

ECONOMIC RESILIENCE: AN ANALYSIS OF THE ADAPTATION OF WOMEN- OWNED BUSINESSES IN THE ALTO PARNAÍBA PIAUIENSE DEVELOPMENT TERRITORY, BRAZIL

**RESILIÊNCIA ECONÔMICA: UMA ANÁLISE DA ADAPTAÇÃO DE NEGÓCIOS
FEMININOS NO TERRITÓRIO DE DESENVOLVIMENTO DO ALTO PARNAÍBA
PIAUIENSE, BRAZIL**

Ciências Sociais Aplicadas • 25/09/2026

REGISTRO DOI: [10.70773/revistatopicos/790301772](https://doi.org/10.70773/revistatopicos/790301772)

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ABSTRACT

Directed productive microcredit serves as a financial inclusion mechanism and supports the continuity of small businesses, particularly among women entrepreneurs in vulnerable contexts. This study aimed to identify socioeconomic factors and factors related to the use of Crediamigo that are associated with different stages of the economic resilience of women-led businesses in the Alto Parnaíba Piauiense Mesoregion during and after the COVID-19 pandemic. A quantitative survey was conducted with 102 women entrepreneurs who benefited from the program. Economic resilience was analyzed as a process comprising three successive stages: anticipation, coping, and adaptation. The results indicate that the perceived importance of Crediamigo was associated with initial business survival, whereas credit use frequency differentiated levels of adaptation among entrepreneurs whose businesses remained active. Perceived financial returns also showed a consistent association with resilience across the models examined. These findings indicate that economic resilience is a dynamic process and that its associated factors vary across stages. The study contributes to the debate on microcredit and economic resilience by providing insights for the design of credit policies that are more responsive to the different levels of vulnerability faced by women entrepreneurs.

Keywords: Microcredit; Economic resilience; Women entrepreneurship; Crediamigo.

RESUMO

O microcrédito produtivo orientado é utilizado como instrumento de inclusão financeira e apoio à continuidade de pequenos negócios, especialmente entre mulheres empreendedoras em contextos de vulnerabilidade. Este estudo teve como objetivo identificar os fatores

socioeconômicos e relacionados ao uso do Crediamigo, associados aos diferentes estágios da resiliência econômica de negócios liderados por mulheres na Mesorregião do Alto Parnaíba Piauiense, durante e após a pandemia de COVID-19. Foi realizada uma pesquisa quantitativa, com 102 mulheres empreendedoras beneficiárias do programa. A resiliência foi analisada em três estágios sucessivos: antecipação, enfrentamento e adaptação. Os resultados indicaram que a percepção de importância do Crediamigo esteve associada à sobrevivência inicial dos negócios, enquanto a frequência de utilização do crédito diferenciou os níveis de adaptação entre as empreendedoras que permaneceram ativas. A percepção de retorno financeiro também apresentou associação consistente com a resiliência nos modelos analisados. Os achados mostram que a resiliência econômica é um processo dinâmico, e que seus fatores associados variam conforme o estágio enfrentado pelas empreendedoras. O estudo contribui para o debate sobre microcrédito e resiliência econômica, oferecendo subsídios para políticas de crédito mais adequadas às diferentes vulnerabilidades.

Palavras-chave: Microcrédito; Resiliência econômica; Empreendedorismo feminino; Crediamigo.

1. INTRODUCTION

Brazil exhibits persistent regional inequalities in income distribution, a pattern that is particularly evident in the Northeast, where poverty rates remain high and the region concentrates approximately half of the country's poor population (Valente Junior *et al.*, 2023). Against this backdrop, oriented productive microcredit has established itself as an instrument of financial inclusion, and it is within this space that Crediamigo, created by Banco do Nordeste in 1998, has consolidated its position as the largest program of its kind in South

America. In 2025, the program disbursed R\$13.42 billion into the regional economy and served approximately 2.2 million active clients, 66% of whom are women (BNB, 2026).

This population of women entrepreneurs was directly affected by the COVID-19 pandemic, whose mobility restrictions, temporary business closures, and demand contraction struck at the core of the businesses they sustain. At the same time, rising unemployment led part of the population to turn to entrepreneurship as an alternative means of income generation (Gomes & Carvalho, 2023), which made access to credit even more essential precisely when it became harder to obtain. This is because women entrepreneurs face greater difficulties in accessing credit due to a scarcity of collateral and financial institutions' perception of higher risk, which constrains the creation, expansion, and sustainability of their ventures (Oliveira, 2025).

In the case of Crediamigo, existing studies have focused on describing its reach and aggregate performance indicators (BNB, 2026; Valente Junior *et al.*, 2023) or on broad dimensions of female empowerment (Cunha Júnior *et al.*, 2022; Mota *et al.*, 2021), without examining which specific characteristics of credit use are associated with businesses' adaptive capacity. In this regard, the international literature tends to treat resilience as a homogeneous factor, overlooking its processual and heterogeneous nature (Rathee & Aggarwal, 2025). Given this context, it remains underexplored, particularly in settings marked by high informality such as the Brazilian Northeast, how factors related to microcredit influence different stages of the economic resilience of women-led businesses.

