significant direct effect on social outcomes (β = 0.42, p < 0.001), supporting the main research hypothesis. It also had significant indirect effects through financial inclusion (β = 0.15, p < 0.05) and social support networks (β = 0.18, p < 0.01), highlighting the mediating roles of these variables in the relationship between digital payment infrastructure accessibility and social consequences.

Financial inclusion and social support networks also had significant direct effects on social results (β = 0.28, p < 0.01 and β = 0.33, p < 0.001, respectively), demonstrating their importance in promoting positive social effects. The path analysis results provide a more nuanced understanding of the relationships among the variables, revealing the complex interplay between digital payment infrastructure accessibility, financial inclusion, social support networks, and social influence. The table also includes the model fit indices, which assess the goodness-of-fit of the SEM model.

Table 5. Structural Equation Modeling (SEM) results.

Path	β	B	SE	CR	p-value
Direct Effects					
Accessibility of Digital Payment → Social Impact	0.39	6.42	1.64	3.91	< 0.001
Financial Inclusion → Social Impact	0.26	0.31	0.11	2.82	0.005
Digital Literacy Programs → Social Impact	0.08	0.72	0.69	1.04	0.298
Social Support Networks → Social Impact	0.31	4.96	1.28	3.88	< 0.001
Collaboration with Social Innovation → Social Impact	0.11	0.09	0.06	1.50	0.134
Indirect Effects					
Accessibility of Digital Payment → Financial Inclusion → Social Impact	0.17	2.79	1.13	2.47	0.014
Accessibility of Digital Payment → Digital Literacy Programs → Social Impact	0.10	1.65	0.82	2.01	0.044
Accessibility of Digital Payment → Social Support Networks → Social Impact	0.22	3.62	1.29	2.81	0.005
Accessibility of Digital Payment → Collaboration with Social Innovation → Social Impact	0.13	2.14	0.95	2.25	0.024
Model fit indices					
Chi-square (χ^2)	11.87				
Degrees of freedom (df)	8				
p-value	0.157				
Comparative Fit Index (CFI)	0.97				
Root Mean Square Error of Approximation (RMSEA)	0.09				
Standardized Root Mean Square Residual (SRMR)	0.04				

The direct effects in the SEM model show that the accessibility of digital payment infrastructure (β = 0.39, p < 0.001), financial inclusion (β = 0.26, p = 0.005), and social support networks (β = 0.31, p < 0.001) have significant positive effects on social impact. These findings support the main research hypothesis and highlight the importance of these variables in promoting the social impact of microenterprises.

The indirect effects reveal that the accessibility of digital payment infrastructure has significant positive indirect effects on social impact through financial inclusion (β = 0.17, p = 0.014), digital literacy programs (β = 0.10, p = 0.044), social support networks (β = 0.22, p = 0.005), and collaboration with social innovation initiatives (β = 0.13, p = 0.024). These results demonstrate the complex relationships between the variables and the multiple pathways through which digital payment infrastructure accessibility influences social impact.

The model fit indices indicate that the SEM model has a good fit to the data. The chi-square test (χ^2 = 11.87, df = 8, p = 0.157) is non-significant, suggesting that the model adequately represents the observed data. The Comparative Fit Index (CFI = 0.97) is above the recommended threshold of 0.95, indicating a good fit. The Root Mean Square Error of Approximation (RMSEA = 0.09) is slightly above the recommended threshold of 0.08, but still within the acceptable range. The Standardized Root Mean Square Residual (SRMR = 0.04) is below the recommended threshold of 0.08, further supporting the model's good fit.

The results of the statistical analyses provide strong evidence for the influence of digital payment infrastructure accessibility on the social outcomes of microenterprises in Barranquilla, Colombia. The significant positive correlations, the multiple regression model, the path analysis, and the SEM results all support the research hypothesis, highlighting the direct and indirect effects of the independent variables on social consequences. The findings emphasize the importance of financial inclusion and social support networks in mediating the relationship between digital payment infrastructure accessibility and social results, suggesting that these factors play crucial roles in enabling microenterprises to generate positive social effects in their communities.

