Do women use microcredit resources better? Evidence for Brazil

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The objective of this study is to verify whether productive microcredit resources are better used by women in terms of employability, using data from a Brazilian microcredit program. We analyze the differential impact both on overall employment generation and on female employment according to the entrepreneur's gender, using dose-response models (with propensity score matching and continuous treatment). In addition, we consider the differential cost of loans for these groups, culminating in a cost-effectiveness analysis. We show that loans for women are a more effective choice compared to loans for men, especially for increasing female employability. The results were significant and corroborate the findings in empirical literature. They were the basis for the creation of a microcredit line targeting women in Brazil.

Keywords: microcredit for women; impact analysis; cost-effectiveness analysis; women entrepreneurship; Latin America; Brazil.

As mulheres usam melhor os recursos do microcrédito? Evidências para o Brasil

O objetivo desse estudo é verificar se recursos de microcrédito produtivo são melhor aproveitados pelas mulheres, em termos de empregabilidade utilizando dados de um programa de microcrédito brasileiro. Analisaremos o diferencial de impacto sobre geração de empregos em geral e empregos femininos conforme o sexo do empreendedor utilizando modelos dose-resposta (com propensity score matching e tratamentos contínuos). Além disso, consideraremos o diferencial de custos de empréstimos para esses públicos, culminando em uma análise de custo-efetividade. Mostramos que empréstimos para mulheres é uma escolha mais efetiva, em comparação a empréstimos para homens, principalmente no que se refere ao aumento da empregabilidade feminina. Os resultados se mostraram significantes, estão alinhados aos achados da literatura empírica e embasaram a criação de uma linha de microcrédito focalizada para mulheres no Brasil.

Palavras-chave: microcrédito para mulheres; análise de impacto; análise custo-efetividade; empreendedorismo feminino; América Latina; Brasil.

¿Las mujeres usan mejor los recursos de microcrédito? Evidencias para Brasil

El objetivo de este estudio es verificar si los recursos productivos del microcrédito son mejor utilizados por las mujeres, en términos de empleabilidad, utilizando datos de un programa de microcrédito brasileño. Analizaremos el impacto diferencial en la generación de empleo en general y empleo femenino según el género del emprendedor utilizando modelos de dosis-respuesta (con propensity matching score y tratamiento continuo). Además, consideraremos el diferencial de costos de los préstamos para estas audiencias, culminando con un análisis de costo-efectividad. Hemos demostrado que los préstamos para mujeres son una opción más eficaz en comparación con los préstamos para hombres, especialmente en lo que respecta al aumento de la empleabilidad femenina. Los resultados resultaron ser significativos, están en línea con los hallazgos de la literatura empírica y apoyaron la creación de una línea de microcrédito enfocada a las mujeres en Brasil.

Keywords: microcrédito para mujeres; análisis de impacto; análisis de costo-efectividad; emprendimiento femenino; América Latina; Brasil.

1 INTRODUCTION

According to the World Bank, 70% of Micro and Small Enterprises (MSEs) owned by women in the formal sector of emerging markets are not served by financial institutions (World Bank, 2015), demonstrating how difficult it is for these entrepreneurs to have access to credit. Brazil is part of the list of countries where this occurs significantly (IFC, 2007). According to the Global Entrepreneurship Monitor, Brazil is also the country with the second highest rate of female entrepreneurship, only behind Indonesia. There are more women entrepreneurs than men, at the rate of 1.04 (GEM, 2017).

Studies on the labor market point out several pieces of evidence on existing discrimination, namely: the existence of unequal pay for similar positions;[1] the limited presence of women in executive management positions and barriers in professional advancement (known as the glass-ceiling);[2] the greater concentration of women in precarious, low-skilled jobs of short duration without social protection, normally in economic activities related to family or personal consumption;[3] and the responsibility for domestic work, which doubles their working hours and makes them less available for paid work.[4] All these factors render a strong demand for inclusion and justice, including by international organizations such as the International Labor Organization (ILO, 2008).

In view of this, microcredit targeting women is a topic of great international appeal. Several organizations (Women's World Banking (WWB), Microcreditsummit, USAID, and the World Bank) utilize it as an efficient way to expand opportunities to women.

The national empirical literature on microcredit is quite extensive, with different approaches. Some studies focus on the role of microcredit in reducing poverty (such as ARAÚJO, 2012; COSTA, 2006; DA MOTA and DE SANTANA, 2011; NERI and CORTES, 2008; RAPIS, 2008); others in the generation of employment, income, and local development (CORSINI, 2007; COSTA, 2001; COSTANZI, 2002; LEITE and MONTORO, 2008; NETO, MONZONI, and PRESTES, 2006; OLIVEIRA, 2007; PEREIRA, 2003); some in financial inclusion (BACEN, 2010, 2015b; CONCEIÇÃO, 2005; FELTRIM, VENTURA and DODL, 2009; VENTURA and DODL, 2009; ZOUAIN and BARONE, 2007); others

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1 Cambota and Pontes (2007); Giuberti and Menezes-Filho (2005); Madalozzo (2010; 2011); Madalozzo et al. (2010).
2 Bruschini and Puppin (2004); Bussmann (2017); Collins and Singh (2006); Morrison and Glinow (1990); Steil (1997).
3 Cambota and Pontes (2007); Carloto (2002); Lavinas (2001).
4 Bruschini, (2007).

assess the financial sustainability of the programs (DALTRO and DE SANTANA (2013); JUNQUEIRA and ABRAMOVAY (2005); NICHTER, GOLDMARK, and FIORI (2002); SOARES and MELO SOBRINHO (2008); VON ENDE and LEOPOLDINO, 2004), among others.

Although it is a topic widely analyzed by empirical literature, studies on the impact of microcredit programs are not consensual about the differential efficiency in relation to gender,[5] with a scarcity of studies that compare impacts with costs, as proposed here.