Against this backdrop, the study seeks to answer the following research question. Which socioeconomic factors and factors related to the use of Crediamigo microcredit are associated with different stages of economic resilience among women-led businesses in the Alto Parnaíba Piauiense Mesoregion, during and after the COVID-19 pandemic? To address this question, the overall objective is to identify the factors associated with the stages of economic resilience of these businesses.

To this end, a quantitative approach was adopted, employing a structured survey administered to 102 women entrepreneurs benefiting from Crediamigo. Theoretically, the study proposes to operationalize the economic resilience of these businesses as a dimension of organizational resilience, conceived as a metacapability developed through successive stages of anticipation, coping, and adaptation (Duchek, 2020). Practically, the findings provide a basis for formulating strategies aligned with actions tailored to the vulnerability stage of each business.

Beyond this introduction, the article is organized as follows. First, the literature review underpinning the study and the research hypotheses are presented. Next, the methodological procedures are described. Subsequently, the results are presented and discussed in light of the literature. Finally, the concluding remarks are set out, highlighting the study's main contributions, limitations, and implications.

2. THEORETICAL FRAMEWORK

The following section presents the literature underpinning the study.

2.1. Female Entrepreneurship, Microcredit, And Structural Constraints

Women have played an increasingly prominent role in entrepreneurship, contributing to economic growth, job creation, and the transformation of social dynamics (Ferreira *et al.*, 2022). According to reports by Sebrae (2024) and GEM (2025), women already represent the majority among individuals with entrepreneurial intent in Brazil, accounting for 54.6% of this group. This advance, however, is marked by persistent structural constraints that affect both the decision to become an entrepreneur and the performance of women-led businesses.

Among these constraints, the burden of unpaid domestic work and barriers to credit access stand out. Data from Sebrae (2024) show that women dedicate, on average, more weekly hours to unpaid work than men, which reduces the time available for business management, while Oliveira (2025) points to high credit rejection rates among women entrepreneurs. Such limitations hinder market entry and continuity, constraining the capacity for investment, innovation, and response to external crises.

This scenario became critical during the COVID-19 pandemic. Women entrepreneurs engaged in activities dependent on in-person service delivery were particularly affected, especially in contexts of low digitalization, which limited their capacity to adapt during periods of restriction (Adebisi & Costanzo, 2023). In this adverse environment, financial inclusion instruments such as microcredit assume a central role by enabling access to productive resources for groups traditionally excluded from the formal financial system.

The trajectory of microcredit, consolidated through the initiatives of Muhammad Yunus in Bangladesh, is grounded in expanding credit access for low-income populations, particularly women (Jesus *et al.*, 2022). In Brazil, this rationale was institutionalized through Law No. 11.110/2005 (Brasil, 2005), which formalized Oriented Productive Microcredit as public policy. Within this context, Crediamigo, implemented by Banco do Nordeste, stands out as one of the largest programs in the world, with an expressive volume of operations and specific initiatives aimed at women, such as Crediamigo Delas (BNB, 2026).

Despite the expansion and relevance of these initiatives, the literature indicates that credit access does not produce homogeneous effects on business performance or women's empowerment. International studies suggest that the impacts of microcredit depend on beneficiaries' capacity to use it productively, converting credit into concrete economic outcomes (Rathee & Aggarwal, 2025). This argument shifts the focus from credit access to the way credit is used, indicating the need to empirically investigate which dimensions of credit use are associated with better business outcomes, particularly in crisis contexts.

2.2. Economic Resilience as a Process And Empirical Evidence On Microcredit

Organizational resilience is understood as a dynamic capability that develops over time. Duchek (2020) proposes a processual approach, structured into three stages, namely anticipation, coping, and adaptation, in which resilience involves both the capacity to react to shocks and the capacity to reconfigure the business model in response to new conditions. This perspective implies recognizing

resilience as a sequential process, in which different factors may operate distinctly at each stage. This conception aligns with statistical approaches based on ordered categories, such as the continuation ratio models developed by Tutz (1990, 1991) and systematized by Fullerton (2009), which allow trajectories to be modeled across successive stages. This convergence between theory and method is particularly suited to analyzing complex phenomena, such as the adaptation of small businesses in crisis contexts.

In the case of female entrepreneurship, studies highlight the role of adaptive strategies, such as digitalization, in sustaining and transforming businesses. A study on European women entrepreneurs showed that practices such as online sales and remote work contributed to the continuity of activities during crisis periods (Gergely *et al.*, 2024). However, access to such strategies is conditioned by financial resources, individual capabilities, and contextual characteristics.