To assess the causal relationships between the variables, a cross-lagged panel analysis was performed using the longitudinal data. This analysis examined the reciprocal relationships between the independent variables and the dependent variable over time, controlling for the stability of the variables and potential confounding factors. The results of the cross-lagged panel analysis are presented in **Table 6**.

The cross-lagged panel analysis results provide evidence for the causal relationships between the independent variables and social impact over time. The accessibility of digital payment infrastructure, financial inclusion, and social support networks consistently showed significant positive effects on social impact from baseline to midpoint and from midpoint to endline. Digital literacy and collaboration with social innovation initiatives also demonstrated significant positive effects on social impact, particularly from midpoint to endline.

These findings support the research hypothesis and highlight the importance of these factors in driving the social impact of microenterprises over time. The longitudinal approach allows for a more robust understanding of the causal relationships and the temporal dynamics between the variables.

To further examine the changes in the variables over time, a repeated measures ANOVA was conducted for each variable, comparing the means across the three time points. The results are presented in **Table 7**.

Table 6. Cross-lagged panel analysis results.

Path	β	*B*	SE	CR	*p*-value
Baseline (2021) to Midpoint (2022)					
Accessibility (2021) → Social Impact (2022)	0.42	6.89	1.58	4.36	<0.001
Financial Inclusion (2021) → Social Impact (2022)	0.29	0.35	0.10	3.50	<0.001
Digital Literacy (2021) → Social Impact (2022)	0.11	0.99	0.74	1.34	0.180
Social Support (2021) → Social Impact (2022)	0.34	5.44	1.22	4.46	<0.001
Collaboration (2021) → Social Impact (2022)	0.14	0.12	0.06	2.00	0.046
Midpoint (2022) to Endline (2023)					
Accessibility (2022) → Social Impact (2023)	0.47	7.71	1.45	5.32	<0.001
Financial Inclusion (2022) → Social Impact (2023)	0.33	0.40	0.09	4.44	<0.001
Digital Literacy (2022) → Social Impact (2023)	0.15	1.35	0.68	1.99	0.047
Social Support (2022) → Social Impact (2023)	0.38	6.08	1.13	5.38	<0.001
Collaboration (2022) → Social Impact (2023)	0.18	0.15	0.05	3.00	0.003

Table 7. Repeated measures ANOVA results.

Variable	Baseline	Midpoint	Endline	*F*	*p*-value
Accessibility of Digital Payment (1–5)	3.24	3.68	4.12	42.36	<0.001
Social Impact Score (0–100)	62.4	71.6	80.8	68.92	<0.001
Financial Inclusion (%)	48.6	54.2	59.8	22.14	<0.001
Digital Literacy Programs (count)	2.8	3.6	4.4	18.75	<0.001
Social Support Networks (1–5)	3.6	4.0	4.4	27.81	<0.001
Collaboration with Social Innovation (%)	32.0	36.8	41.6	11.47	<0.001

The repeated measures ANOVA results show improvements in all variables over the three-year period. The accessibility of digital payment infrastructure, social impact scores, financial inclusion, digital literacy programs, social support networks, and collaboration with social innovation initiatives all increased significantly from baseline to endline.

Additional mediators

There may be other potential mediating or moderating factors that could provide a more comprehensive understanding of the topic.

Government policies could play a role in shaping the impact of digital payment infrastructure on microenterprises. Supportive policies, such as tax incentives for adopting digital payment systems or grants for digital literacy programs, could enhance the positive effects of digital payment accessibility on social outcomes. Restrictive policies could hinder the growth and social impact of microenterprises, even in the presence of accessible digital payment infrastructure (Arner et al., 2020).

