

Figure 7. Length of time in the business of men microentrepreneurs.

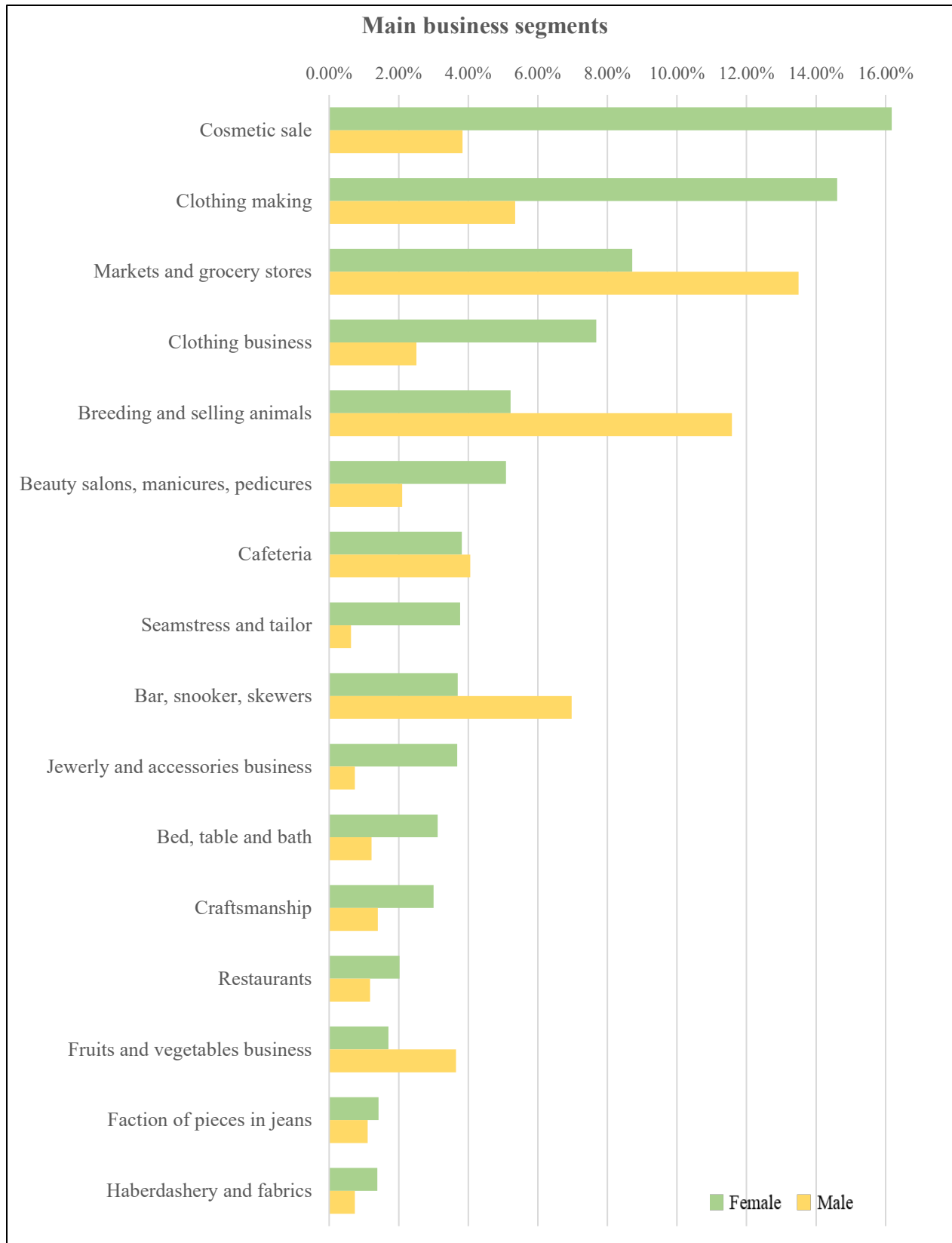


Figure 8. Main segments of activity of microentrepreneurs, segregated by gender.