The empirical literature on microcredit and resilience reflects this heterogeneity of outcomes. Part of the literature associates credit access with gains in autonomy, income, and decision-making capacity, reinforcing its role as an instrument of economic empowerment (Kabeer, 2001; Hussain *et al.*, 2019). Conversely, other strands of research suggest that microcredit may, under certain conditions, increase beneficiaries' vulnerability, particularly when associated with indebtedness without productive return (Ganle *et al.*, 2015; Banerjee & Jackson, 2017).

This divergence suggests that the effects of microcredit are not universal, depending on factors such as institutional context, the entrepreneur's profile, and, above all, how the resources are used.

Studies conducted in Brazil corroborate this argument by pointing to the existence of multiple adaptation pathways among small businesses during the pandemic, with different combinations of factors associated with survival and recovery (Feitosa & Mascarini, 2025; Lima *et al.*, 2026). In this sense, it becomes necessary to move toward approaches that capture this heterogeneity, treating resilience as a staged process and investigating how different dimensions of microcredit use influence each stage of this process.

2.3. Research Hypotheses And Conceptual Model

Based on the literature presented, the following hypotheses are formulated.

H1. The perception that microcredit was relevant during the crisis is positively associated with the probability that the entrepreneur kept the business operating, even if only minimally (Kabeer, 2001; Duchek, 2020).

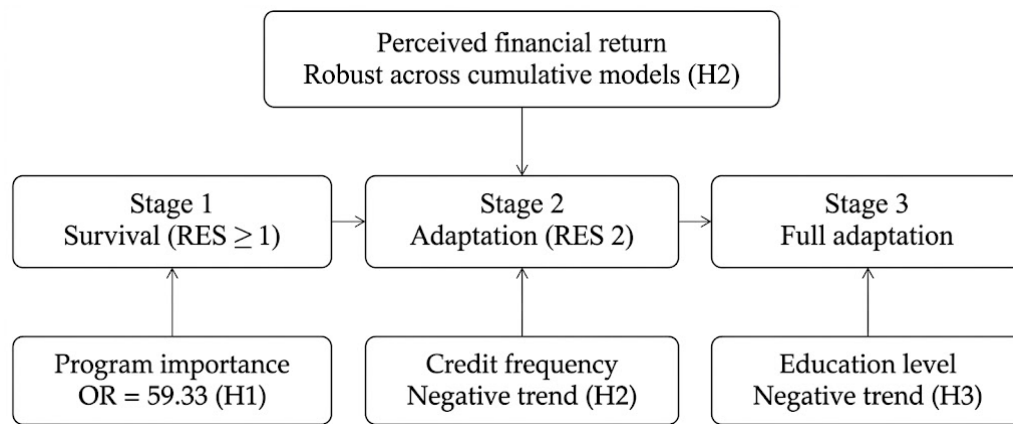
H2. The quality of credit use, measured by the perception of effective financial return, is more strongly associated with business resilience than the mere frequency of credit access (Ganle *et al.*, 2015; Banerjee & Jackson, 2017; Rathee & Aggarwal, 2025).

H3. The determinants of business resilience vary along the adaptation trajectory, differing according to the stage of the process (Duchek, 2020; Fullerton, 2009).

Figure 1 summarizes these hypotheses as a conceptual model, operationalizing business resilience as a sequential three-stage process, following Duchek's (2020) processual approach and

statistically modeled through the continuation-ratio logit (Fullerton, 2009).

Figure 1. Conceptual model of business resilience as a three-stage process



Source: Prepared by the authors (2026).

Figure 1 synthesizes the study's hypotheses. Perceived financial return functions as a transversal predictor, consistently associated with resilience throughout the entire process (H2). The stages of survival, adaptation, and full adaptation, in turn, are driven by distinct predictors at each point, perceived importance of Crediamigo in the first stage, and credit frequency and education in the subsequent stages, evidencing that the determinants of resilience are not constant along the trajectory (H1 and H3).

3. METHODOLOGY

The following section presents the methodological procedures adopted for this research.

3.1. Research Design And Data Collection

This research is characterized as applied, with a quantitative approach and a cross-sectional design, conducted through a survey

with women entrepreneurs benefiting from the Crediamigo program. In addition, a synthesis of the empirical literature on microcredit, female entrepreneurship, and resilience was carried out to contextualize the results. The unit of analysis corresponds to the woman entrepreneur benefiting from Crediamigo.

Primary data were collected in February 2025 through an electronic questionnaire administered to 102 participants residing in eight municipalities of the Alto Parnaíba Development Territory (PI). Uruçuí, Bertolândia, Ribeiro Gonçalves, Benedito Leite, Sebastião Leal, Baixa Grande do Ribeiro, Bom Jesus, and Antônio Almeida. Selection followed non-probabilistic convenience sampling, with the inclusion criterion being the use of Crediamigo microcredit to finance the respondent's own business. Prior to administration of the instrument, all participants accepted the Informed Consent Form (ICF). Secondary data from Banco do Nordeste, Sebrae, and the Global Entrepreneurship Monitor (GEM) were used for contextualization and grounding.

