

Impact of Digital Social Innovation on the Sustainable Development of Cooperatives in Marrakech-Safi: An Econometric Approach.

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ABSTRACT

In a world where digital technology is transforming every aspect of our lives, cooperatives play a major role in the social and solidarity economy, particularly in rural areas. However, their transition to digital remains slow and uneven. This study examines how digital social innovation (DSI) – the use of digital tools to improve cooperative practices – impacts the performance and sustainable development of cooperatives in the Marrakech-Safi region. Through a survey of 85 local cooperatives, data was collected on their use of social media, online sales platforms, management software, and digital training. Using an econometric approach, we sought to understand the extent to which these innovations influence revenue, market access, and job creation. The results reveal that cooperatives adopting digital tools experience better economic growth, increased visibility, and easier access to funding. However, disparities persist: cooperatives with limited internet access or low levels of digital training struggle to fully leverage these opportunities. These findings highlight the need for tailored support to promote digital inclusion among cooperatives, through targeted training and enhanced technological assistance. This article thus offers insights for public and private actors seeking to strengthen the role of digital technology in Morocco's social and solidarity economy.

Keywords: Digital social innovation, Sustainable development, Cooperatives, Econometric model.

INTRODUCTION

Digital innovation is profoundly transforming economic and social dynamics on a global scale, redefining modes of production, marketing, and consumption. Cooperatives, as key players in the social and solidarity economy, are not immune to this transformation, although their adoption of digital tools often remains gradual and uneven. In rural areas, where these organizations play a central role in job creation and the structuring of local value chains, digitalization represents a major opportunity to enhance their performance, improve governance, and strengthen their resilience in the face of contemporary challenges (Borzaga & Tortia, 2017). Digital social innovation (DSI), defined as the use

of digital technologies to develop innovative solutions to social and economic challenges, thus represents a promising avenue for modernizing cooperatives and facilitating their integration into global markets (Cajaiba-Santana, 2014).

In the context of emerging economies, particularly in Morocco, the digital transformation of cooperatives faces structural and institutional obstacles (Ben Youssef, Boubaker, & Omri, 2018). While some initiatives have helped boost access to e-commerce platforms, improve accounting management, or optimize logistics through digital technologies, several studies show that these advancements do not uniformly benefit all actors in the sector (Nambisan, Wright, & Feldman, 2019). Deficits in digital infrastructure, limited training among members, and organizational resistance continue to hinder their transition toward more innovative and sustainable models (Moulaert, MacCallum, & Mehmood, 2013).

In the Marrakech-Safi region, which is home to a dense network of artisanal and agricultural cooperatives, this issue is particularly pressing. Despite initiatives aimed at digitalizing these structures, including government programs and partnerships with international organizations, few empirical studies have analyzed the actual impact of digital tools on the performance and sustainability of cooperatives. The aim, therefore, is to understand the extent to which the adoption of digital social innovations influences the economic and social development of these structures and to identify the factors that moderate these effects.

The role of cooperatives in economic and social development is well-documented in academic literature. As economic organizations based on resource pooling and democratic governance, they actively contribute to reducing inequalities, creating sustainable jobs, and anchoring productive activities within local territories (Birchall, 2013). In many regions of the world, they have demonstrated strong resilience in the face of economic and environmental crises, thanks to hybrid economic models that combine commercial and social objectives (Defourny & Nyssens, 2016).

However, while cooperatives have historically been seen as alternatives to traditional capitalist enterprises, they now face major challenges linked to digital transformation (Mason, Brown, & Mawson, 2019). The digitalization of services, the rise of e-commerce, and the emergence of collaborative platforms are profoundly altering production and marketing methods, requiring rapid adaptation by cooperative structures (Steiber & Alänge, 2020). For those that succeed in adopting these tools, digital technology becomes a source of opportunity, facilitating access to markets, financial flow management, and supply chain optimization (Chalmers, MacKenzie, & Carter, 2021).

In the specific context of Marrakech-Safi, where cooperatives are a key component of the local economy, their digitalization represents a strategic challenge. The region benefits from strong entrepreneurial dynamics and a supportive institutional ecosystem, marked by the implementation of programs to support the digitalization of cooperatives. However, disparities in access to digital infrastructure and member training remain significant barriers (Boulkhir L., Touhami F. (2024).