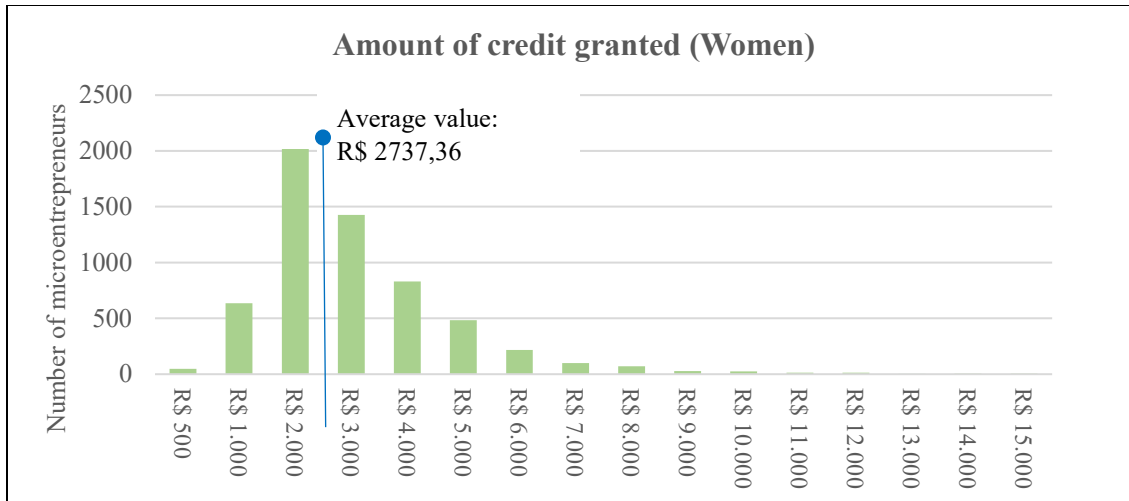


Figure 9. Amount of credit granted to women microentrepreneurs.

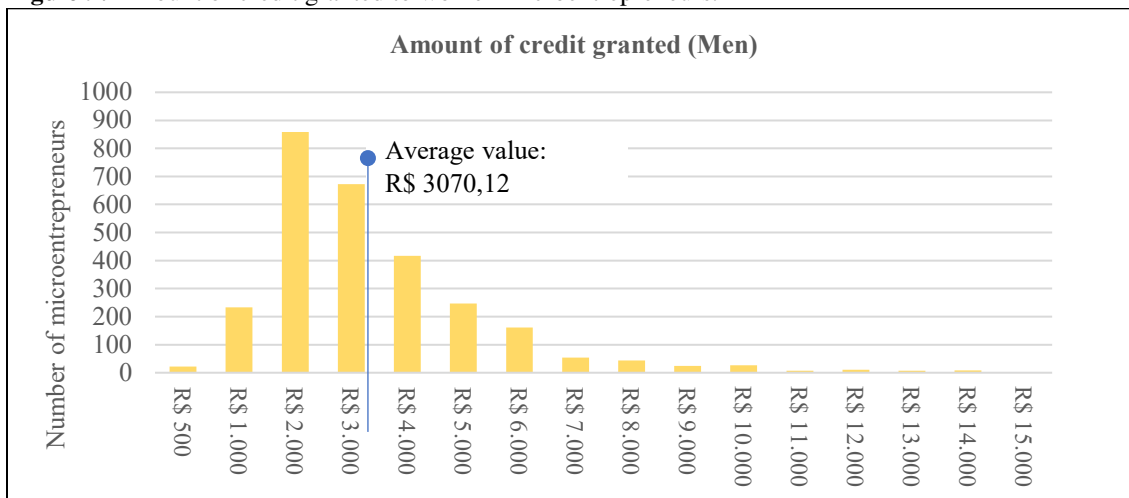


Figure 10. Amount of credit amount granted to male microentrepreneurs.