Therefore, the objective of this study is to verify whether microcredit resources used by women entrepreneurs render better results in terms of employability, as well as differences in cost. For this purpose, data comprehending 2010 – 2015 from the program "Banco do Empreendedor Microcredito", a Brazilian microcredit line implemented in the State of Paraná, will be used. The impacts on overall employment levels and female employment will be assessed according to the borrower's gender. In addition to verifying the impact differential, this study aims to measure the differential cost by exploring the difference in defaults between groups, in order to show whether loans for women or for men are more cost-effective. We found that there are no cost differences and that loans to women result in better female employability outcomes, so, yes, women use microcredit resources better than men.

We intend to contribute to the empirical literature on microcredit for women and support the creation of public policies. Indeed, the results of this study supported the creation of a regional microcredit policy targeting women in the State of Paraná, the "Banco da Mulher Paranaense Microcrédito", which provides more attractive interest rates for this public (Fomento Paraná, 2019).

To meet the objectives, we initially present the context of the program, the data, and the empirical strategy adopted; discuss the results; and finally outline the conclusions.

2 Context of the program

Brazil is a country with profound social and regional inequalities, where gender still affects opportunities. In the country, 40.51% of the families residing in private households

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5 Regarding the relationship between the results of microcredit for women, the studies can be mentioned: AGIER and SZAFARZ (2013); WORLD BANK (2017); BANERJEE et al. (2015); BARDASI; SABARWAL; TERRELL (2011); BECKER (2010); CHOWDHURY; AMIN; FARHA (2012); COLEMAN, (2000); DE MEL; MCKENZIE; WOODRUFF (2009); MALAPIT (2012); NWOSU et al. (2015); SECK et al. (2015); STUPNYTSKA et al. (2014).

are headed by women and, of these, 41% own businesses (IBGE, 2015)[6], highlighting the importance of female businesses in maintaining the national economy.

The growth of female-owned companies may be one of the main factors in reducing the high unemployment rates in Brazil since unemployment rates for women are historically higher than those for men (despite women being the majority of the population). Some international studies found that women are more likely to hire other women (World Bank, 2015; OECD, 2004), suggesting that opportunities for female entrepreneurs can generate an even greater impact on employability, especially among women. Therefore, facilitating access to credit for women is a possible means of fostering the country's economic and social development.

Brazilian microcredit programs are designed differently according to the regional profile; thus, it is important to contextualize the reader about the program analyzed here.

Although adopted by several countries around the world, microcredit programs are designed in different ways depending on context and objectives. For example, some programs focus on providing small loans to rural people, as in the case of the Grameen Bank; others focus on urban microenterprises, such as BancoSol in Bolivia; others have conditionalities for lower interest rates, such as training courses (Banco do Empreendedor Microcrédito); some make loans to groups (such as the Grameen Bank and Crediamigo in Brazil), only to women (for example, Banco Compartamos in Mexico), or to any business, formal or informal, that fits annual profitability as a condition of participation (Programa Nacional de Microcrédito Produtivo e Orientado e o Banco do Empreendedor Microcrédito). Regarding the objectives, some programs focus on poverty reduction, others on the increase of micro-entrepreneurship and the generation of employment and income. What they have in common is the search for promoting local development and correcting market failures by allowing access to credit.

An important distinction concerns the focus between natural persons (including informal companies) and legal entities (formal establishments). On the national average, 94.8% of the portfolio corresponds to "natural person borrowers," and 5.2% to "legal entity borrowers." The regions that deviate from the national standard the most are the Northeast (with a high poverty rate) and the South (one of the regions with the lowest poverty rates). In the Northeast, almost the entire portfolio is destined to natural persons (99.5%), and

6 The information about households headed by women is available at sidra.ibge.gov.br (Table 1942) and we used the microdata with complex sample weights to obtain the information about how many of these women have their own business.

in the South, the weight of the legal entities is much greater (about 20%). In addition, the distribution of the value of the national microcredit portfolio by region shows that the Northeast concentrates almost 55% of the portfolio attributed to natural persons, and the South region attributes almost 70% of the portfolio to legal entities (BACEN, 2015a, p. 9).

According to these data, Paraná, one of the states in the South region, represented 20.3% of the region's portfolio value in 2013 (accounting for approximately R$ 184 million, the equivalent of nearly 85 million American dollars)[7], and approximately 27% of total customers and operations of the region (or 5% of the number of national customers, representing more than 92 thousand customers in the state and 113 thousand financing operations).

Regarding grantors, Brazilian microcredit is highly concentrated in banks (91.4% of the portfolio's value), followed by the representation of credit unions (6.1%), development agencies (2%), and micro-entrepreneur credit societies (0.4%). However, when analyzing only credits directed to legal entities in the country, the value of the bank portfolio falls to 45.6% of the total value of the portfolio destined for legal entities, followed by the development agencies (29.9%), Credit Cooperatives (24.2%), and micro-entrepreneur credit societies (0.2%). Given this focus on serving legal entities, development agencies totaled a portfolio of more than R$ 82 million, with 4,127 operations in 2013 (BACEN, 2015a, p. 25). Only the Paraná development agency (Fomento Paraná) had a microcredit portfolio of R$ 32.2 million in 2013, with 5,048 active contracts, representing about 40% of the national microcredit portfolio of the nine development agencies considered in the aforementioned study (Bacen, 2015a; Fomento Paraná, 2013).

From this, the representativeness of the credit line evaluated is contextualized, called "Banco do Empreendedor Microcredito", operated by the development agency of the state of Paraná.[8] Fomento Paraná is a financial institution whose major shareholder is the State Government; therefore, it is an important agent for public financial inclusion policies.

The program has existed since 2001 and serves micro-enterprises, formal or informal, releasing resources of up to R$ 15,000.00 (the equivalent of nearly US$ 4.502)[9]. Since 2010, its focus has been on productive microcredit, serving mostly micro-enterprises

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7 Using the average exchange rate for 2013, when one U.S. dollar was equivalent to 2.16 Brazilian reals.
8 This credit is only available through this financial institution located in Curitiba, but there are many "credit agents" acting as facilitators in almost every municipality.
9 Using the average exchange rate for 2015: when one U.S. dollar was equivalent to 3.33 Brazilian reals.

of legal-entity nature. **Table 1** shows the number of contracts served by the program evaluated between 2010 – 2015, for formal and informal enterprises, distinguishing the owner's gender.