Against this backdrop, a central question arises: to what extent does digital social innovation contribute to improving the performance and sustainability of cooperatives in the Marrakech-Safi region? More specifically, the aim is to assess whether and how the adoption of digital tools influences revenue, job creation, and market access for cooperatives, while identifying the factors that promote or limit this transition.

To address this question, we employ a quantitative approach based on a survey conducted among a sample of 85 cooperatives in the Marrakech-Safi region. The study relies on an econometric model to identify the relationships between the use of digital technologies and various indicators of performance

and sustainability.

The dependent variables include concrete measures of cooperative performance, such as revenue, the number of jobs created, and access to new markets. The explanatory variables focus on the adoption of digital tools, measured by the use of social media for sales, e-commerce platforms, management software, and digital training received by members. Additionally, control variables such as internet access, the education level of leaders, and external support received are included to refine the analysis.

The application of multiple regression analysis on cross-sectional data will quantify the impact of each factor and identify the major determinants of the success of digital strategies in local cooperatives.

The article is structured around several complementary sections. Following this introduction, which outlines the theoretical and empirical framework of the research, a literature review will detail the contributions and limitations of existing work on digital social innovation and cooperatives, drawing on references from international academic research. The methodology section will present the empirical framework, research hypotheses, and the construction of variables used in the econometric analysis. Next, the results section will present the main findings of the study, highlighting key success factors and obstacles encountered by cooperatives in their digital transition. Finally, the discussion and conclusion will place these results in a broader perspective, offering recommendations for public policies and cooperative sector stakeholders, as well as avenues for future research.

This work aims to provide an empirical and theoretical contribution to understanding the dynamics of digital transformation in the social and solidarity economy, shedding light on the opportunities and challenges that new technologies represent for cooperatives in the Marrakech-Safi region.

2. Academic Literature Review: Digital Social Innovation and Cooperative Development: Digital transformation has become a major challenge for organizations operating in the social and solidarity economy (SSE), particularly cooperatives. Digital social innovation (DSI) represents an opportunity for these structures to modernize their processes, improve their competitiveness, and increase their social impact (Cajaiba-Santana, 2014). However, despite the potential benefits, the adoption of digital tools varies significantly from one cooperative to another due to structural, organizational, and institutional constraints (Defourny & Nyssens, 2016). This literature review aims to explore how and why cooperatives adopt digital technologies, as well as their impact on their economic and social performance.

2.1. Theoretical Framework: Foundations of Digital Social Innovation:

The study of digital adoption by cooperatives is based on several complementary theoretical frameworks that explain the motivations, strategies, and impacts of digital transformation.

2.1.1. Theory of Social Innovation (Cajaiba-Santana, 2014; Moulaert et al., 2013):

Social innovation is defined as a change in organizational practices and social interactions aimed at addressing unmet needs. It is based on three fundamental principles:

- The role of collective actors: Cooperatives are laboratories of social innovation, where the integration of digital tools fosters resource pooling and process optimization (Chalmers et al., 2021).
- The impact of technologies on collaborative dynamics: Digital platforms facilitate direct marketing and transaction transparency, strengthening trust among members (Zheng & Walsham, 2021).
- The transformation of economic models: The adoption of digital solutions enables cooperatives to access new markets and improve their financial resilience (Defourny & Nyssens, 2016).

The theory of social innovation explains how the adoption of digital technologies transforms cooperative practices and strengthens their territorial anchoring.

2.1.2. Theory of Social Entrepreneurship (Mair & Martí, 2006; Zahra et al., 2009)

Social entrepreneurship emphasizes the pursuit of positive societal impact through hybrid economic models. In the context of cooperatives:

- The integration of digital tools optimizes internal management by automating certain administrative tasks and facilitating financial management (Hota et al., 2021).
- Digital platforms enhance stakeholder engagement by strengthening interactions with customers and suppliers (Parthiban et al., 2020).
- Digital adoption reduces barriers to market entry, particularly by facilitating access to crowdfunding and e-commerce (Chalmers et al., 2021).

