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Abstract

This paper compares the loans granted to male and female entrepreneurs by a French microfinance institution (MFI). The sample period is split in two: before and after the MFI implemented France's regulatory EUR 10,000 loan ceiling. In the first period, the MFI does not co-finance projects with mainstream banks and loan size is gender-insensitive. In the second period, the MFI does co-finance above-ceiling projects with mainstream banks, and we observe a gender gap in loan size. The results suggest that co-financing leads the originally gender-neutral MFI to import disparate treatment from mainstream banks.

1 Introduction

Female entrepreneurship is advocated as a driving force in economic development. Even so, access to credit is still a challenging barrier to women entrepreneurs. Two types of gender bias in lending are documented in the literature. The first stems from harsher credit approval (Orser *et al*., 2000; Cavalluzzo *et al*., 2002; Fay and Williams, 1991). The second relates to credit conditions, including collateral requirements and loan size.[1] We contribute to this stream of the literature by scrutinizing the loan granting process of a French microfinance institution (MFI). In France, women account for 47% of the workforce but only 30% of entrepreneurs (Brana, 2013). Hence, there are grounds to suspect that women find it harder than men to set up a business.

In developed countries, gender discrimination has been detected in various economic activities. The evidence is overwhelming that women are penalized on the job market (Altonji and Blank, 1999; Blau and Kahn, 2000), confirming that competition is insufficient to deter discriminatory practices. Evidence is also found in other markets, such as those for cars (Ayres and Siegelman, 1995) and housing (Page, 1995). Gender discrimination can thus potentially interact with economic decision-making in any area. Unfortunately, data are often insufficient to assess this situation. Because of US legal requirements,[2] race and gender discrimination has been scrutinized in mortgage lending (Munnell *et al*., 1996; Han, 2004) and in the small business credit industry (Blanchiflower *et al*. 2003; Cavalluzzo and Wolken, 2005). In mortgage lending, black applicants face the worst denial rate (Shafer and Ladd, 1981) while female applicants

[1] Riding and Swift (1990), Coleman (2000), and Bellucci et al. (2010) find that collateral requirements are gender-related in Canada, the UK, and Italy, respectively. Alesina et al. (2013) and Agier and Szafarz (2013a) show that female micro-entrepreneurs receive smaller loans than male ones, in Italy and Brazil, respectively.

[2] The US lending industry is subject to anti-discrimination regulations including: the Fair Housing Act of 1968, the Equal Credit Opportunity Act (ECOA) of 1974, and the Home Mortgage Disclosure Act (HMDA) of 1975, which was amended in 1989 to make it mandatory for lenders to report race and ethnicity of their loan applicants.

experience disparate treatment (Ladd, 1998). Stereotypes thus seem to have survived the enforcement of the US Equal Credit Opportunity Act.

In Europe, discrimination in lending is difficult to test directly because banks are not required to release individual data. To get around this issue, we used an indirect identification strategy, which consists in observing the impact of mainstream banks' loan approval process on applicants to an MFI. This is made possible by the French regulatory context. In France, licensed MFIs, i.e. those allowed to finance their activity through borrowing, are subject to a strict EUR 10,000 loan ceiling.[3] However, a significant percentage of entrepreneurs targeted by French MFIs[4] have business projects that require above-ceiling loans. To apply for microcredit, these entrepreneurs have to secure co-financing from a mainstream bank beforehand. Accordingly, the gender and project characteristics of microcredit applicants with above-ceiling projects partly reveal how banks treat female applicants.