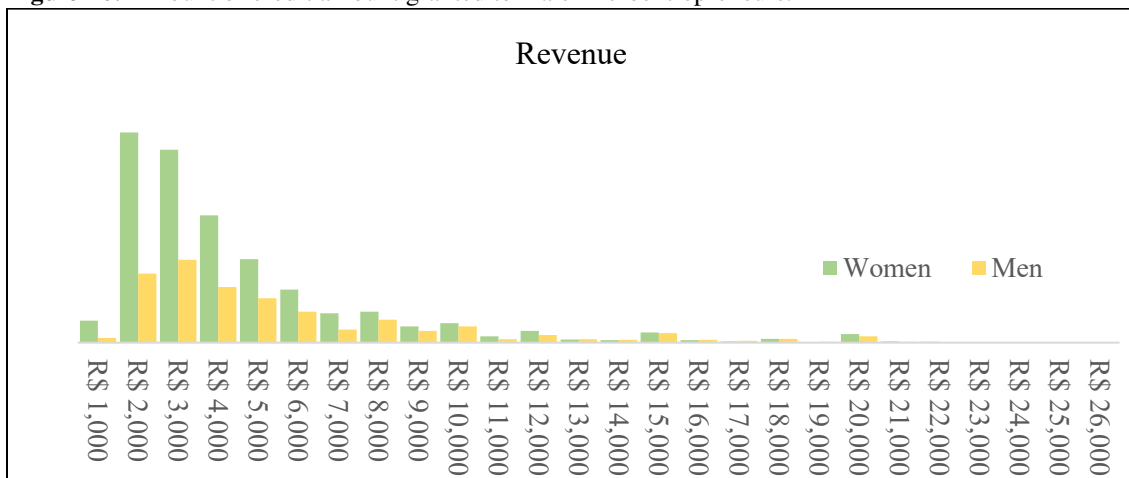


Figure 11. Revenue comparison between men and women.