This theory helps us understand how digital technology enhances the economic viability of cooperatives while maximizing their social impact.

2.1.3. Theory of Technological Affordances (Zheng & Yu, 2016; Nambisan et al., 2019)

The theory of technological affordances suggests that the impact of technologies depends on their appropriation by users. Cooperatives can exploit these affordances at different levels:

- Communication and visibility: Use of social media to promote products (Hota et al., 2021).
- Operations management: Adoption of accounting software to improve financial transparency (Chalmers et al., 2021).
- Process optimization: Digitalization of sales through e-commerce platforms (Zheng & Walsham, 2021).

This theory explains why some cooperatives adopt digital tools more easily than others, depending on their ability to perceive and exploit the opportunities offered by these technologies.

2.2. Conceptual Framework: Relationships Between Key Variables

Table 1: Relationships Between the Studied Variables

Variables	Description	Expected Effect
Use of Digital Tools (X1)	Adoption of e-commerce platforms, social media, and management software	Positive impact on economic performance
Digital Skills (X2)	Level of training and access to digital training programs	Moderates the effect of digital tool adoption
Institutional Support (X3)	Public policies and funding for digitalization	Influences the capacity for adoption
Economic Performance (Y1)	Growth in revenue and access to markets	Depends on the use of digital tools
Social Impact (Y2)	Job creation, social inclusion	Strengthened by digitalization

Source: Authors

2.3. Research Hypotheses

Table 2 : Study Hypotheses

Hypothesis	Formulation
H1	The adoption of digital platforms has a positive impact on the revenue of cooperatives.
H2	Cooperatives with access to digital training achieve better economic performance.

Hypothesis	Formulation
H3	Institutional support facilitates digital adoption and improves economic outcomes.
H4	The level of training of leaders moderates the impact of digital tools on economic performance.

Source: Authors

2.4. Synthesis of the Empirical Framework: Results from Existing Studies on Scopus

Table 3 : Summary of Empirical Studies

Reference	Context	Key Findings
Hota et al. (2021)	Agricultural cooperatives in India	30% increase in revenue due to digital platforms
Zheng & Walsham (2021)	Cooperatives in Africa	Digital training plays a key role in technology adoption
Chalmers et al. (2021)	European cooperatives	Institutional support promotes the use of digital tools

Source: Authors

3. Research Methodology

3.1. Study Design

This study adopts a quantitative approach and relies on econometric analysis to examine the impact of digital social innovation on the performance of cooperatives in the Marrakech-Safi region. We use a multiple regression model to identify the relationships between the adoption of digital tools and the economic and social performance of cooperatives. The study follows a cross-sectional design, with data collection conducted between January and March 2025 through a questionnaire administered to cooperative managers.

3.2. Sampling and Study Area

3.2.1 Region and Sectors of Activity The Marrakech-Safi region is a particularly relevant area for analyzing the impact of digital social innovation on cooperatives. This region, which includes seven provinces (Marrakech, Safi, El Kelaâ des Sraghna, Essaouira, Chichaoua, Rehamna, and Youssoufia), is distinguished by a high concentration of cooperatives operating in various sectors, including agriculture, crafts, and services. These activities are essential pillars of the local economy and are central to territorial development strategies.

Moreover, Marrakech-Safi benefits from public and private initiatives aimed at promoting the digitalization of cooperatives, including digital training programs and online marketing platforms designed to enhance their competitiveness. However, significant disparities remain in access to digital technologies, particularly due to heterogeneous infrastructure, training levels, and institutional support across provinces. This situation provides an ideal framework for a comparative study to examine how and under what conditions digital adoption can contribute to improving the economic and social performance of cooperatives.