In France, as elsewhere, commercial banks are the main providers of small-business finance (Berger and Udell, 2002; Cornée and Szafarz, 2013), while MFIs are new players in the field. By imposing a low loan ceiling on MFIs, the French regulator sought to preserve the banks' prerogative to provide small businesses with loans above EUR 10,000 (Brabant *et al.*, 2009). In practice, however, the French regulation has led to projects being co-financed by banks and MFIs. This outcome can be viewed as a somewhat unexpected byproduct[5] of the particularly low loan ceiling enforced by the French government (Cozarenco and Szafarz, 2013).[6] It can be rationalized by the fact

[3] This ceiling is significantly lower than the EUR 25,000 threshold recommended by the European Commission.
[4] Most of them are unemployed people aiming at self-employment.
[5] MFIs and banks have different statuses. MFIs are subsidized institutions maximizing social performance within a budget constraint, while banks are driven by profit maximization (Aubert et al., 2009). However, Armendariz and Szafarz (2011) provide evidence that the social mission varies across MFIs.
[6] In the United States, the loan ceiling for microcredit is USD 50,000. The European Union (EU) recommends the use of a EUR 25,000 ceiling, but member states remain free to set their own rules. Some countries (Romania, Italy) have adopted the EU recommendation, while others, like Hungary, Portugal,

that co-financing is profitable to credit providers through information sharing (Bennardo *et al*., 2009) and natural complementarities (Fall, 2010). In India, the ICICI Bank has entered into partnership arrangements with 30 MFIs (Ananth, 2005). According to these arrangements, loan contracts are directly signed by the bank and the borrowers, and the MFI acts as guarantor against defaults. This arrangement reduces the MFI's cost of capital while preserving its incentives to monitor borrowers.

Under French regulations, business co-financing can be attractive to all parties involved, i.e. the bank, the borrower, and the MFI, for several reasons. First, co-financing gives banks access to new market segments while limiting their risk. Banks are typically reluctant to finance credit-history-free start-ups. Second, for borrowers lacking credit history co-financing may be the only way to launch relatively large business projects at reasonable cost.[7] Third, co-financing allows ceiling-constrained MFIs to attract entrepreneurs with above-ceiling projects. To some extent it also offers MFIs an opportunity to free-ride on banks' screening processes.[8]

At the same time, the feasibility of co-financing means that MFIs' pools of applicants become at least partly shaped by banks. We use this feature as an identification strategy for scrutinizing the banks' attitude toward female loan applicants. More precisely, we exploit a natural experiment, since we observe the full loan-granting process of an MFI before and after the loan ceiling is introduced, i.e. *before and after* the emergence of co-financing. Changes in the pool of the applicants give us insights into the banks' loan granting process, while the profiles of the co-financing recipients tells us how the MFI reacts to this process.

Slovakia, and the UK, allow MFIs to grant loans exceeding EUR 25,000. France is the only EU member to impose a ceiling lower than the EU recommendation.

[7] In our dataset, we observe that in three years out of four (2009, 2010, and 2011, but not 2012) the interest rates charged by the banks are significantly higher than that charged by the MFI.

[8] In our dataset, 71% of the applicants with a secured bank loan ended up with a co-financing arrangement.

Co-financing is still understudied. While the literature cites evidence of co-financing schemes linking formal and informal institutions in developing countries (Jain, 1999; Andersen and Malchow-Moller, 2006, Degryse et *al*., 2013), co-financing between banks and MFIs in developed countries has not been reported so far. This might indicate that the French situation is fairly exceptional. Alternatively, one could argue that the microfinance industry in developed countries is still in its infancy and has not yet fully exploited market opportunities. In 2010, developed countries accounted for only 2.6% of the microfinance clients reported in the Microcredit Summit Campaign Report 2012.[9]

Based on partial-least-square estimations, our results confirm that the introduction of the loan ceiling dramatically changed loan allocation in the MFI we have studied. Specifically, the institution moved from a gender-neutral allocation to a gender-biased one. Before the ceiling was introduced, the MFI granted loans without bank co-financing, and we detect no gender gap in loan size. After the ceiling was brought in, the institution started co-financing above-ceiling projects with mainstream banks, while women received significantly smaller loans than men, all else equal. Our findings suggest that co-financing has led the originally gender-neutral MFI to import disparate treatment from mainstream banks.

The remainder of this paper is structured as follows. Section 2 provides an overview of the data. The econometric model in Section 3 pinpoints the relationship between gender, loan size and loan approval. In section 4 we discuss the results by period. Section 5 concludes.