Table 1 – Number of contracts of the banco do empreendedor microcredito[10] between 2010 and 2015 by gender and legal nature

Sex	Natural Person	Legal Entity	Total
Women	2,829	5,281	8,110
Men	2,415	5,444	7,859
Not informed	1	22	23
Total	5,245	10,747	15,992

Source: elaborated by the authors.

It is important to note the representation of legal entities (67%), and that women represent 49% of these contracts. These 10,747 corporate contracts constitute the treated sample used since employability data are only available to formal establishments.

To be eligible for the program, the applicant must be Brazilian or reside in the country for more than one year, be over 18 years old, be the owner of a formal or informal micro or small company located in Paraná, which preferably has generating capacity employment and income, develop activities that do not harm the environment, have difficulty with other conventional forms of credit, have a negative debt certificate, and have gross annual revenue of up to R$ 360 thousand. They can use the credit as working capital or as fixed investment. There is an audit using samples to verify the application of the resource.

3 MATERIAL AND METHODS

This section aims to present the database used for research, as well as the empirical strategies adopted. To do so, the presentation is divided into these two subsections, respectively.

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10 The information in this table only refers to "Banco do Empreendedor Microcrédito," the Paraná program of microcredit.

3.1 Material

Databases from two confidential sources were used: the financial institution that manages the program and the Ministry of Labor. Three types of data were used: information on microcredit contracts (including the gender of the owner), default information on these contracts, and the Ministry of Labor's identified database, called Rais (Annual Social Information Report) with employability information by Taxpayers ID (CPF) or National Register of Legal Entities (CNPJ). Crossing this information resulted in an exclusive database, containing detailed information on microcredit and employment contracts at the corporate level. The database was filtered to formal companies with more than 9 employees per year to have the control observations more consistent with that of the treated sample (micro companies), and the information at a firm level for the consolidated period (2010 to 2015) was used.

3.2 Methods

This section provides a brief description of the methodological decisions and is divided into two parts: an empirical strategy for measuring impact and differential cost.

3.2.1 Impact Analysis

In order to analyze the differential impact of the use of microcredit by women on general employment and female employment, it is necessary to verify whether higher doses correspond to greater impacts. The dose-response model was used for this purpose (BIA; MATTEI, 2008; GUARDABASCIO; VENTURA, 2014; HIRANO; IMBENS, 2004; IMBENS, 2000; LECHNER, 2001).

In this model, the level of treatment, in addition to having a dose of continuous treatment (amount borrowed), is not randomly distributed; thus, it is necessary to address selection bias: better companies are able to loan higher values. To control this issue, a series of observable variables (X_i) was used to estimate the model by means of matching: the Generalized Propensity Score (GPS) method was used to compare similar companies, allowing access to the causal impact of the program under the unconfoundedness assumption, that is, that the relevant variables for the selection bias are being considered (Hirano and Imbens, 2004). Among the available variables, those that could influence the performance of companies were used, and the following was used to perform the

matching (vector "X") and build the GPS:

- *Company characteristics*: revenue; formal age of the company; inclusion Simples Nacional (type of simplified taxation system available for Brazilian micro-companies); economic activity (through the division of the National Classification of Economic Activities); amounts obtained by other financing lines of Fomento Paraná; category of wages paid by the company; owner's age; interest rate; and size of the establishment.

- *Characteristics of the workers*: working time at that establishment in months; proportion of workers with basic education; proportion with high school; proportion with higher education; proportion of workers according to occupation category.

The model initially pairs companies using a generalized propensity score (GPS), then generates a simple linear regression between the value granted (*ln*) and the value of the variable of interest (*ln*), controlled by GPS.

Our interest lies in the Average Treatment Effect on the Treated (ATT), that is, the average impact of the treated companies. The ATT for the case of a categorical treatment variable for two treatment doses "t" and "s" would be given by:

$$\theta_0^{t,s} = E(Y_i^t - Y_i^s | T=t) = E(Y_i^t | T=t) - E(Y_i^s | T=t)$$

Where Y_i is the set of potential results and T is the treatment level. Since we have a model with multiple doses, we used the dose-response function by the mean, applied in Guardabascio and Ventura (2014):

$$\psi(t) = E\{Y_i(t)\},$$

Where $\psi(t)$ is the dose-response function by the mean and $Y_i(t)$ is the set of potential results within the universe of treated companies *(t∈T)*.

To estimate the potential results, we used the generalized propensity score model (GPS), obtained from a generalized linear model (GLM), in which the conditional treatment density is defined as:

$$r(t,x) = f(T|X_i(t|x))$$

Where GPS is $R = r(T|X)$ and X_i is the covariate vector.

Given the balance property and, according to the unconfoundedness assumption, Hirano and Imbens (2004) show that GPS can be used to eliminate any bias associated

with differences in covariates.

In this way, the average results can be estimated by conditioning only to the GPS. Finally, the dose-response function can be represented as:

$$\gamma(t,r)= E\{Y\,(t)|r(t,X)= r\}= E(Y\,|T = t,R = r)$$

$$\psi(t)= E[\gamma\{t,r(t,X)\}]$$

The estimation steps are: initially calculate the propensity score (r(t,x)) using the generalized linear model (GLM); then, conditional hope is modeled as a function of the treatment level and the GPS $(E(Y\,|T = t,R = r))$, or, in other words, Y=T+GPS; finally, the dose-response function $(\psi(t))$ is estimated by means of the average conditional expectation $(\hat{\gamma}\{t,r(t,X)\})$ along with the GPS for each treatment dose. For the standard errors, bootstraps were used.

This function is represented by a graph that shows the causal relationship of the variables according to the model. The results indicate the average effect of the value released between the treated companies for each group (men and women), considering the consolidated period between 2010 and 2015 (companies benefited more than once in this period had the values of their contracts added together). All this information allowed us to obtain conclusions to be drawn on the effectiveness of credit to women based on the chosen variables.