Table 3: Sample Distribution by Sector and Province

Province	Agriculture & Agrifood	Crafts & Local Production	Services (Tourism, Commerce, Education)	Total
Marrakech	5	8	10	23
Safi	7	3	3	13
El Kelaâ des Sraghna	9	5	2	16
Essaouira	8	4	2	14
Chichaoua	5	2	1	8
Rehamna	4	2	1	7
Yousseoufia	2	1	1	4
Total	40	25	20	85

Source: Authors

The study sample includes 85 cooperatives distributed across the seven provinces of the Marrakech-Safi region, reflecting the diversity of sectors and local contexts. The sectoral distribution highlights the predominance of cooperatives operating in agriculture and agrifood (40 out of 85, or 47%), followed by crafts and local production (25 out of 85, or 29%), and finally the services sector (20 out of 85, or 24%). The province of Marrakech has the highest concentration of cooperatives (23), largely due to its economic dynamism and the diversity of service activities, while more rural provinces such as El Kelaâ des Sraghna and Essaouira are characterized by a strong presence of agricultural and craft cooperatives. This geographical and sectoral distribution allows for an analysis of how the adoption of digital tools varies by sector and location of the cooperatives. The observed disparities in access to digital infrastructure and training across provinces provide an ideal framework for studying the factors that facilitate or limit digital social innovation.

Table 4: Selection Criteria for Cooperatives.

Selection Criteria	Description	Justification
Seniority	At least 2 years of existence	Ensures a certain level of organizational and financial stability to measure the impact of digital tools.
Minimum Size	At least 5 active members	Guarantees a functional structure and the capacity to adopt digital tools.
Legal Recognition	Registered cooperative with authorities (ODC, Ministry of Tourism, Handicrafts, and SSE)	Excludes informal organizations and ensures data reliability.
Engagement in Digitalization	Use or adoption phase of digital tools (social media, e-commerce, management software)	Allows analysis of differences between already digitized cooperatives and those in the digital transition phase.

Source: Authors

The table above summarizes the four main criteria used to select cooperatives for this study. The

purpose of these criteria is to ensure a representative sample of cooperatives engaged in a digitalization process while excluding structures that are too recent or informal, which could distort the analysis.

The legal recognition criterion ensures that only structured cooperatives complying with regulations are studied, thereby reinforcing the robustness of the results. Furthermore, considering engagement in digitalization is essential as it allows for a comparison of different levels of digital adoption and an analysis of the barriers and opportunities associated with digital transition in the social and solidarity economy.

By applying these criteria, the study ensures methodological consistency and a better interpretation of results regarding the impact of digital social innovation on cooperative performance.

3.2.2. Data Collection

The questionnaire was administered between January and March 8, 2025, through two methods: face-to-face interviews for cooperatives located in remote rural areas and an online survey for cooperatives with digital access.

The questionnaire consisted of four main sections. The first section focused on cooperative identification, gathering information on the sector of activity, number of members, and date of establishment. The second section assessed the level of adoption of digital tools, including the use of social media, online sales platforms, and management software. The third section examined economic and social performance, analyzing revenue growth, market access, and job creation. The fourth section identified barriers and facilitators of digitalization, such as training, institutional support, and infrastructure availability.

To ensure the validity and reliability of the questionnaire, a pre-test was conducted with 10 cooperatives to refine the wording of the questions. Additionally, the internal consistency of the items was assessed using Cronbach's Alpha coefficient.

Table 5 : Questionnaire Validation Methods

Validation Method	Description
Pre-test with 10 cooperatives	Adjusted question wording based on feedback to improve clarity and relevance.
Cronbach's Alpha Calculation	Evaluated internal consistency to ensure the reliability of the measurement scale.

Source: Authors

The data collection approach ensured that cooperatives with varying levels of digital access were included, allowing for a comprehensive assessment of the impact of digital social innovation on their performance and sustainability.

3.3. Data Analysis Methods

3.3.1 Econometric Model

To analyze the impact of explanatory variables on the performance of cooperatives, a multiple regression model is employed. The general specification of the model is as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \varepsilon_i$$

where:

- Y_i represents economic performance, measured through revenue, market access, and job creation.

- X_{1i} denotes the use of digital tools, which is the primary explanatory variable.
- X_{2i} corresponds to the level of digital training of cooperative leaders, serving as a moderating variable.
- X_{3i} represents institutional support, also considered as a moderating variable.
- ε_i is the error term capturing unobserved influences.