[9] http://www.microcreditsummit.org/uploads/resource/document/web_socr-2012_english_62819.pdf

2 Data and Descriptive Statistics

Individual data were hand-collected on the applicants and borrowers of a French MFI set up in 2006. The database covers the period from 2008 to 2012 and includes detailed information on 1,098 credit applicants. The MFI's pool of applicants is made up of unemployed people seeking self-employment, and start-ups lacking collateral and credit history. Until April 2009, the institution operated under the unregulated NGO status. As such, it was required to finance its activity through subsidies only, which restricted its growth. From then on, the NGO changed its status to a regulated MFI in order to gain access to funds at preferential rates. Since then, the MFI has been subject to the EUR 10,000 loan ceiling. Although the change of status enabled the MFI to grow significantly,[10] the institution has preserved its social purpose.

Since it was founded, the MFI has used the typical individual microcredit lending methodology, charging all borrowers the same interest rate. Over the sample period, the interest rate changed slightly due to market conditions, but remained between 4% and 5% p.a., which is remarkably low given the risks involved in start-up financing. Loans are to be repaid in monthly instalments. The average loan duration is 51 months. Loan applications are examined by a loan officer, while the credit committee has the final say on loan approval. Typically, the decision is binary: the credit committee either approves or denies a loan of the size requested by the applicant.[11] Loan size is rarely questioned by the loan officers because the MFI delegates this task to third parties. Specifically, NGOs are in charge of helping applicants define their financial needs and offering them business development services. The MFI has however no commitment toward these independent—and typically subsidized—NGOs.

[10] In 2010, the MFI opened two new branches and its staff passed from six to ten employees.
[11] In only 7.6% of our sample is the granted loan size smaller than the demanded one. This way of doing departs from the lending methodology adopted by many MFIs, which use loan size as a decision variable (Agier and Szafarz, 2013b).

The full sample period is split in two. The first period (April 2008-April 2009) corresponds to the status of an unregulated NGO. The second (May 2009-June 2012) is longer and begins with the enforcement of the loan ceiling. During the first period, the MFI received 227 applications and granted 100 loans. During the second, it received 871 applications and granted 519 loans.

In practice, the main difference between the two periods is the emergence of co-financing. Figs. 1 and 2 illustrate the change that took place in May 2009. In the first period (Fig. 1), the MFI financed projects up to EUR 40,000[12] without bank intervention. In the second period (Fig. 2), the EUR 10,000 loan ceiling was introduced. The holders of below- and above-ceiling projects follow distinct paths. For those below the ceiling, there is no change. They retain the right to apply to the MFI directly. In contrast, holders of above-ceiling projects are required to secure a partial bank loan before applying to the MFI. Their best interests dictate that they apply to a bank for the portion of their desired loan exceeding EUR 10,000. Doing so has two advantages. First, it maximizes their chances of obtaining a loan from the bank. Second, it minimizes the financial burden of their debt since the MFI charges an interest rate that is typically lower than that of mainstream banks. Projects denied by banks may be either abandoned or downsized to an amount that does not require bank financing. However, downsizing can strongly compromise the investment project. Therefore, we conjecture that projects requiring loans well above EUR 10,000 that are denied by banks are mostly abandoned. In any case, we do not observe the outcomes of the bank application process; we observe only the occurrence of bank loans among MFI applicants as well as the size and interest rates of these loans.

[12] This threshold was hardly binding.