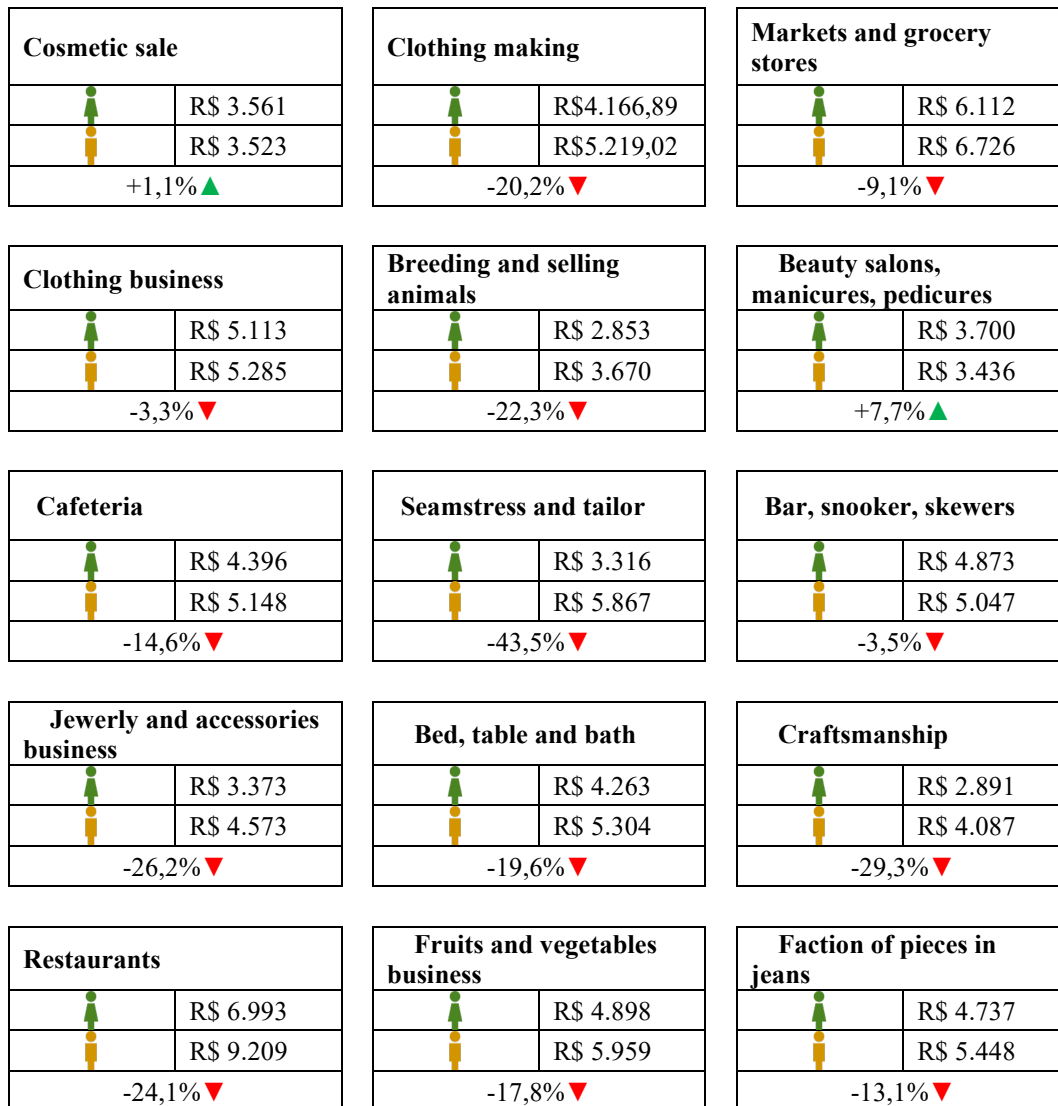


Figure 12. Revenue disparity between male and female microentrepreneurs by industry.

PART II - Methodology

To assess the impact from microcredit on microentrepreneurs, we chose revenue as a proxy. The declared revenue was collected in two different moments. First, during the process of evaluation for the concession of credit. Then, after a few months, it was collected once again for those microentrepreneurs who had completed the payment of their installments and requested a credit renewal. Therefore, we are able to compare revenue “before” and “after” a certain period of time, for each microentrepreneur. This group of microentrepreneurs will be referred to as the *treatment group*.

In order to do a proper comparison, we also considered a *control group*, that is, a group of microentrepreneurs that did not receive any credit at all. We used as a control group the set of microentrepreneurs who applied for credit in two different moments. At first, he or she requested credit but, for diverse reasons, the loan was not approved. At this stage, all necessary information about that microentrepreneur was collected. In a second moment, if the microentrepreneur reapplies for credit, all the necessary information will be collected again. Therefore, we are able to

compare revenue “before” and “after” a certain period of time, for these microentrepreneurs in the control group too. It is worth mentioning that, as credit policy, an entrepreneur can only reapply for credit after two months.

By comparing these two groups, we can validate whether the impact generated by microcredit actually existed or not in the treatment group (INSPER, 2020). In our study, the treatment group contains 8724 microentrepreneurs and the control group control contains 4270 microentrepreneurs. This difference occurs because many microentrepreneurs, after being rejected for a loan, do not reapply for credit in the future. Despite being a smaller sample, the control group has some characteristics that are very similar to those of the treatment group, such as geographic distribution, average loan ticket and interest rates. Also, the distribution curves of the revenue for both groups presented very similar shapes, as shown in Figure 13. Thus, we considered these two groups fairly comparable.