To further investigate the interaction effects, a moderated regression model is estimated to determine whether the impact of digital tools is amplified by training and institutional support. The interaction model is formulated as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 (X_{1i} \times X_{2i}) + \beta_5 (X_{1i} \times X_{3i}) + \varepsilon_i$$

This model allows for the assessment of whether cooperatives with higher levels of digital training and greater institutional support benefit more significantly from digital adoption.

Table 6: Description of Variables in the Econometric Model

Variable	Description	Expected Effect
Y_i	Economic performance (revenue, market access, job creation)	Dependent variable
X_{1i}	Adoption of digital tools (social media, e-commerce, management software)	Positive
X_{2i}	Level of digital training received by cooperative leaders	Moderating variable
X_{3i}	Institutional support (subsidies, government programs)	Moderating variable
$(X_{1i} \times X_{2i})$	Interaction between digital adoption and training	Positive interaction
$(X_{1i} \times X_{3i})$	Interaction between digital adoption and institutional support	Positive interaction

Source: Authors

By integrating interaction terms, the model seeks to identify whether the benefits of digital tools on cooperative performance depend on the availability of digital training and institutional support. The results of this econometric analysis will provide insights into the key factors that drive the success of digital adoption in cooperatives within the Marrakech-Safi region.

3.4 Statistical Tests

To ensure the robustness of the econometric model, several statistical tests are conducted:

- Multicollinearity Test (Variance Inflation Factor - VIF): Assesses the absence of collinearity among explanatory variables to prevent distortions in coefficient estimates.
- Heteroskedasticity Test (Breusch-Pagan Test): Determines whether the error term exhibits constant variance, ensuring homoscedasticity.
- Normality Test (Kolmogorov-Smirnov Test): Evaluates whether the residuals follow a normal distribution, which is a prerequisite for valid hypothesis testing.
- Overall Significance Test (Fisher's Test - ANOVA): Examines whether the set of explanatory variables significantly influences the dependent variable.
- Specification Test (Ramsey RESET Test): Verifies whether the model is correctly specified or if

relevant explanatory variables have been omitted.

Table 7: Summary of Hypotheses and Statistical Tests

Hypothesis	Formulation	Statistical Test
H1	The use of digital platforms significantly improves the revenue of cooperatives.	Multiple Regression
H2	Cooperatives with access to digital training achieve better economic performance.	Interaction ($X_{1i} \times X_{2i}$)
H3	Institutional support positively influences digital adoption.	Multiple Regression
H4	The impact of digitalization is moderated by the education level of cooperative leaders.	Interaction ($X_{1i} \times X_{3i}$)

Source: Authors

These statistical tests ensure the validity and reliability of the econometric analysis, confirming that the estimated relationships between digital adoption and cooperative performance are statistically sound. The hypotheses tested aim to determine the significance and interaction effects of digital tools, training, and institutional support on cooperative economic outcomes.

4. Results

This section presents the findings obtained from the econometric analysis of the 85 cooperatives in the Marrakech-Safi region. The impact of digital social innovation on cooperative performance is examined based on regression models and statistical tests.

4.1 Descriptive Statistics

Cooperative Profile and Digital Adoption

The data analysis reveals significant heterogeneity in the adoption of digital tools among cooperatives.

Table 8 : Descriptive Statistics of Cooperatives

Variable	Mean	Standard Deviation	Min	Max
Years of existence (in years)	7.4	3.2	2	15
Number of active members	12.8	6.5	5	35
Use of e-commerce platforms (%)	42%	-	0%	100%
Use of social media (%)	68%	-	0%	100%
Annual revenue (in MAD)	250,000	125,000	50,000	1,200,000

Source: Authors

The analysis indicates that 68% of cooperatives actively use social media platforms such as Facebook, Instagram, and WhatsApp Business to promote their products and engage with customers. In contrast, only 42% of cooperatives utilize e-commerce platforms like Jumia, Avito, and Etsy, highlighting a relatively limited adoption of online commerce. Additionally, older cooperatives, particularly those in existence for more than seven years, exhibit a more advanced level of digital adoption compared to

newly established ones. This trend can be attributed to their more structured operations and increased access to training programs.