Figure 1: Loan Allocation Process in the First Period

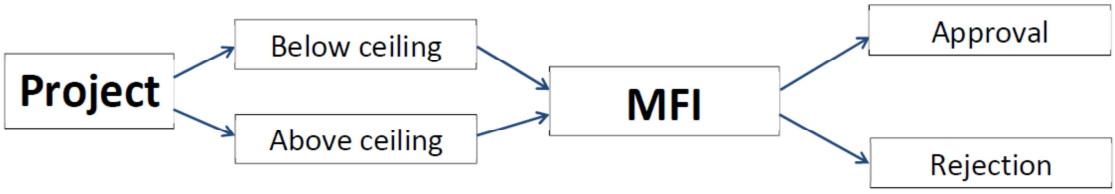

Figure 2: Loan Allocation Process in the Second Period

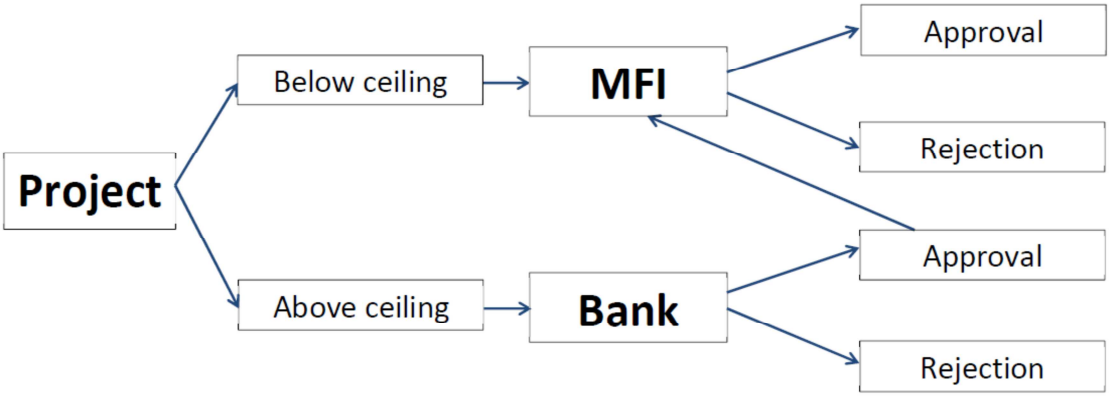

Table 1 displays descriptive statistics concerning the MFI's applicants, disaggregated by period and gender, together with t-tests for equal means between men and women.[13] To focus on the demand side of the market, Table 1 reports statistics for applicants rather than actual borrowers. However, the figures for borrowers are displayed in Table 4 in Appendix 1.

The proportion of female applicants remains similar over the two periods: 38% in the first, 41% in the second. For the first period, the t-tests in Table 1 do not detect any significant differences in financial characteristics between male and female applicants. However, in the second period, women apply to the MFI for smaller loans than men and actually receive even smaller ones. The emergence of co-financing is visible in Table 1 and Table 4 in the Appendix. In the first period, the few applicants holding a bank loan (2.7% of the sample) were all rejected by the MFI. In the second period 27% of applicants and 33% of borrowers had previously secured a bank loan. Unarguably, co-

[13] The sample size is smaller for the first period, which may result in larger standard deviations and less rejections of H_0.

financing went from being a liability for the MFI in the first period to being an asset in the second.

Interestingly, we detect no gender gap in the likelihood of obtaining a bank loan. In contrast, there is a huge gender gap in the size of the bank-supplied loans. Women also tend to undertake smaller projects than men, probably because the loans they manage to obtain from banks are on average 28% lower than those extended to men (EUR 45,940 against EUR 33,050). The average gap (EUR 12,890) represents 47% of the average project size of female applicants (EUR 27,590). Table 4 in Appendix A shows that the sizes of the loans granted by the MFI to women exhibit similar features. This gender-specific credit rationing is in line with previous evidence by Agier and Szafarz (2013a), who detect a "glass-ceiling effect" at a Brazilian MFI, meaning that loan approval is not discriminatory, but women with ambitious projects tend to receive smaller loans than men. Presumably, the fact that gender-related disparate treatment in microcredit affects credit conditions rather than loan approval is linked to the microfinance tradition of serving female borrowers (Armendariz and Morduch, 2010).

Table 1 exhibits large gender disparities in business activities. Strikingly, the share of female projects in the food and accommodation sector dropped in the second period. This decline could be related to the economic crisis that made the sector less attractive.