3.2.2 Cost-Effectiveness Analysis

Besides the differential effectiveness, it is necessary to verify if there is a differential cost between the listed groups. Therefore, the possible differential effects in collaboration with the program managers were mapped and it was found that the main influencing effect was the difference in default. In the theoretical framework, it was verified that women tend to be more compliant (D'ESPALLIER et al., 2011; KEVANE and WYDICK, 2001). It will be verified if this information has empirical support in the sample used.

Because studies on microcredit defaults in Brazil are sparse, this study aimed to contribute to this literature by executing the models as follows: the variables that impact default for a general sample of micro-companies (with up to 9 employees) were verified, as well as for the sample in focus: micro-employers. That is, in addition to the previous cut, in the second sample, only companies that had some employment in the period were

kept (this cut was used for the impact models since the variables of interest were linked to Rais, that is, to formal employment itself).

The impact on default was carried out using two models: initially. probit[11] was used to verify the impact of a series of variables on the probability of bad debt; next, with access to the defaulted amount per contract and interested in the monetary measurement of the differential cost, a tobit[12] model with the same controls was used, allowing the use of a censored distribution at zero, since most companies are not in default.

For both models, the following independent variables were used: year; owner's gender; type of activity (predominantly female or not); municipality; type of loan (working, fixed, and mixed); Contract value; company billing value; contract deadline; and interest rate. All monetary variables used in the study were considered in real values for 2015, being deflated by official prices indices.[13] Defaults were considered as defined by the Central Bank: more than 90 days overdue (BACEN, 2005).

In addition to the financial cost, there could be a higher operational cost since, in many countries, loans for women require greater assistance, monitoring of contracts, and training courses, given that in many countries women's schooling is much lower than that of men (D'ESPALLIER; GUÉRIN; MERSLAND, 2011). This does not apply to Brazil's case. Concerning the evaluated program, no differences were found.

Finally, with estimates of differential efficiency and differential cost (LEVIN et al, 2018), the cost-effectiveness analysis can be carried out, analyzing the alternatives separately and comparing them to try to answer whether it is worth increasing microcredit targeting women. For this purpose, the Incremental Cost-Effectiveness Ratio (ICER), given by the equation below, was used:

$$ICER = \frac{\Delta C}{\Delta E} = \frac{(costs\ of\ project\ 1\text{-}costs\ of\ project\ 2)/}{(effectiveness\ of\ project\ 1\text{-}effectiveness\ of\ project\ 2)}$$

Where project 1 is the loan for women, and project 2 for men.

3.3 Descriptive statistics

Before presenting the results of the models, it is advisable to deal with some

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11 To verify the formalization of the *probit* model, see CAMERON and TRIVEDI (2009, chap. 14).
12 For the formalization of the *tobit* model, see CAMERON and TRIVEDI (2009, cap. 16) e WOOLDRIDGE (2015, seç. 17.2).
13 The price index called "IPCA" was used (with the exception of wages, which were deflated by "INPC").

descriptive statistics of the "Banco do Empreendedor Microcrédito", according to the cutouts adopted. The total values obtained by formal companies during the analyzed period are shown in **Table 2**, differentiating the statistics by the owner's gender. The number of contracts for each one is also highlighted, making it possible to observe their average value.

TABLE 2 – VALUE OF THE CREDIT PORTFOLIO, NUMBER OF CONTRACTS AND MEAN VALUE OF CONTRACTS BY GENDER AND YEAR, 2010-2015

By Gender	Total Value		Number		Mean Value of Contract	
	Women	Men	Women	Men	Women	Men
2010	4,001,324.68	5,242,601.19	368	451	10,873.16	11,624.39
2011	5,663,232.53	6,122,649.53	509	526	11,126.19	11,640.02
2012	10,058,175.88	11,423,130.52	781	818	12,878.59	13,964.71
2013	10,641,642.26	11,317,064.60	886	925	12,010.88	12,234.66
2014	13,746,623.98	15,187,953.65	1,244	1,278	11,050.34	11,884.16
2015	14,653,169.21	15,132,884.76	1,398	1,345	10,481.52	11,251.22
Total	58,764,168.55	64,426,284.25	5,186	5,343	11,331.31	12,058.07

Source: elaborated by the authors.
Note: monetary values in R$ (2015).

It is observed that women have become more frequent in the program in recent years. In the analyzed period, with information from companies that obtained more than one credit operation in the year condensed, 5,186 contracts for women (maintaining the representativeness of approximately 49%) and 5,343 for men (51%) were considered for the calculations. On average, the value contracted by women is lower than the value by men, which can be seen by the average value of contracts.

Table 3 shows the descriptive statistics of all the variables used in the models, as well as the t-test of difference of means between genders. In general, no significant difference in employability was observed, but there was a significant difference in the mean female employability and the contracted value. Of the control variables, the following is highlighted: female-owned companies are younger, have lower revenues, and lower pay.

Table 3 – Descriptive statistics and t-test of mean differences according to gender, 2010 – 2015

	Sex	Obs.	Mean	Standard-deviation	Minimum	Maximum	p-value
Contracted Value	F	5,186	11,331.31	4,921.03	889.2365	26,837.28	0
	M	5,343	12,058.07	4,692.14	6,198,328	27,385.34	
Jobs	F	5,186	0.472	1.136	0	9	0
	M	5,343	0.583	1.243	0	9	
Female Jobs	F	1,467	1.031	1.219	0	9	0
	M	1,814	0.778	1.077	0	9	
Vector "X":							
Revenue	F	5,186	100,956.80	82,675.54	0	482,729	0
	M	5,342	118,979.60	93,280.33	6,000	483,536	
Formal age of the company	F	5,162	3.241	4.82	0	48	0
	M	5,315	3.998	5.951	0	49	
Inclusion Simples Nacional	F	5,186	0.958	0.201	0	1	0.8264
	M	5,343	0.962	0.192	0	1	
Economic Activity (division of CNAE)	F	1,467	47.809	19.391	1	96	0.0043
	M	1,814	47.269	16.129	1	96	
Amounts obtained by other financing lines	F	5,186	23.71	1,211.28	0	66,597	0.0183
	M	5,343	10.55	770.88	0	56,348	
Wages paid by the company	F	1,238	956.45	308.01	0	3,080.92	0
	M	1,506	997.39	322.09	0	3,240.31	
Owner's age	F	5,184	42.658	11.334	17	86	0.9852
	M	5,340	42.559	11.687	15	87	
Interest rate	F	5,186	10.112	1.772	6.6	13.59	0.0002
	M	5,343	10.268	1.709	6.6	13.59	
Size of the establishment	F	1,467	1.911	0.465	1	3	0.0007
	M	1,814	1.9	0.48	1	3	
Working time (months)	F	1,467	30.23	48.64	0	504.2	0.0002
	M	1,814	32.24	52.06	0	429.2	