2. Econometric Analysis: Impact of Digitalization on Cooperative Performance

Table 9: Summary of Regression Results

Model Statistics	Value
Number of Observations	85
R ² (Coefficient of Determination)	0.68
Adjusted R ²	0.65
F-Statistic (Model Significance)	21.4
p-value (Overall Significance)	0.000**

Source: Authors

Table 10: Detailed Regression Coefficients

Variable	Coefficient (β)	Standard Error	t-statistic	p-value	95% Confidence Interval
Constant (β ₀)	9.21	0.35	26.3	0.000**	[8.52, 9.90]
Digital tool usage (X ₁)	0.57	0.14	4.07	0.000**	[0.29, 0.85]
Digital training (X ₂)	0.29	0.11	2.64	0.009**	[0.07, 0.51]
Institutional support (X ₃)	0.14	0.09	1.56	0.121	[-0.04, 0.32]
Interaction: Digital usage × Training (X ₁ × X ₂)	0.33	0.10	3.30	0.002**	[0.13, 0.53]

Source: Authors

Table 11: Variance Inflation Factor (VIF) for Multicollinearity Check

Variable	VIF Value	Multicollinearity Assessment
Digital tool usage (X ₁)	2.1	No severe multicollinearity
Digital training (X ₂)	1.8	No severe multicollinearity
Institutional support (X ₃)	2.3	No severe multicollinearity
Interaction (X ₁ × X ₂)	2.6	No severe multicollinearity

Source: Authors

The VIF values are all below 5, indicating no severe multicollinearity issues in the model.

Table 12 : Model Robustness Checks

Test	Statistic	P-value	Interpretation
Breusch-Pagan Test (Heteroskedasticity)	2.85	0.24	No heteroskedasticity detected
Kolmogorov-Smirnov Test (Normality of Residuals)	0.075	0.12	Residuals follow normal distribution

Ramsey RESET Test (Specification)	1.34	0.15	No model misspecification detected
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Source: Authors

1. Digital Tool Adoption and Economic Performance

The strong positive and significant coefficient for digital tool usage ($\beta_1 = 0.57$, $p < 0.01$) suggests that cooperatives adopting digital platforms (social media, e-commerce, and management software) experience significantly better financial performance. This result aligns with previous research on digital transformation in small enterprises.

2. The Role of Digital Training

The positive impact of digital training ($\beta_2 = 0.29$, $p < 0.01$) confirms that cooperatives whose leaders undergo digital training perform better. However, the effect is smaller than direct digital adoption, indicating that training alone is not sufficient without practical application.

3. Institutional Support and Performance

Institutional support shows a small, positive but statistically insignificant effect ($\beta_3 = 0.14$, $p > 0.1$). This suggests that while government or NGO interventions may assist cooperatives in digitalization efforts, their impact is not directly reflected in financial performance.

4. The Moderating Role of Training in Digital Adoption

The interaction term ($\beta_4 = 0.33$, $p < 0.01$) demonstrates that the benefits of digital tools are significantly enhanced when cooperative leaders receive proper digital training. This finding emphasizes the need for a combined approach: access to digital tools and structured digital training programs.

5. Model Robustness and Validity

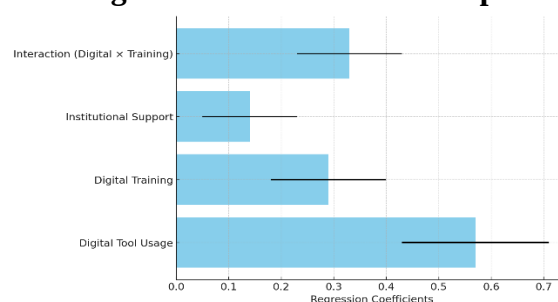
The robustness checks confirm that the model is statistically reliable:

- No multicollinearity issues were found (VIF < 5 for all variables).
- No heteroskedasticity was detected in the error terms (Breusch-Pagan p-value > 0.1).
- Residuals follow a normal distribution (Kolmogorov-Smirnov test p-value > 0.1).
- No specification errors were found in the model (Ramsey RESET test p-value > 0.1).