Table 1: Descriptive Statistics on Applicants

	First period: No ceiling			Second period: Ceiling		
	Male	**Female**	**t-test**	**Male**	**Female**	**t-test**
Loan approval rate	0.47	0.39	0.08	0.60	0.59	0.00
Financial Characteristics						
Requested amount (EURk)	18.51	18.10	0.41	7.14	6.80	0.34*
Granted loan size (EURk)	15.08	17.01	-1.93	7.12	6.55	0.57**
Project size (EURk)	30.64	29.17	1.47	32.40	27.59	4.81*
Has bank loan (%)	0.03	0.01	0.02	0.27	0.28	-0.01
Bank loan (EURk)[a]	40.00	92.20	-52.20	45.94	33.05	12.89**
Has personal investment (%)	0.84	0.77	0.07	0.83	0.83	0.00
Personal investment (EURk) [a]	6.79	5.24	1.55	6.62	5.54	1.08
Business Characteristics						
Start-up (%)	0.84	0.74	0.10*	0.86	0.83	0.03
Food and accommodation (%)	0.10	0.27	-0.17***	0.13	0.13	0.00
Trade (%)	0.19	0.28	-0.08	0.26	0.37	-0.10***
Services (%)	0.30	0.24	0.06	0.25	0.36	-0.11***
Construction (%)	0.15	0.00	0.15***	0.18	0.01	0.16***
Arts and entertainment (%)	0.06	0.06	0.00	0.04	0.04	0.00
Other sectors (%)	0.19	0.15	0.04	0.14	0.09	0.05**
Individual Characteristics						
Unemployed for at least 6 months (%)	0.57	0.52	0.05	0.59	0.60	-0.01
Single (%)	0.53	0.69	-0.17**	0.49	0.54	-0.05
Age (in years)	40.12	36.26	3.86***	39.04	39.03	0.01
Dependent children	0.86	1.04	-0.18	0.80	1.00	-0.20***
Education (# qualifications)	2.58	2.95	-0.38*	2.57	3.07	-0.51***
Household income (EURk)	1.11	1.10	0.00	1.40	1.57	-0.17**
Observations	140	87		518	353	

[a] Computed only for non-zero points.

Overall, the descriptive statistics point to the necessity of controlling for business sector in the regression analysis.

Table 1 also highlights the change in applicants' individual characteristics. In the first period, female applicants are younger than men and more often single. These significant differences disappear in the second period. Concurrently, other differences emerge. The second-period female applicants have more dependent children than their male counterparts; they also exhibit higher education levels and belong to wealthier households. The introduction of the loan ceiling seems to have squeezed out young, single, and poorer female applicants.

Gender aside, Table 1 corroborates the finding that the MFI's pool of applicants changed dramatically in the second period. Practically non-existent in the first period, the occurrence of bank loan holders among applicants jumped to 27%. Meanwhile, the loan approval rate increased. This increase was probably driven by free-riding on bank screening, since the MFI partly relies on the bank's approval decision. Importantly, the average size of the projects submitted to the MFI seems insensitive to the introduction of the ceiling, remaining around EUR 30,000. This might indicate that there is a critical size for entrepreneurial projects in France.

3 Regression Analysis: Methods

Our aim was to estimate the period-specific impacts of the applicant's gender on both loan approval and loan size. We proceeded as follows. For each period separately, we ran a probit regression for approval and an OLS regression for loan size. In both cases, the explained variables of interest include gender (*F*, which takes value 1 if the applicant is female and 0 otherwise) and project size (*PS*, in EUR). In addition, for the second-period estimations, we include the pre-approved bank loan size, if any (*BL*, in EUR, which is equal to zero if there is no bank loan). The control variables grouped in vector $\boldsymbol{X}$ include the applicants' business characteristics (start-up, business sector) and

individual characteristics (marital status, age, number of dependent children, education level and household income).