	Sex	Obs.	Mean	Standard-deviation	Minimum	Maximum	p-value
Vector "X":							
Proportion of workers with basic education	F	1,238	0.188	0.344	0	1	0.041
	M	1,506	0.206	0.357	0	1	
Proportion with high school	F	1,238	0.715	0.397	0	1	0.0533
	M	1,506	0.7	0.399	0	1	
Proportion with higher education	F	1,238	0.096	0.262	0	1	0.9271
	M	1,506	0.093	0.247	0	1	
Proportion of workers according to occupation category 1	F	1,238	0.136	0.309	0	1	0
	M	1,506	0.215	0.361	0	1	
Proportion of workers according to occupation category 2	F	1,238	0.701	0.413	0	1	0
	M	1,506	0.628	0.43	0	1	
Proportion of workers according to occupation category 3	F	1,238	0	0	0	0	0.0458
	M	1,506	0.001	0.026	0	1	

Source: elaborated by the authors.

For the cost analysis, it was necessary to explore the default differences according to the owner's gender, which can be seen in **Table** 4.

Table 4 – Degree of default according to gender - by value and by number of defaulted contracts[14]

	Value		Number	
	Women	Men	Women	**Men**
2010	1.34%	0.97%	2.36%	1.68%
2011	2.13%	2.46%	3.64%	3.11%
2012	3.23%	2.73%	5.02%	4.96%
2013	6.44%	4.85%	10.59%	8.11%
2014	6.79%	8.40%	10.03%	11.89%
2015	6.19%	8.25%	12.31%	15.04%
Total	5.14%	5.54%	8.84%	9.29%

Source: elaborated by the authors.

The results are variable over the period. On average, they indicate that women are 'more compliant in terms of value. In terms of the number of contracts, it is also observed that contracts signed by women appear less in default in the last two years of the analysis. These discrepancies over the period point to the need for more a rigorous investigation, which will be carried out next.

The mean difference test of the selected variables according to gender is presented in Table 5, as well as the number of observations and their means. The differences in the two proposed cuts were identified: the default in the micro companies cut seems to be distinct from the default in the employer micro companies cut, which is of particular interest. In any case, in both cuts, there does not seem to be a highly significant difference in the mean value of default and default dummy according to gender, indicating a possible inexistence of this causal relationship, which will be verified next.

14 Default contracts with delays of more than 90 days were considered, as defined by the Central Bank (BACEN, 2005).

Table 5 – T-test for the difference in means of the variables of interest of the default model according to the owner's gender

A) TREATED MICRO COMPANIES:

	Women		Men		p-Value
	Obs.	Mean	Obs.	Mean	
Defaulted value	5,186	585.22	5,342	670.03	0.0896
Default dummy	5,186	0.09	5,342	0.1	0.2460
Owner's age	5,186	42.64	5,342	42.54	0.7051
Municipality	5,184	411331	5,341	411339	0.6778
Borrowed value	5,186	11331	5,342	12,060	0.0000
Revenue	5,186	100957	5,342	118,980	0.0000
Term of contract	5,186	26.75	5,342	28.39	0.0000
Interest rate	5,186	10.11	5,342	10.27	0.0002

B) EMPLOYING MICRO COMPANIES:

	Women		Men		p-Value
	Obs.	Mean	Obs.	Mean	
Defaulted value	1,294	226.02	5,186	585.22	0.2459
Default dummy	1,294	0.04	5,186	0.09	0.3586
Owner's age	1,294	44.79	5,186	42.64	0.4355
Municipality	1,294	411381	5,184	411331	0.5823
Borrowed value	1,294	13364	5,186	11331	0.5923
Revenue	1,294	175513	5,186	100957	0.0268
Term of contract	1,294	28.4	5,186	26.75	0.0400
Interest rate	1,294	10.29	5,186	10.11	0.1065

Source: elaborated by the authors.

Having listed the main descriptive statistics, the analysis of the impact and cost models will be presented in the next section.

4 Results

This section is organized as follows: Initially, the results of the models of impact analysis are presented; finally, the cost analysis (including the default analysis) is presented.

4.1 Impact analysis

In this topic, it is verified whether the companies present different responses to the loan, given the owner's gender, using the dose-response models. To do this, the impact on total employment is first presented, followed by the impact on female employability.[15]

In terms of jobs, the results can be found in **Table 6**, which demonstrates the positive and significant impact of microcredit for both, even with the addition of controls. There was, however, no great heterogeneity in the impact: for every 1% increase in loan for women, **0.294** p.p. was generated in jobs, compared to **0.293** for companies headed by men.

Table 6 – Results of dose-response models according to owner's gender - impact on employment

| Impact of the released value on Female Employment (LNEMPR)						
	WOMEN			MEN		
	(1)	(2)	(3)	(1)	(2)	(3)
ATT	0.293***	0.301***	0.294***	0.293***	0.304***	0.293***
Standard-error	0.064	0.064	0.064	0.057	0.058	0.057
p-Value	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.024	0.022	0.023	0.025	0.023	0.025
Observations	1,460	1,460	1,460	1,841	1,841	1,841
Control groups:						
Characteristics of the establishment	Yes		Yes	Yes		Yes
Characteristics of the workers		Yes	Yes		Yes	Yes

Source: elaborated by the authors.
Note: ***p<0.01, **p<0.05, *p<0.1. Standard errors were calculated using bootstraps with 50 repetitions.