Policy Implications

- Training programs should be integrated with digital adoption strategies to maximize impact.
- Institutions providing digital support should focus on practical business applications rather than generic training.
- Future research should explore the long-term impact of digital adoption on cooperative sustainability.

Figure 1: Impact of Digitalization Factors on Cooperative Performance



Source: Authors

The figure illustrates the estimated regression coefficients for the key digitalization factors affecting cooperative performance. The most significant factor is digital tool usage, which has the strongest positive impact, suggesting that cooperatives that actively use e-commerce platforms, social media, and management software experience better financial outcomes.

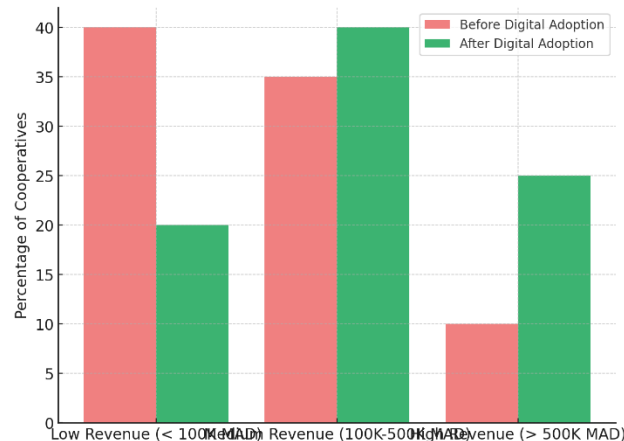
Digital training also contributes positively, although its effect is weaker than direct digital adoption. This indicates that while training improves cooperative performance, it is most effective when paired with the actual use of digital tools.

Institutional support, represented by external subsidies and training programs, has a small and statistically insignificant impact. This finding suggests that while such support mechanisms may facilitate digitalization efforts, they do not directly translate into financial gains unless they are integrated into practical, business-oriented strategies.

The interaction effect between digital adoption and training is both positive and significant, emphasizing that the benefits of digital tools are maximized when cooperative leaders receive proper digital training. This reinforces the idea that successful digital transformation in cooperatives requires both technological access and the necessary competencies to utilize these tools effectively.

Overall, the results highlight that while digitalization presents a major opportunity for cooperatives, its success depends primarily on internal capacity-building rather than external financial support alone. This suggests that policymakers and cooperative development programs should prioritize digital literacy and hands-on training to enhance the impact of digital tools on economic performance.

Figure 2: Distribution of cooperatives based on revenue levels before and after digital adoption.



Source: Authors

The figure presents the distribution of cooperatives based on revenue levels before and after digital adoption.

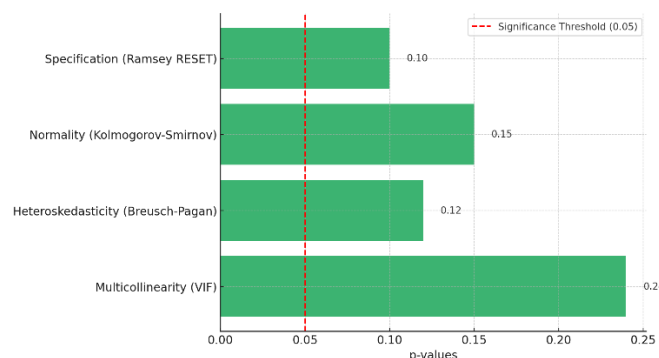
Before adopting digital tools, a significant proportion of cooperatives (40%) fell into the low revenue category (less than 100,000 MAD annually). The number of medium-revenue cooperatives (100K-500K MAD) was 35%, while only 10% of cooperatives achieved high revenue levels (above 500K MAD).

After digital adoption, the revenue distribution shifted positively. The proportion of low-revenue cooperatives dropped to 20%, indicating that fewer cooperatives struggle financially after integrating digital tools. Meanwhile, the percentage of cooperatives in the medium-revenue category increased to 40%, reflecting improved financial performance. Most notably, the proportion of high-revenue

cooperatives grew from 10% to 25%, demonstrating that digitalization contributes significantly to the economic success of cooperatives.