The questionnaire was organized into four blocks. a) socioeconomic profile; b) business characteristics; c) use of Crediamigo; and d) open-ended questions to substantiate the results. The operationalization of the dependent variable and explanatory variables is presented in Table 1.

Table 1. Operationalization of the study variables

Variable type	Variable	Description / operationalization
Response	Business resilience (RES)	Ordinal variable with four categories, ranked from the lowest to the highest degree of resilience.

		0, was unable to keep the business running even with Crediamigo; 1, kept the business running but with a reduction in customer base; 2, kept the business running through adaptation, mainly via virtual and delivery channels; and 3, kept the business running with no significant change, since it was already operating virtually before the pandemic, grounded in the conceptualization of organizational resilience as a process unfolding in successive stages.
Predictor	Education	Ordinal variable ranging from 0 (elementary education) to 3 (graduate education).
Predictor	Business as main source of income	Binary variable (1 = yes; 0 = no).
Predictor	Frequency of credit applications	Ordinal variable ranging from 0 (once) to 3 (more than five times).
Predictor	Perceived financial return on credit	Binary variable (1 = obtained a return; 0 = did not obtain a return).
Predictor	Perceived importance of Crediamigo	Binary variable (1 = considers it important; 0 = made no difference).

Source: Prepared by the authors, based on Duchek (2020).

3.2. Data Analysis Procedures

The analysis began with a synthesis of the literature. This was followed by descriptive analysis of the data. Finally, ordinal logistic

regression models were estimated to identify the factors associated with the different levels of resilience among the women entrepreneurs.

The main analytical strategy was based on the continuation-ratio logit model. This model was chosen because it is appropriate for ordinal variables whose categories represent successive stages of progression, as is the case with the resilience measure adopted in this study (Tutz, 1990, 1991; Fullerton, 2009). Its estimation was carried out through successive binary logistic regressions, a procedure equivalent to estimating the full model by maximum likelihood (Fienberg, 2007; Agresti, 2010).

As a robustness check, the cumulative ordinal logistic regression model was also estimated using both maximum likelihood and a Bayesian approach (McKelvey & Zavoina, 2010; Agresti, 2010). The proportional odds assumption was assessed using the Brant test (1990), while issues of separation and small sample size were addressed through Firth correction (1993) and Bayesian estimation with weakly informative priors (Heinze & Schemper, 2002; Kosmidis, 2014; Bürkner & Vuorre, 2019).

Mann-Whitney and Kruskal-Wallis tests, as well as Multiple Correspondence Analysis (Greenacre & Blasius, 2006), were also employed. The convergence of results across the different techniques was used to reinforce the robustness of the inferences. All analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 27.

4. RESULTS AND DISCUSSION

This section first presents a systematization of the main empirical studies on microcredit, entrepreneurship, and female resilience or empowerment. It then presents the findings of the research, including the descriptive profile of the sample and the quantitative analysis of the primary data.

4.1. Microcredit And Female Empowerment In The Literature: A Qualitative Systematization

Studies were considered eligible if they reported the collection and analysis of primary empirical data, whether qualitative, quantitative, or mixed methods, on microcredit, microfinance, or related oriented productive credit programs; if their population of interest consisted of women entrepreneurs benefiting from credit programs; if they analyzed empowerment, business performance, survival, or resilience of the business; and if they had been published in a peer-reviewed journal or in publicly available institutional technical reports between 2000 and 2026.

Studies of an exclusively theoretical, conceptual, or methodological nature, lacking their own empirical component, were excluded. This category encompasses references related to the statistical techniques employed (Agresti, 2010; Brant, 1990; Duchek, 2020; Fullerton, 2009; Tutz, 1990, 1991), as well as aggregate statistical reports without a defined primary empirical research design. Based on the literature review conducted for this article, 16 studies with an eligible empirical component were identified. After applying the criteria above, two of these were excluded for not detailing the sampling design or method sufficiently to allow data extraction comparable to the other studies, leaving 14 included studies, ordered chronologically (see Table 2).