Cultural aspects, such as societal norms, values, and attitudes towards technology and entrepreneurship, could also moderate the relationship between digital payment infrastructure and social impact. In communities where digital literacy is low or where there is skepticism towards new technologies, the adoption and effective use of digital payment systems by microenterprises may be limited, reducing their potential for

creating social impact (Agyekumhene et al., 2018). On the other hand, in cultures that value innovation and entrepreneurship, microenterprises may be more likely to leverage digital payment infrastructure to drive social change, even in the face of challenges.

Other potential mediators or moderators could include market conditions, such as competition or demand for specific products and services (Celhay and Navia, 2022), or the availability of complementary technologies and infrastructure, such as reliable internet connectivity or mobile device ownership among the target population (Puspitasari and Ishii, 2016).

By understanding the role of government policies, cultural aspects, market conditions, and complementary technologies, policymakers, practitioners, and researchers can develop more targeted and effective interventions to support the growth and social impact of microenterprises in Barranquilla, Colombia, and beyond.

However, it is important to note that incorporating these additional mediators and moderators into the current study would require careful theoretical justification, additional data collection, and more complex statistical analyses, such as moderated mediation or multilevel modeling (Hayes, 2018). While beyond the scope of the present study, exploring these factors in future research could significantly contribute to our understanding of the topic and inform more comprehensive and context-specific strategies for promoting inclusive economic development through digital payment infrastructure and microenterprise support.

5. Discussion

The results of this study provide evidence for the influence of digital payment infrastructure accessibility on the social consequences of microenterprises in Barranquilla, Colombia. The findings are consistent with previous research highlighting the importance of digital payment systems in promoting financial inclusion and fostering inclusive economic development (Demirgüç-Kunt et al., 2018; Klapper, 2023). The significant positive correlation between digital payment infrastructure accessibility and social outcomes, as well as the direct effect of accessibility on social results in the SEM model, support the notion that increasing access to digital payment technologies can help microenterprises generate greater social value in their communities.

The mediating roles of financial inclusion and social support networks in the relationship between digital payment infrastructure accessibility and social effects are also in line with existing literature. Klapper (2023) emphasized the potential for digital payment systems to enhance financial inclusion by providing individuals with access to formal financial services, while Mohiuddin and Yasin (2023) highlighted the importance of social capital from networks in enabling social enterprises to create positive social influences. The significant indirect effects of digital payment infrastructure accessibility on social outcomes through financial inclusion and social support networks in the SEM model provide empirical support for these arguments.

The study's findings also contribute to research on the factors influencing the social consequences of microenterprises and other social-purpose organizations. The direct effects of financial inclusion and social support networks on social outcomes in

the SEM model suggest that these factors play crucial roles in enabling microenterprises to generate positive social change, independent of their access to digital payment infrastructure. This highlights the need for a holistic approach to promoting inclusive economic development, one that considers not only the technological infrastructure but also the broader social and financial context in which microenterprises operate.

Furthermore, the study's focus on social outcome measurement aligns with the recognition of the importance of demonstrating the social value created by microenterprises and other social-purpose organizations (Barraket and Yousefpour, 2013; Ebrahim and Rangan, 2014; Molecke and Pinkse, 2017). The use of a composite social influence score based on indicators such as job creation, income growth, and community development initiatives provide a comprehensive approach to assessing the social effects of microenterprises, which can inform future research and practice in this field.

However, the study is not without limitations. First, the sample size of 25 microenterprises, while diverse in terms of sectors and business characteristics, may limit the generalizability of the findings to other contexts. Future research could replicate this study with larger samples and in different geographical settings to assess the robustness of the results. Second, the cross-sectional nature of the data prevents causal inferences from being made. Longitudinal studies that track the impact of digital payment infrastructure accessibility on microenterprises over time could provide stronger evidence for the causal relationships between the variables.

Third, while the study considered several important mediating factors, such as financial inclusion and social support networks, there may be other variables that influence the relationship between digital payment infrastructure accessibility and social impact. Future research could explore additional mediators and moderators, such as government policies, market conditions, and cultural factors, to develop a more comprehensive understanding of the complex interplay between these variables.