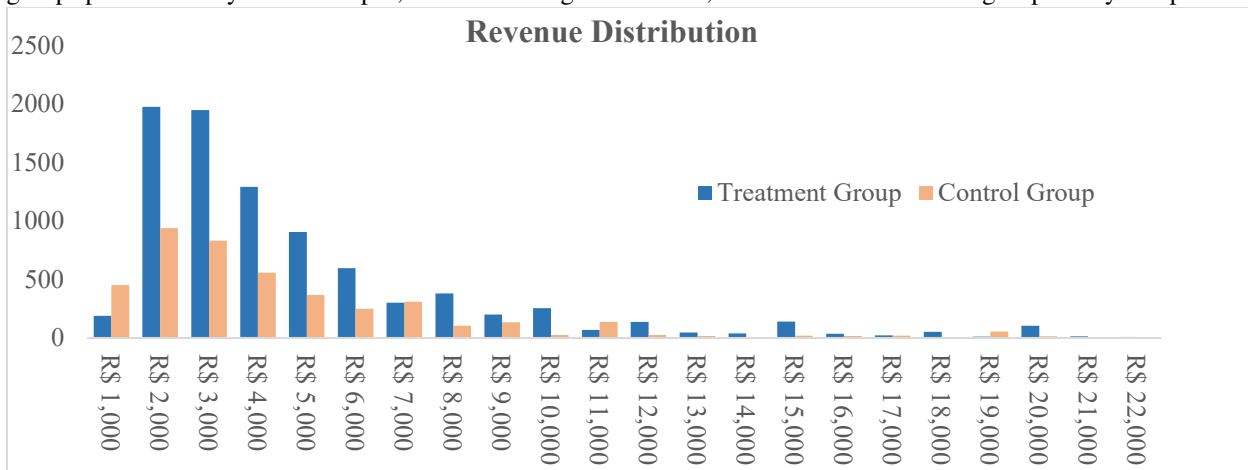


Figure 13. Distribution of Average Revenue for the treatment and control groups.

The average revenue for the two groups, before and after, are shown in Figure 14. Note that there is an increase in the revenue of the treatment group. Our goal here is to assess whether this increase was caused or not by the microcredit offer, using a 95% confidence level.

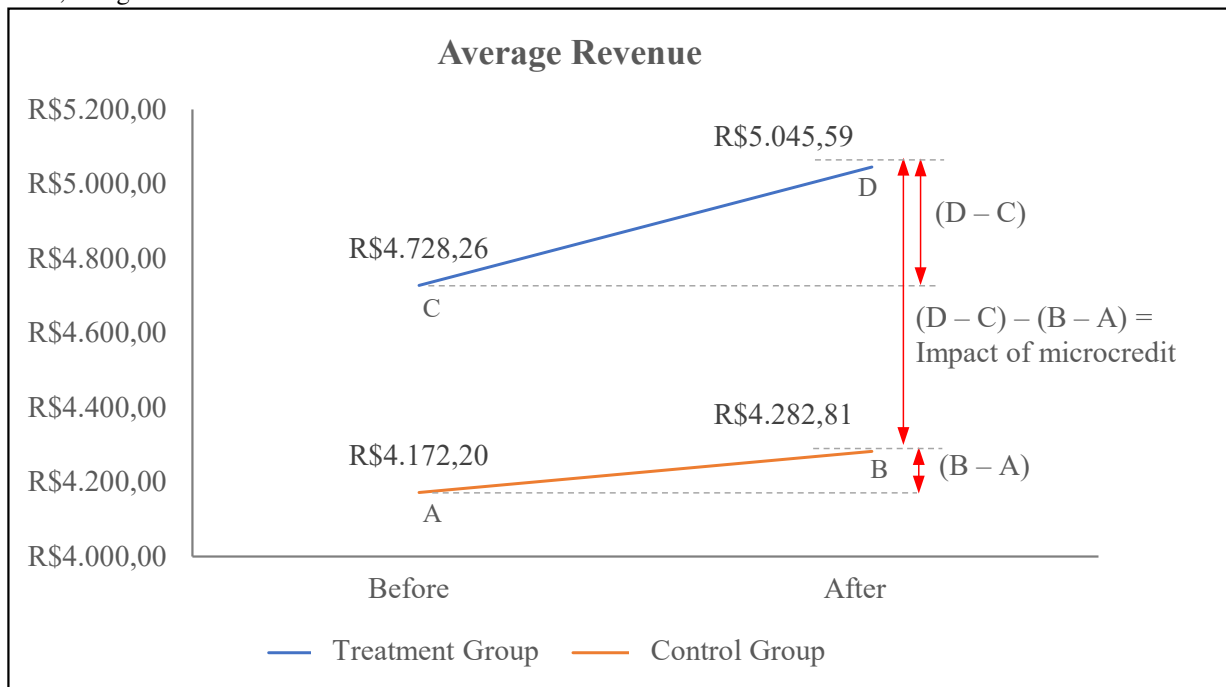


Figure 14. Average revenue of the treatment and control groups, before and after.