15 All models presented in this discussion satisfied the balancing property at a level lower than 0.01.

The dose-response models generated impact functions whose graphs are represented in **Figure 1.**

Figure 1 – Dose-response functions according to owner's gender - employment
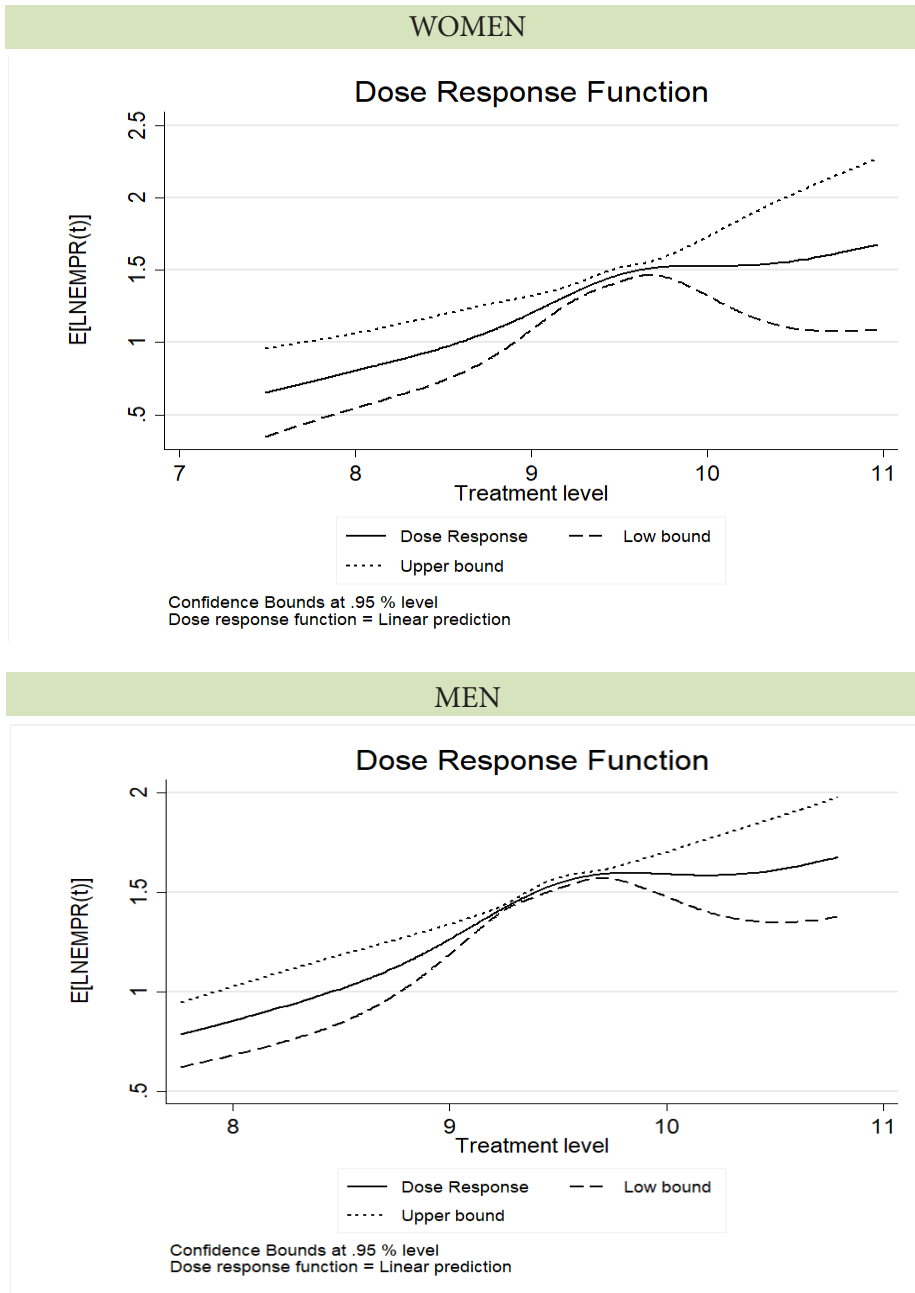
Source: elaborated by the authors.

When female employability is observed, a greater impact for companies headed by women is found, as expected. According to data in **Table 7**, the impacts are robust for both genders; for women, 1% more in the amount granted impacts **0.297** p.p. on female employment, while for companies headed by men this impact is **0.177** p.p..

Table 7 – Results of dose-response models according to owner's gender - impact on female employment

	Impact of the released value on Female Employment (LNEMPRFEM)					
	WOMEN			MEN		
	(1)	(2)	(3)	(1)	(2)	(3)
ATT	0.298***	0.308***	0.297***	0.177***	0.181***	0.177***
Standard-error	0.068	0.068	0.068	0.060	0.060	0.060
p-Value	0.000	0.000	0.000	0.003	0.002	0.003
R^2	0.020	0.020	0.020	0.013	0.013	0.013
Observations	1,460	1,460	1,460	1,841	1,841	1.841
Control groups:						
Characteristics of the establishment	Yes		Yes	Yes		Yes
Characteristics of the workers		Yes	Yes		Yes	Yes

Source: elaborated by the authors.
Note: ***p<0.01, **p<0.05, *p<0.1. Standard errors were calculated using bootstraps with 50 repetitions. The dose-response functions for female employment can also be verified using the graphs in Figure 2.