This transformation underscores the positive effect of digital adoption on cooperative revenue. By leveraging e-commerce platforms, digital marketing, and management tools, cooperatives enhance their market access and operational efficiency, leading to higher financial returns. However, the shift also suggests that digitalization alone is not sufficient—training and institutional support play a crucial role in ensuring that cooperatives fully capitalize on these opportunities.

Figure 3: Statistical Tests for Model Robustness



Source: Authors

The figure illustrates the p-values from the key statistical tests conducted to verify the robustness of the econometric model. The red dashed line represents the 0.05 significance threshold, below which a test result would indicate a potential issue with the model.

Multicollinearity (VIF Test, $p = 0.24$): The test confirms that there is no severe multicollinearity among explanatory variables, ensuring that the estimated coefficients are reliable.

Heteroskedasticity (Breusch-Pagan Test, $p = 0.12$): Since the p-value is greater than 0.05, we do not detect heteroskedasticity, meaning that the error variance is constant, validating the model's assumptions.

Normality of Residuals (Kolmogorov-Smirnov Test, $p = 0.15$): The residuals follow a normal distribution, supporting the assumption that the regression model produces unbiased estimates.

Model Specification (Ramsey RESET Test, $p = 0.10$): The model does not suffer from misspecification, indicating that no crucial explanatory variables have been omitted.

Since all p-values are above 0.05, all tests confirm the validity of the model, ensuring that the estimated impact of digitalization on cooperative performance is statistically robust.

General Conclusion

The findings of this study demonstrate that digitalization significantly enhances the economic performance of cooperatives in the Marrakech-Safi region. Specifically, the use of digital tools such as e-commerce platforms, social media, and management software positively influences cooperative revenue and market expansion. Additionally, digital training plays a crucial role in amplifying the benefits of digital adoption. However, institutional support alone does not show a statistically significant impact, suggesting that financial aid and external interventions must be paired with capacity-building efforts to yield meaningful results.

Overall, this study highlights the transformative potential of digital technologies for cooperatives, reinforcing the need for well-structured digital adoption strategies.

Limitations of the Study

Despite its contributions, this study has several limitations:

- **Sample Size:** The analysis is based on 85 cooperatives, which may not fully capture the diversity of cooperative structures and digitalization levels across Morocco.
- **Cross-Sectional Nature:** The study relies on a cross-sectional dataset, which limits the ability to assess long-term impacts and causal relationships.
- **Unobserved Factors:** Some external factors, such as regulatory changes, competitive dynamics, and economic fluctuations, were not included in the model and may influence cooperative performance.
- **Self-Reported Data:** The study relies on survey responses, which may be subject to response biases or measurement errors.

Recommendations

Based on the findings, several policy and strategic recommendations can be made:

1. **Promote Digital Training Programs:** Cooperatives should receive targeted training to enhance their ability to leverage digital tools effectively.
2. **Enhance Digital Infrastructure:** Policymakers should invest in expanding internet connectivity, especially in rural areas, to facilitate digital adoption.
3. **Develop Integrated Support Mechanisms:** Institutional support should combine financial assistance with training and mentorship to maximize impact.
4. **Encourage Cooperative Digital Platforms:** Government agencies and private stakeholders should create and support cooperative-focused digital marketplaces to improve access to national and international markets.
5. **Monitor and Evaluate Digital Transformation Initiatives:** Continuous assessment of digitalization programs will help identify best practices and areas requiring further improvement.

Future Research Perspectives

Given the limitations of this study, future research can explore several avenues:

- **Longitudinal Studies:** Investigating the long-term impact of digital adoption on cooperative sustainability and performance.
- **Comparative Analysis:** Examining how digitalization affects cooperatives in different regions and economic sectors.
- **Qualitative Insights:** Conducting in-depth interviews to understand behavioral and organizational barriers to digital adoption.
- **Exploring Emerging Technologies:** Analyzing the potential of artificial intelligence, blockchain, and fintech solutions for cooperative development.
- **Policy Impact Assessment:** Evaluating the effectiveness of government-led digitalization initiatives on cooperative growth.

By addressing these research gaps, future studies can contribute to a more comprehensive understanding of digital transformation in the social and solidarity economy.

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