The probit model for loan approval reads:

$$P(A_i = 1) = \Phi(\beta_0 + \beta_F F_i + \beta_{PS} PS_i + \beta_{BL} BL_i + \boldsymbol{\beta}_{\boldsymbol{x}}' \boldsymbol{X}_{\boldsymbol{i}}) \quad (1)$$

where $\Phi(.)$ is the normal cumulative distribution function, A_i is the dummy, which has a value of 1 when applicant *i* receives a loan and 0 otherwise. Variable *BL* in the right-hand side of Eq. (1) is absent from first-period estimations.

The OLS model for loan size is given by:

$$LS_i = \alpha_0 + \alpha_F F_i + \alpha_{PS} PS_i + \alpha_{BL} BL_i + \boldsymbol{\alpha}_{\boldsymbol{x}}' \boldsymbol{X}_{\boldsymbol{i}} + \varepsilon_i \quad (2)$$

where LS_i is the size of loan i. Variable *BL* in the right-hand side of Eq. (2) is absent from first-period estimations.

Eq. (1) is estimated by using the full sample of applicants while Eq. (2) is estimated on the smaller sample consisting of actual borrowers only. Given that the MFI typically grants the loan size requested by the successful applicants, loan approval or denial represents the only decision variable in the hands of the MFI. The subsequent sizes of approved loans are straightforward outcomes of the loan allocation process.

The estimation of Eqs (1) and (2) may be affected by multicollinearity, however. In both periods, the project size depends on the applicant's characteristics, possibly including gender. In addition, in the second period project holders with a bank loan have necessarily passed the bank's screening process. Their loan size thus depends on both their project size and characteristics. To address this double source of potential multicollinearity, we used the partial least squares (PLS) estimation strategy suggested

by Agier and Szafarz (2013a). At the MFI level, this approach allowed us to disentangle the impacts of demand-side and supply-side factors on both loan approval and loan size.

Specifically, for the first period, we used a single PLS estimation, while for the second we performed a double PLS (2PLS) estimation. For both periods, the first step involved regressing project size on both gender and control variables in the following way:

$$PS_i = \gamma_0 + \gamma_F F_i + \boldsymbol{\gamma}_{\boldsymbol{x}}' \boldsymbol{X_i} + RPS_i \qquad (3)$$

where *RPS* is the residual project size net of the influence of applicant's characteristics.

For the first period, the final steps involved the estimation of Eqs. (1) and (2), where PS_i is replaced by RPS_i obtained from (3):

$$P(A_i = 1) = \Phi(\beta_0 + \beta_{PS}\gamma_0 + (\beta_F + \beta_{PS}\gamma_F)F_i + \beta_{PS}RPS_i + (\boldsymbol{\beta}_{\boldsymbol{x}}' + \beta_{PS}\boldsymbol{\gamma}_{\boldsymbol{x}}')\boldsymbol{X_i}) \qquad (4)$$

$$LS_i = \alpha_0 + \alpha_{PS}\gamma_0 + (\alpha_F + \alpha_{PS}\gamma_F)F_i + \alpha_{PS}RPS_i + (\boldsymbol{\alpha}_{\boldsymbol{x}}' + \alpha_{PS}\boldsymbol{\gamma}_{\boldsymbol{x}}')\boldsymbol{X_i} + \varepsilon_i \qquad (5)$$

For the second period, we applied a second PLS estimation. The size of the bank loan was regressed on gender, residual project size, and the controls. Taking into account Eq. (3), we obtained:

$$BL_i = \delta_0 + (\delta_F + \delta_{PS}\gamma_F)F_i + \delta_{PS}RPS_i + (\boldsymbol{\delta}_{\boldsymbol{x}}' + \delta_{PS}\gamma_X)\boldsymbol{X_i} + RBL_i \qquad (6)$$

where RPL_i is the residual bank loan size net of the influence of all the other explanatory variables, including gender and project size. The estimation of Eq. (6) in itself reveals information on the screening process at banks. The results should be interpreted with care, however, since they may be affected by a selection bias. Indeed, we observe only the bank loans of successful applicants who subsequently applied to the MFI.