Figure 2 – Dose-response functions according to owner's gender - female employment
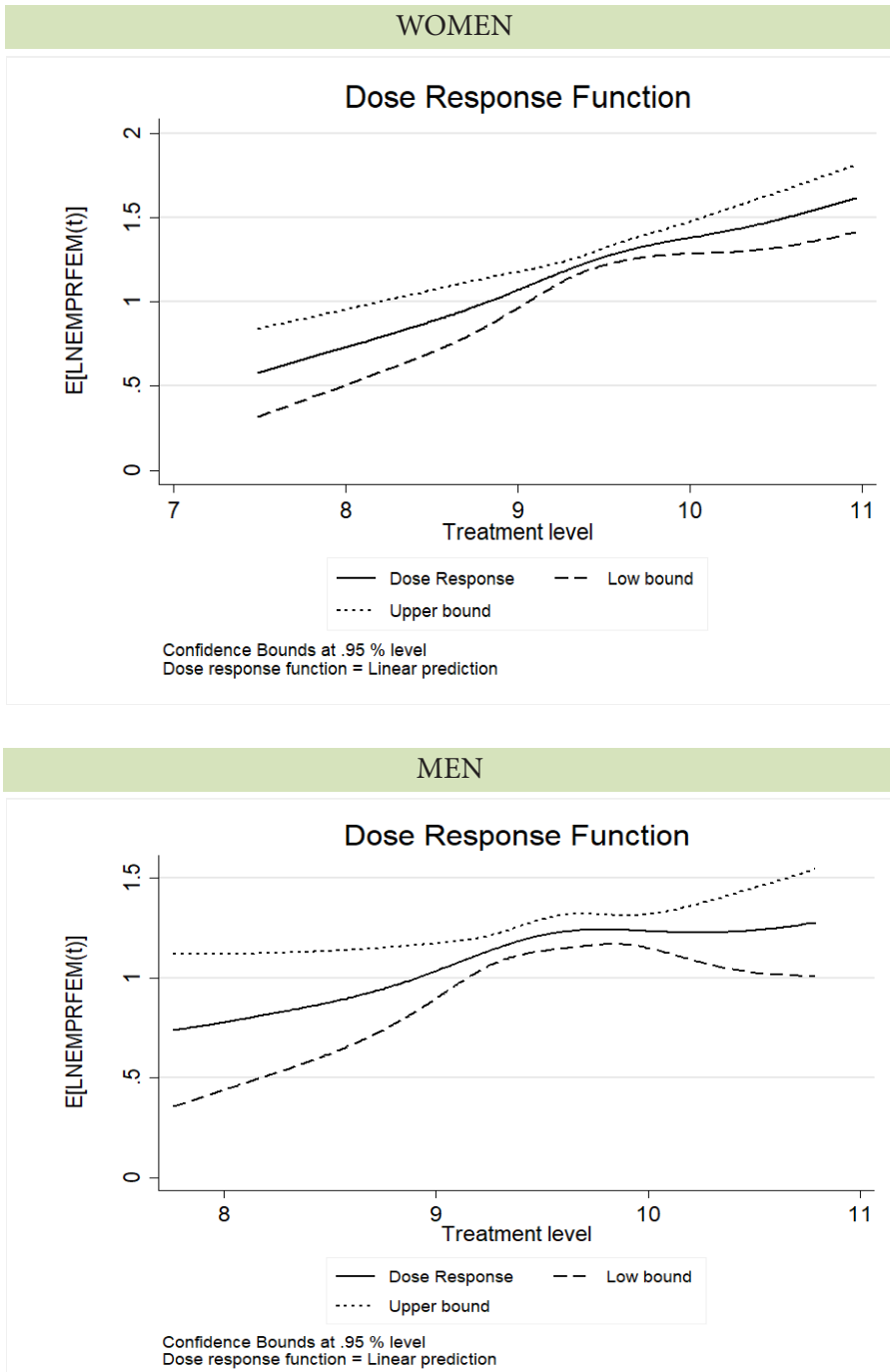
Source: elaborated by the authors.

Better impacts were observed for general employment (although the difference was small) and more strongly for female employment when companies were headed by women.

4.2 Cost-effectiveness analysis

The results of the impact analysis show that micro-credit for women was better used, mainly considering the result on female employment. However, to assess whether it is more effective to target credit to women, it is necessary to analyze the additional cost that this decision entails.

After mapping the program's cost items, it was found that costs could be broken down into operating costs and financial costs. In the case of operating costs, there was no difference in the cost of analysis or monitoring according to the owner's gender in the program evaluated.

Additionally, it was seen that the mean value contracted by women is lower than that of men, which may result in a higher opportunity cost, that is, smaller contracts have a fixed cost of analysis and monitoring, but generate lower financial income due to the incidence of interest rate on a lower value.

It should be noted that interest rates until then were not differentiated according to gender. Thus, there could be a differential cost caused by the lower contracted value. To address this issue, a model was estimated to check whether gender or type of activity had an influence on the contracted value, controlled by other variables (such as municipality, CNAE (National Classification of Economic Activities), company revenue, interest rate, owner's age, and term of contract). The results showed that the value of the contract does not depend significantly on the owner's gender. Therefore, the results suggest that there is no difference in operational costs related to women. This conclusion is in line with the evidence found by D'ESPALLIER; GUERIN; MERSLAND (2013). The authors raise the question of the importance of assessing costs beyond the impact on defaults, but, when analyzing 398 microcredit programs from 73 different countries following them for 10 years, they also found no evidence of differences in operating costs linked intrinsically to the gender difference.

Thus, it remains to be verified whether there is a difference in the financial cost, that is, in default. The consideration of this item is quite pertinent to the literature since there is evidence of differences in defaults according to gender.

Initially, the analysis of the default differential was carried out, and in possession of these results, which constitute the differential cost, the cost-effectiveness analysis was performed by choosing the variables of general job creation and female employment in the calculation of the Incremental Cost-Effectiveness Ratio (ICER).

4.2.1 Financial cost analysis - default differential

For default analysis, in addition to the gender cut, each model was carried out with two samples: micro-companies in general and micro-employers, which constitute the sample used for the impact models previously presented.

Table 8 shows the results for the probability of default. It was found that gender had no effect on the probability of default in any of the samples.

Table 8 – Results of probit models – default

TOBIT	A) MICRO COMPANIES		B) MICRO-EMPLOYERS	
	dy/dx	dy/dx	dy/dx	dy/dx
	(1)	(2)	(1)	(2)
Year	0.026***	0.024***	0.014***	0.015***
Owner's gender	-0.006	-0.008	-0.005	-0.006
Type of activity (Female or not)	-0.034***	-0.038***	-0.002	
Owner's age	-0.001***		0.000	
Municipality	0.000**		0.000	
Type of loan				
Fixed Capital	0.062***		0.019	
Mixed Capital	0.045***		-0.003	
Loan value	0.000***	0.000*	0.000**	0.000***
Company's revenue	0.000***	0.000***	0.000**	0.000***
Term of contract	0.002**	0.001***	0.001	0.000
Interest rate	0.003*		0.000	
Number of observations	10,525	10,770	2,895	3,018
Log pseudolikelihood	-3,097.34	-3,177.98	-485.22	-501.959
Wald chi²(10)	386.03	276,08	74.11	60.44
Prob > chi²	0.0000	0,0000	0.0000	0.0000
Pseudo R²	0.0653	0.0479	0.0746	0.0571

Source: elaborated by the autrors..
Note: ***p<0.01, **p<0.05, *p<0.1. The coefficients are in terms of marginal effects (dy/dx).