The method used to compare the treatment and control groups is called DiD (differences in differences) (ANGRIST, 2009) and can be extracted from Figure 14 and schematized according to Figure 15.

	Before	After	Differences
Control Group	A	B	B-A
Treatment Group	C	D	D-C
Differences	C-A	D-B	(D-C)-(B-A)

Figure 15. Scheme of differences in differences.

Part II – Results

Our first goal is to determine if the microcredit did or did not impact the revenue of microentrepreneurs, regardless of gender. The DiD method can be represented using a multivariate regression shown in Equation 1, in which Y represents the mean of the studied variable. In our case, Y represents the revenue of the microentrepreneur. Although the process to obtain the equation will not be discussed in this article, a brief explanation of the regression equation used in this work is shown in Equation 2.

Equation 2: Regression equation to estimate the impact of microcredit for microentrepreneurs.

$$Y = a + b_1 \times D_1 + b_2 \times D_2 + b_3 \times D_1 \times D_2 + e$$

where,

a: constant.

b₁, b₂, b₃: coefficients.

e: error of the regression model.

D₁: dummy variable that indicates control group (= 0) or treatment group (= 1).

D₂: dummy variable that indicates before (= 0) or after (= 1).

D₁ × D₂: dummy variable that indicates the impact generated by the two variables **D₁** and **D₂** combined.

The result of the regression is shown in Table 2.

Table 2. Multivariate regression statistics to verify the impact of microcredit on the entrepreneurs who had access to it. Result generated via MS Excel.

Regression Statistics	
Multiple R	0,08847993
R-Square	0,0078287
Adjusted R-Square	0,00771415
Standard Error	3798,69471
Observation	25988

ANOVA					
	gl	SQ	MQ	F	Signif. F

Regression	3	295854185 2	986180617	68,341999	5,1541E- 44
Residue	25984	3,7495E+1 1	14430082		
Total	25987	3,7791E+1 1			

	Coefficient s	Std Error	Stat t	P-value	95% lower	95% higher	Lower 95.0%	95% higher
Intersection	4172,20	58,13	71,77	0,0000	4058,26	4286,14	4058,26	4286,14
Treatment (D1)	556,06	70,95	7,84	0,0000	417,00	695,12	417,00	695,12
Time (D2)	110,61	82,21	1,35	0,1785	-50,53	271,75	-50,53	271,75
D1 x D2	206,72	100,33	2,06	0,0394	10,06	403,38	10,06	403,38

The results indicate that the coefficient of the variable D1 x D2 presented a P-value of 0.0394, indicating that the level of maximum confidence for this variable is $1 - 0.0394 = 96.06\%$. Therefore, it is reasonable to conclude that there is statistical significance within a 95% confidence interval. In other words, we have a strong indication that the microcredit concession event for the microentrepreneurs studied had a positive impact on their revenue.

Our second and most important goal is to determine if the microcredit impacted the revenue of male and female microentrepreneurs differently. For this, we added a gender variable in the initial model, and we created an additional variable measure to measure the impact of microcredit on women microentrepreneurs. The regression equation with the inclusion of gender is given in Equation 3.

Equation 3: Regression equation to estimate the impact of microcredit for male and female microentrepreneurs.

$$Y = a + b_1 \times D_1 + b_2 \times D_2 + b_3 \times D_3 + b_4 \times D_1 \times D_2 \times D_3 + e$$

where,

a: constant.

b₁, b₂, b₃, b₄ : coefficients.

e: error of the regression model.

D₁: dummy variable that indicates control group (= 0) or treatment group (= 1).

D₂: dummy variable that indicates before (= 0) or after (= 1).

D₃: dummy variable that indicates gender male (= 0) or gender female (= 1).