Table 2. Systematization of selected empirical studies on microcredit, entrepreneurship, and female resilience or empowerment

ID	Study	Context / Sample	Methods	Main findings
1	Kabeer (2001)	Sri Lanka; microcredit beneficiaries	Qualitative case study	Microcredit associated with greater self-confidence, control over household decisions, and reduced reported domestic violence.
2	Chliova <i>et al.</i> (2015)	Multinational; 90 studies, 545 observations	Meta-analysis	Positive effect of microcredit on financial well-being and women's emancipation, conditional on institutional context.
3	Augsburg <i>et al.</i> (2015)	Bosnia and Herzegovina	Randomized controlled experiment	Microcredit expansion increases self-employment, with a more pronounced effect among men than among women.
4	Fofana <i>et al.</i> (2015)	Ivory Coast	Quantitative survey	Microfinance users show higher income

				and assets, but gains are directed mainly toward household assets.
5	Ganle <i>et al.</i> (2015)	Ghana; rural women	Qualitative study	Heterogeneous empowerment; some beneficiaries report little control over credit use and violence associated with default.
6	Banerjee and Jackson (2017)	Rural Bangladesh	Critical qualitative study	Limited impact on social prosperity; credit access increases decision-making autonomy but also vulnerability and indebtedness.
7	Hussain <i>et al.</i> (2019)	Bangladesh; approximately 2,500 households	Longitudinal survey	Microcredit associated with greater self-employment, working hours, and annual household income, with poverty reduction.

8	Mota <i>et al.</i> (2021)	Recife (PE), Brazil; Crediamigo beneficiaries	Descriptive survey	Participation in Crediamigo associated with gains in beneficiaries' economic and household empowerment.
9	Cunha Júnior <i>et al.</i> (2022)	Northeast Brazil; Crediamigo clients	Institutional study (BNB/ETENE)	Program associated with gains in female empowerment among the beneficiaries analyzed.
10	Adebisi and Costanzo (2023)	Developing countries (review)	Narrative review	Effect of microcredit conditional on business digitalization, family support, and complementary training.
11	Gergely <i>et al.</i> (2024)	Seven European countries; 608 women entrepreneurs	Quantitative survey	Digitalization practices contributed to the maintenance and adaptation of women-led businesses during the pandemic.
12	Feitosa and Mascarini (2025)	Brazil; 6,470 SMEs	Generalized ordinal probit regression	Rigidity of mobility restrictions, business age, and manager

				leadership affect business survival.
13	Rathee and Aggarwal (2025)	Haryana, India; 360 women	Logistic and ordinal logistic regression; Wilcoxon test	Positive interconnection between microcredit, entrepreneurship, and empowerment; effect conditional on converting credit into economic outcomes.
14	Lima <i>et al.</i> (2026)	Northeast Brazil; 218 managers	Cluster analysis; ANOVA	Managers' risk tolerance and internal resources, rather than formal planning capacity, associated with resilience.

Source: Prepared by the authors (2025).

The reading of the 14 studies points to three patterns for interpreting the quantitative findings. First, there is consensus that microcredit exerts a positive effect on empowerment, self-confidence, and decision-making autonomy (Kabeer, 2001; Chliova *et al.*, 2015; Mota *et al.*, 2021; Cunha Júnior *et al.*, 2022), an effect that corresponds to the role played by the perceived relevance of Crediamigo in the results obtained here. Second, there is also consensus that the effect of microcredit on objective economic outcomes, such as income,

assets, and business survival, is conditional, depending on the beneficiary's capacity to convert credit into productive outcomes (Fofana *et al.*, 2015; Rathee & Aggarwal, 2025) and on complementary factors such as digitalization and training (Adebisi & Costanzo, 2023; Gergely *et al.*, 2024), a pattern that converges with the finding that credit frequency, in isolation, is not positively associated with full business adaptation.

Third, divergence remains regarding the adverse effects of microcredit. Studies such as Ganle *et al.* (2015) and Banerjee and Jackson (2017) document increased vulnerability and indebtedness among subgroups of beneficiaries, a result that qualifies the negative association between credit frequency and full adaptation found in this study. Overall, none of the 14 studies analyzes business resilience as a process composed of successive and statistically distinct stages.

4.2. Business Resilience Among Crediamigo Beneficiaries: Results From The Sequential Model

The data were estimated based on the responses of 102 Crediamigo beneficiaries residing in eight municipalities of the Alto Parnaíba Development Territory, in Piauí. Of the sample, 60.6% of respondents are over 35 years old, 58.8% are married or live in a stable union, and only 4.9% have, at most, an elementary education level. More than half, 52.0%, report that the business is the main source of household income (see Table 3).

Table 3. Demographic and credit-use profile of respondents (n = 102)

Variable	Category	AF	RF
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Age	Up to 25 years	14	13.7%
	26-35 years	31	30.4%
	36-45 years	27	26.5%
	46-60 years	24	23.5%
	61 years or older	6	5.9%
Marital status	Married/stable union	60	58.8%
	Single	37	36.3%
	Widowed	3	2.9%
	Separated/divorced	2	2.0%
Education	Elementary	5	4.9%
	Secondary	45	44.1%
	Higher education (complete/incomplete)	37	36.3%
	Graduate	15	14.7%
Business is the main source of income	Yes	53	52.0%
	No	49	48.0%
Frequency of credit applications to Crediamigo	Once	13	12.7%
	2 to 3 times	17	16.7%
	4 to 5 times	29	28.5%
	More than 5 times	43	42.2%

Source: Research findings (2025).