With these results considered, the monetary impact of these different variables was verified, as presented in Table 9. As with the previous model, the results indicate that gender has no significant interference in the defaulted value.

Table 9 – Results of tobit models – default

TOBIT	A) MICRO COMPANIES		B) MICRO-EMPLOYERS	
	dy/dx	dy/dx	dy/dx	dy/dx
	(1)	(2)	(1)	(2)
Year	312.253***	291.638***	268.578***	281.699***
Owner's gender	-80.549	-102.462	-115.699	-138.504
Type of activity (Female or not)	-476.077***	-518.411***	-27.639	10.406
Owner's age	-19.194***		-6.902	
Municipality	-0.117**		0.024	
Type of loan				
Fixed Capital	864.54***		355.692	
Mixed Capital	679.654***		-95.346	
Loan value	-0.011	0.032***	-0.045*	0.041***
Company's revenue	-0.003***	-0.004***	-0.002**	-0.002***
Term of contract	18.605**	18.92***	26.862	-0.024
Interest rate	48.048**		-1.045	
Number of observations	10,583	10,770	2,895	3,078
Log pseudolikelihood	-12,958.30	-12,966.57	-1,724.38	-1739.5
Wald chi2(10)	37.29	47.11	6.87	9.47
Prob > chi²	0.0000	0.0000	0.0000	0.0000
Pseudo R²	0.0162	0.0124	0.0213	0.0172

Source: elaborated by the authors.
Note: ***$p<0.01$, **$p<0.05$, *$p<0.1$. The coefficients are in terms of marginal effects (dy/dx).

Thus, since there is no difference in operating and financial costs, it is possible to conclude that the differential cost according to sex is null.

4.2.2 Calculation of the ICER

The existence of a positive impact differential from the dose-response models for women was verified, but there was no evidence of differential cost. Although a lower cost

of default was expected, it was concluded that loaning to women has a positive impact and does not generate additional costs, which is a desirable outcome.

The dose-response models showed that every 1% increase in the amount loaned to women impacted the level of employment by 0.294 and for men by 0.293, a difference of 0.001. As for female employability, the differential is greater: the models pointed out that every 1% increase in the amount loaned to women impacts 0.297 female employment, while for men the impact on this same variable is 0.177. The difference is therefore 0.12 p.p.. That is, an increase in female employability by 0.12 p.p. was possible just by prioritizing credit to women and without incurring additional costs to do so.

Thus, the calculation of ICER is, in a way, redundant because:

$$ICER = \frac{\Delta C}{\Delta E} = \frac{0}{(\Delta E > 0)} = 0$$

However, as seen in Figure 3, the graphical location of the point referring to the ICER has interesting information, especially when compared to other projects. First, it is situated between the northeast quadrant and the southeast quadrant, implying that it is in the white area of the figure and, therefore, loaning to women is preferred over loaning to men (baseline). In case there were another proposal to be compared, it would be located in the cost-effectiveness plan and compared for decision making. Assuming that the differential costs are equal (and identical to 0), one can only sort by impact, choosing the alternative with the highest result.[16] This means that the location of this point in the cost-effectiveness plan is important, even if its calculation seems unnecessary.

16 Likewise, if there were equal impacts and different costs, the lowest cost would be chosen.

Figure 3 – The cost-effectiveness plan - result
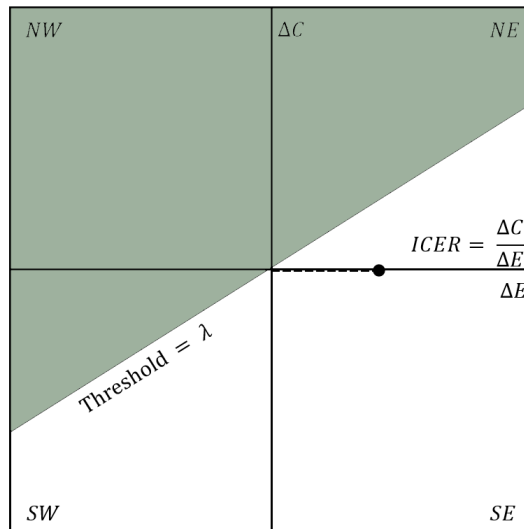
Source: elaborated by the authors, based on Willian and Briggs (2006).

For instance, it will be easier for the policy maker to justify microcredit targeting women if the aim is to increase female employability than if the objective is to increase jobs in general, as they will be situated further east. It is noteworthy that in the case studied, as is null, the choice of the manager's shadow price (λ) is not important, but the choice of the variable of interest to define the is.

5 Conclusions

The study provided an analysis of the female differential in the use of microcredit using a Brazilian case study directed at formal companies. It analyzed effects on general employment and female employment, as well as the existence of incremental costs.

The results showed that the impact of female management on the use of the resource was positive, that is, companies headed by women obtained better responses on female employment and similar ones on employment in general.

In addition, it was verified whether there was evidence of differences in costs for the financial institution, measuring operating costs and impacts on default. It was concluded that there are no differences in any of the costs according to gender.

Finally, a cost-effectiveness analysis was carried out, showing the feasibility of microcredit targeting women, especially if the manager's interest is to increase female

employability in the region.

By dealing with such a relevant and current issue and adding impact analysis to cost-effectiveness, this study seeks to contribute to the literature on the subject and foster new designs of public policies based on evidence. An example of an outcome of this research occurred in 2019, when the State Government created a differentiation of microcredit interest rates for women in Paraná to support their activities.

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