D₁ × D₂ × D₃: dummy variable that indicates the impact of the three variables **D₁**, **D₂** and **D₃** combined.

The result of the regression is shown in Table 3.

Table 3. Multivariate regression statistics to verify the impact of microcredit on women entrepreneurs who had access to it. Result generated via MS Excel.

Regression Statistics	
Multiple R	0,1258
R-Square	0,0158
Adjusted R-Square	0,0157
Standard Error	3783,43
Observation	25988

ANOVA

	gl	SQ	MQ	F	Signif. F
Regression	4	5,981E+09	1,495E+09	104,45934	2,01715E-88
Residue	25983	3,719E+11	14314310		
Total	25987	3,779E+11			

	Coefficient s	Std Error	Stat t	P-value	95% lower	95% higher	Lower 95.0%	95% higher
Intersection	4017,57	54,77	73,3494	0,0000	3910,2146	4124,9312	3910,2146	4124,9312
Treatment (D1)	565,42	52,68	10,7337	0,0000	462,1721	668,6727	462,1721	668,6727
Time (D2)	113,60	51,70	2,1972	0,0280	12,2625	214,9319	12,2625	214,9319
Gender (D3)	454,72	60,23	7,5500	0,0000	336,6691	572,7665	336,6691	572,7665
D1 x D2 x D3	629,99	100,54	6,2663	0,0000	432,9336	827,0478	432,9336	827,0478

The results show that the coefficient of the variable D1 x D2 x D3 showed a significantly small P-value, indicating that the maximum confidence level for this variable is $1-0.0000 \approx 100\%$. That is, there is statistical significance within a 95% confidence interval. So we have a pretty strong indication that the event of granting microcredit to microentrepreneurs women had a positive impact on their earnings. From these indications, we then calculate the annualized increase in the average turnover of microentrepreneurs for the treatment group. The result is shown in Table 3. We observed that the average annualized earnings for women were consistently higher than that of men in all evaluated states.

Table 4. Growth in average revenue for women compared to men, after access to microcredit.

Location	Gender	Increase in revenue	Women vs. men
Ceará State	Women	19.03%	26.38% ▲
	Men	15.06%	
Maranhão State	Women	19.58%	9.20% ▲
	Men	17.93%	
Paraíba State	Women	20.69%	63.05% ▲
	Men	12.69%	
Pernambuco State	Women	20.20%	55.98% ▲
	Men	12.95%	

Conclusion

This work was motivated by the observation that the number of female microentrepreneurs is significantly larger than male. For this reason, microentrepreneur-oriented microcredit can have a major impact on the empowerment of women and an important role in reducing gender inequality.

In this study, we tried to infer the impact of microcredit on the revenue of microentrepreneurs. Then, our analysis went further to compare the impact for women and for men. To do this, we needed to compare the group of microentrepreneurs who received credit with a control group, which did not have access to credit. Also, to make a comparison between men and women, we needed to measure the impact of microcredit specifically on the female group.

Our regressions show a positive impact on the revenue of those who had access to microcredit in relation to those who did not. Last but not least, regressions show a positive impact for women in comparison to men. The results have shown that the average revenue increase for female microentrepreneurs was 39.37% higher than that for male, after the microcredit.

Limitations

The type of analysis done in this research is known to be quite complex in the academic world. Therefore, this work made a few simplifications. First, it is important to emphasize that, as pairing between the observable characteristics of the treatment group and the control group was not perfect, it is perfectly possible that we have some level of bias in the data. Second, our regression methodology does not take into account control variables that could affect the dependent variable (revenue), such as education level and previous experiences of the microentrepreneurs. Finally, the time horizon is relatively short.

Discussion

It is of great importance that the players in the microcredit market, including private companies and government, consider the impact of gender in their policies and methodologies. As future steps, our working group intends to further increase the volume of analyzed data, the time-space, and improve the methodology for group pairings. For now, the initial indications already suggest that the microcredit impact on female microentrepreneurs must indeed be positive, consistent and greater than the impact for male.

Acknowledgements

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