In order to analyze how respondents navigated the crisis, business resilience was modeled using a continuation-ratio model, an approach suited to ordinal variables representing sequential stages of a process, in which each category can only be reached after the preceding one has been overcome (Fullerton, 2009; Tutz, 1990, 1991). The model was structured into three successive steps, each comparing a specific pair of outcomes.

The first step, estimated over the full sample ($n = 102$), contrasts keeping the business running to some degree ($RES \geq 1$, $n = 94$) against being unable to keep it running at all ($RES = 0$, $n = 8$). At this step, only perceived importance of Crediamigo proved significant, with an odds ratio of 59.33 (95% CI 2.34-1,506.20; $p = 0.013$). The remaining variables, education, main source of income, credit frequency, and perceived financial return, did not reach the conventional 5% significance level. The explanatory power of this first model also proved substantial, with a McFadden pseudo- R^2 of 0.276 (see Table 4).

Table 4. Step 1. Kept the business running to some degree versus was unable to keep it running ($n = 102$)

Variable	OR	95% CI	p
Education	3.23	0.80 - 13.03	0.099
Business is main source of income	2.16	0.35 - 13.35	0.408
Credit frequency	1.88	0.81 - 4.34	0.141
Perceived financial return	3.14	0.43 - 22.74	0.257
Perceived importance	59.33	2.34 - 1,506.20	0.013*

Note: * $p < 0.05$. McFadden pseudo- $R^2 = 0.276$; likelihood ratio chi-square = 15.47 (df = 5; $p = 0.0085$). **Source:** Research findings (2025).

The second step, restricted to those who kept the business running ($n = 94$), compares adapting the business ($RES \geq 2$, $n = 40$) against keeping it running with a reduced customer base ($RES = 1$, $n = 54$). Perceived importance was removed from this step due to near-complete separation within the subsample. No variable reached significance at the 5% level, although credit frequency came close, with a negative sign (odds ratio = 0.71; $p = 0.097$), suggesting that requesting credit more frequently may be associated with a lower likelihood of full adaptation among those who had already survived the crisis (see Table 5).

Table 5. Step 2. Adapted the business versus kept it running with a reduced customer base ($n = 94$)

Variable	OR	95% CI	p
Education	1.26	0.72 - 2.22	0.419
Business is main source of income	1.45	0.61 - 3.45	0.394
Credit frequency	0.71	0.47 - 1.06	0.097
Perceived financial return	4.39	0.45 - 42.85	0.203

Note: Perceived importance excluded due to near-complete separation. McFadden pseudo- $R^2 = 0.048$; likelihood ratio chi-square = 6.17 (df = 4; $p = 0.187$). Source: Research findings (2025).

The third step, restricted to those who adapted or were already operating virtually (n = 40), contrasts already operating virtually with no change (RES = 3, n = 5) against having adapted specifically during the pandemic (RES = 2, n = 35). Perceived financial return and perceived importance were dropped from the model for the same reason as in the previous step. The overall model is statistically significant ($p = 0.010$), with education and credit frequency very close to the individual significance threshold ($p = 0.066$ and $p = 0.097$), both with a negative sign (see Table 6).

Table 6. Step 3. Already operating virtually, with no change, versus adapted during the pandemic (n = 40)

Variable	OR	95% CI	p
Education	0.011	0.0001 - 1.33	0.066
Business is main source of income	3.75	0.23 - 62.40	0.356
Credit frequency	0.14	0.01 - 1.43	0.097

Note: Perceived financial return and perceived importance excluded due to near-complete separation. McFadden pseudo- $R^2 = 0.376$; likelihood ratio chi-square = 11.32 (df = 3; $p = 0.010$), 5 cases in the highest resilience category. Source: Research findings (2025).

To verify whether this shift in predictors across steps was genuine, the Brant test examined the proportional odds assumption of the cumulative model, a formal procedure proposed to test whether this assumption holds in ordinal logistic regressions (Brant, 1990). The test flagged the two variables that had behaved most inconsistently across steps, credit frequency ($p = 0.045$) and perceived importance

($p = 0.016$), while the assumption remained valid for the remaining variables, including perceived financial return ($p = 0.639$) (see Table 7).

Table 7. Brant test for the proportional odds assumption

Variable	Coef. ($Y \leq 0$)	Coef. ($Y \leq 1$)	Q	p
Education	-1.173	-0.274	1.389	0.239
Business is main source of income	-0.769	-0.347	0.169	0.681
Credit frequency	-0.629	0.322	4.029	0.045*
Perceived financial return	-1.144	-1.859	0.220	0.639
Perceived importance	-4.083	0.750	5.817	0.016*

Note: * $p < 0.05$, indicates violation of the proportional odds assumption. Source: Research findings (2025).