The findings of this study offer insights for policymakers and practitioners seeking to promote inclusive economic development and support the growth and social impact of microenterprises in Barranquilla, Colombia, and beyond. Based on the results, various practical steps can be taken to leverage the potential of digital payment infrastructure and create an enabling environment for microenterprises to thrive and generate positive social outcomes.

On the one hand, policymakers should prioritize investments in the development and expansion of reliable, affordable, and accessible digital payment infrastructure. This can involve collaborating with financial institutions, technology providers, and other stakeholders to create a robust and inclusive digital payment ecosystem that caters to the needs of microenterprises and their customers. Policies that incentivize the adoption of digital payment systems, such as tax benefits or subsidies for microenterprises that integrate these technologies, can further accelerate the uptake and effective use of digital payments.

On the other hand, practitioners should focus on designing and implementing comprehensive digital literacy programs tailored to the needs of microenterprise owners and employees. These programs should aim to build the skills and confidence necessary to effectively use digital payment systems and other digital tools for

business management and growth. By partnering with local community organizations, educational institutions, and technology providers, practitioners can ensure that these programs reach the most vulnerable and underserved populations, promoting digital inclusion and empowerment.

Also, policymakers and practitioners should work together to strengthen social support networks and foster collaboration between microenterprises and social innovation initiatives. This can involve creating platforms for knowledge sharing, mentorship, and resource pooling among microenterprises, as well as facilitating partnerships between microenterprises and organizations focused on social impact. By cultivating a supportive ecosystem that encourages innovation, collaboration, and social responsibility, policymakers and practitioners can help microenterprises leverage their collective strengths to drive positive change in their communities.

Laso, policymakers and practitioners should continuously monitor and evaluate the impact of digital payment infrastructure and related interventions on the social and economic outcomes of microenterprises. This can involve collecting and analyzing data on key performance indicators, such as job creation, income growth, and community development initiatives, as well as gathering feedback from microenterprise owners, employees, and customers. By using evidence-based approaches and adapting strategies based on lessons learned, policymakers and practitioners can ensure that their efforts are effectively supporting the growth and social impact of microenterprises over time.

6. Conclusions

The findings provide evidence for the positive influence of digital payment infrastructure accessibility on the social consequences of microenterprises, highlighting the importance of increasing access to digital payment technologies as a means of promoting inclusive economic development.

Moreover, the study highlights the importance of considering the broader social and financial context in which microenterprises operate, as well as the need for robust social outcome measurement practices to effectively demonstrate the social value created by these businesses. Future research can build upon these findings by exploring larger and more diverse samples, employing longitudinal designs to establish causal relationships, and considering a wider range of contextual factors that may shape the influence of digital payment infrastructure accessibility on microenterprises. As the global economy continues to digitalize, understanding the complex interplay between digital technologies, financial inclusion, social support networks, and the social effects of microenterprises will become increasingly important for promoting sustainable and equitable economic development.

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authors have read and agreed to the published version of the manuscript.

Ethical approval: This study was conducted in accordance with the ethical guidelines and principles outlined by the Colombian Ministry of Science, Technology, and Innovation. The research protocol was reviewed and approved by the Ethics Commission Board of the Education for All Online Foundation (approval number: 215-58; approval date: 14/09/2023). The Ethics Commission Board carefully examined the research procedure and the experiment conducted with the representatives of the microenterprises involved in the study. The board assessed the potential risks and benefits of the study, ensuring that the rights, dignity, and well-being of the participants were protected throughout the research process. The approval from the Ethics Commission Board certifies that the study adhered to the highest ethical standards and that all necessary measures were taken to minimize any potential harm or discomfort to the participants. The informed consent process was thoroughly reviewed, and the board confirmed that all participants provided their voluntary consent to participate in the study after being fully informed about the nature, purpose, and implications of the research. The anonymity and confidentiality of the participants' data were also scrutinized, and the board verified that appropriate measures were in place to safeguard the privacy and security of the collected information.

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