Given this violation, two complementary cumulative models were estimated under distinct inferential approaches, following the treatment of ordinal logistic regression established in Agresti (2010) and Fávero and Belfiore (2017). In the Bayesian model, with weakly informative priors, perceived financial return was the only variable whose 95% credible interval did not cross zero (odds ratio = 4.63; 95% CrI 1.03-22.04) (see Table 8).

Table 8. Bayesian ordinal logistic regression model (weakly informative priors)

Variable	Posterior median	OR (median)	95% credible interval	P($\beta > 0$)
Education	0.287	1.33	0.82 - 2.18	0.871
Business is main source of income	0.457	1.58	0.73 - 3.47	0.881
Credit frequency	-0.219	0.80	0.55 - 1.17	0.129
Perceived financial return	1.533	4.63	1.03 - 22.04	0.977
Perceived importance	0.388	1.47	0.21 - 13.02	0.648

Source: Research findings (2025), based on the study's primary data. Model estimated by MCMC sampling (NUTS algorithm, PyMC), 4 chains, R-hat = 1.00 for all parameters.

The cumulative maximum likelihood model, in the same format used by Rathee and Aggarwal (2025), confirmed this finding. Perceived financial return remains the only significant predictor (coefficient = 1.741; $p = 0.033$), as shown in Table 9.

Table 9. Maximum likelihood ordinal logistic regression model ($n = 102$)

Variable	Coefficient	Standard error	Z	p-value
Education	0.289	0.256	1.130	0.259
Business is main source of income	0.489	0.397	1.231	0.218

Credit frequency	-0.196	0.189	-1.039	0.299
Perceived financial return	1.741	0.816	2.133	0.033*
Perceived importance	0.794	1.214	0.654	0.513

Note: * $p < 0.05$. LR $\chi^2 (5) = 10.774$; Prob $> \chi^2 = 0.05605$; log-likelihood = -101.835; pseudo- $R^2 = 0.050$; mean of the response variable = 1.363; maximum variance inflation factor = 1.16. Source: Research findings (2025).

The Kruskal-Wallis and Mann-Whitney tests complement this analysis with non-parametric comparisons between independent groups, appropriate for variables that do not meet the normality assumptions required by equivalent parametric tests (Fávero & Belfiore, 2017). Education and credit frequency differentiate the resilience groups ($p = 0.045$ and $p = 0.047$), while age makes no difference ($p = 0.343$) (see Table 10).

Table 10. Kruskal-Wallis test results by business resilience group

Variable	H	df	p	ϵ^2
Age	3.333	3	0.343	0.003
Education	8.036	3	0.045*	0.051
Credit frequency	7.951	3	0.047*	0.051

Note: * $p < 0.05$. Source: Research findings (2025).

The Mann-Whitney test, in turn, shows that those who obtained a financial return on the credit used exhibit higher mean resilience

(1.41) than those who did not (0.89), an expressive difference ($U = 591.0$; $p = 0.024$). Perceived importance of Crediamigo, on its own, does not separate the groups ($p = 0.485$) (see Table 11).

Table 11. Mann-Whitney test results for groups defined by perceptions of Crediamigo

Grouping variable	Group (n)	Mean resilience	U	p
Perceived financial return	Obtained a return (n = 93)	1.41	591.0	0.024*
	Did not obtain a return (n = 9)	0.89		
Perceived importance of Crediamigo	Considers it important (n = 98)	1.38	233.0	0.485
	Made no difference (n = 4)	1.00		

Note: * $p < 0.05$. Source: Research findings (2025).

Finally, Multiple Correspondence Analysis, an exploratory technique suited to visually representing associations among multiple categorical variables in a low-dimensional space (Fávero & Belfiore, 2017), was run on eight categorical variables including business resilience, explaining 10.1% and 7.7% of total inertia on the first two axes, 17.8% cumulatively, with the category “did not obtain a financial return” among the most distinctive in the multidimensional space (coordinates 1.92 and 1.05).

These results allowed the three formulated hypotheses to be evaluated. Hypothesis H1, that perceived importance of Crediamigo would be positively associated with keeping the business running, is corroborated by the first step, with an odds ratio of 59.33 and substantial explanatory power. This finding corroborates the studies of Kabeer (2001) and Cunha Júnior *et al.* (2022), which associate microcredit with gains in self-confidence and perceived institutional support, subjective dimensions that appear to function as the determinant of the initial moment of coping with the crisis.

Hypothesis H2, that the quality of credit use would weigh more heavily than mere frequency of access, finds partial support. In the two complementary cumulative models, Bayesian and maximum likelihood, perceived financial return is the only robust predictor, while credit frequency does not come close to significance in either. In the sequential model, however, it is credit frequency that approaches significance at the second step, with a negative sign, indicating that requesting credit more frequently is associated with a lower likelihood of full adaptation among those who had already withstood the crisis.

This negative pattern may indicate reverse causality, whereby weakened businesses resort to credit more frequently because they fail to generate sufficient working capital on their own, a hypothesis consistent with Ganle *et al.* (2015) and Banerjee and Jackson (2017), who argue that repeated credit access may, under certain conditions, signal or even deepen vulnerability rather than resolve it. Alternatively, it may indicate that using credit recurrently merely to sustain current operations, without investing in transforming the business model, such as adopting digital channels, is not sufficient to produce full adaptation, an interpretation consistent with the

literature on digitalization as a mechanism of adaptation for women-led businesses in crisis (Adebisi & Costanzo, 2023; Gergely *et al.*, 2024).

Hypothesis H3, that the determinants of resilience would not remain constant throughout the trajectory, is corroborated. The Brant test identified a violation of the proportional odds assumption in the two variables whose effects fluctuated across steps, credit frequency and perceived importance, and the comparison across the three steps itself shows that no variable remains significant throughout. This heterogeneity aligns directly with the notion of organizational resilience as a metacapability built through successive and qualitatively distinct stages (Duchek, 2020), and helps explain why a sequential model extracts more effective information from the primary data than a single cumulative model (Fullerton, 2009).

It is worth noting that the cumulative model's finding, of financial return as a consistent predictor when the process is viewed in aggregate, does not contradict the sequential model but rather complements it. Because the cumulative model imposes a constant effect across the entire resilience scale, it ends up capturing the predictor whose effect remains stable in magnitude across the three steps, whereas the sequential model suggests that the perceived importance of Crediamigo, with a concentrated and intense effect at the very first step, becomes diluted when forced into a single average with the remaining steps.

From a theoretical standpoint, these results depart from perspectives that associate credit availability directly with the strengthening of female entrepreneurship without considering what mediates this relationship, or the possibility that these

conditions change over the course of the process. The contribution of this study lies in empirically showing that the metaphor of successive stages, proposed by Duchek (2020), can be statistically operationalized through sequential models (Tutz, 1990, 1991; Fullerton, 2009), suggesting distinct candidate mechanisms for each stage of the resilience trajectory, which resonates with evidence on the heterogeneity of factors associated with the survival and adaptation of Brazilian small businesses during the pandemic (Feitosa & Mascarini, 2025; Lima *et al.*, 2026).

In practice, the results indicate that oriented productive microcredit policies work best when differentiated according to the vulnerability stage of the supported business, rather than treated as a one-size-fits-all intervention. For businesses at risk of not surviving, reinforcing the perceived value and institutional support of the program appears to matter more than expanding credit volume. For businesses that survived but are still seeking full adaptation, mechanisms for training in financial management and digitalization appear more promising than simply repeating credit cycles.

5. CONCLUDING REMARKS

This study aimed to identify the socioeconomic factors and factors related to microcredit use, through the Crediamigo program, associated with the stages of economic resilience of women-led businesses in the Alto Parnaíba Piauiense Mesoregion, during and after the COVID-19 pandemic. To this end, a systematization of 14 empirical studies on microcredit, entrepreneurship, and female empowerment or resilience was combined with a quantitative analysis of primary data collected from 102 women entrepreneurs benefiting from the program. Resilience was treated as a sequential

three-stage process, estimated through a continuation-ratio model and complemented by cumulative models for robustness.

The findings suggest that the resilience of women-led businesses in the Alto Parnaíba Piauiense constitutes a dynamic, staged process, in which distinct factors assume relevance at specific points. Perceived importance of Crediamigo proved decisive for business survival, whereas, among those that survived, credit use frequency, rather than perceived program importance, differentiated levels of adaptation. In addition, the cumulative models corroborated the role of perceived financial return on the credit applied. The hypotheses formulated based on the literature review were corroborated to varying degrees, reinforcing the conception of organizational resilience as a metacapability progressively built through successive stages.

Regarding its theoretical contribution, the study demonstrates the feasibility of operationalizing staged organizational resilience through sequential models, offering a replicable methodological path for research on microcredit and entrepreneurship in crisis contexts. From a practical standpoint, the findings suggest that oriented productive microcredit policies tend to be effective when differentiated according to the business's vulnerability stage, rather than applied homogeneously throughout entrepreneurs' trajectories.

Despite these contributions, the study has limitations. The non-probabilistic sample, concentrated in the municipality of Uruçuí-PI (the region's hub municipality), restricts the generalizability of the results. The sequential model faced sample limitations at the third stage, with a low number of observations and cases in the highest

resilience category, in addition to the exclusion of variables due to near-complete separation.

Furthermore, the cross-sectional design limits the analysis of temporal evolution and causal inference between credit use and resilience. Future studies are recommended to adopt longitudinal designs, expand the sample size and geographic coverage, and incorporate control groups to strengthen the capacity to identify causal effects.

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