In the last step of the second-period estimations, double PLS (2PLS) estimations for the approval rate and the loan size were performed by replacing PS_i by RPS_i (from (3)) and BL_i by RBL_i (from (6)) in both Eqs. (1) and (2). Our equations of interest became:

$$P(A_i = 1) = \Phi(\lambda_0 + \lambda_F F_i + \beta_{BL} RBL_i + \lambda_{PS} RPS_i + \boldsymbol{\lambda_x' X_i}) \quad (7)$$

$$LS_i = \theta_0 + \theta_F F_i + \alpha_{BL} BL_i + \theta_{PS} PS_i + \boldsymbol{\theta_x' X_i} + \varepsilon_i \quad (8)$$

The structure of the λ and θ loadings is provided in Appendix B. The next section discusses the estimation results.

4 Regression Results

4.1 First-Period Estimations

In the first period (April 2008-April 2009), the MFI has the legal status of an unregulated NGO. It is not subject to the EUR 10,000 loan ceiling, and there is no co-financing with banks. Table 2 summarizes the results of the first-period estimations for the demand side (project size), the supply side (approval rate), and the outcome (granted loan size). The estimation methodology follows the lines set out in Section 3. It enables us to trace the impacts of gender and other characteristics throughout the MFI's loan allocation process.

Column (A) reports the loadings of the OLS regression for the project size (Eq. (3)). We do not detect any significant impact of gender on project size, suggesting that women did not undertake smaller projects than men. This outcome is in line with the findings of Bernard *et al.* (2013) who claim there is no gender gap in small start-up financing in France. According to the authors, gender disparities become apparent only

for loans exceeding EUR 25,000. The characteristics that exhibit a significantly positive influence on project size are: education level and some business sectors. A significant influence is observed for three sectors: trade, services, and arts and entertainment.

Table 2: First Period: Project Size, Loan Approval, and Loan Size

	(A)	(B)	(C)
Explained variable	Project size	Approval	Loan size
Estimation method	OLS	Probit/PLS	PLS
Female	-6,030	-0.0574	-666.0
	(4,286)	(0.0886)	(1,658)
Residual project size		-4.55e-06**	0.516***
		(1.95e-06)	(0.049)
Start-up	-4,515	-0.0288	-4,805***
	(5,002)	(0.106)	(1,813)
Food and accommodation	4,202	-0.134	2,904
	(6,576)	(0.131)	(2,464)
Trade	-10,455*	0.114	-6,423***
	(5,987)	(0.123)	(2,172)
Services	-13,766**	-0.0203	-5,905***
	(5,584)	(0.116)	(2,010)
Construction	-14,559*	0.105	-5,579**
	(7,868)	(0.161)	(2,664)
Arts and entertainment	-21,388***	-0.130	-11,437***
	(8,191)	(0.164)	(3,362)
Unemployed for at least 6 months	-3,149	-0.181**	-3,265**
	(3,857)	(0.0786)	(1,421)
Single	-6,650	0.104	-3,988**
	(4,470)	(0.0921)	(1,629)
Age (in years)	-317.1*	0.00396	-204.2***
	(186.2)	(0.00382)	(72.24)
Dependent children	-1,432	-0.0189	-625.8
	(1,838)	(0.0380)	(727.8)
Education (# qualifications)	3,734***	0.0268	1,797***
	(1,288)	(0.0274)	(533.4)
Household income	900.7	0.04	-396.8
	(1,834)	(0.036)	(749.8)
Constant	53,352***		34,269***
	(11,384)		(4,708)
Observations	186	186	88
(Pseudo) R-squared	0.189	0.09	0.753

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Column (B) gives the results for the probit/PLS estimation (Eq. (4)). It reports the marginal effects at the mean for the probability of approval. Gender is not significant. Remarkably, the residual project size has a significantly negative impact on loan

approval. This means that, all else equal, the unconstrained MFI shows a preference for financing smaller projects, which is in line with its social purpose of serving poor borrowers. Among the other explanatory variables, only long-term unemployment stands out with a significantly negative impact on the probability of loan approval.

Column (C) in Table 2 uses PLS estimation (Eq. (5)) for loan size. Again, gender is not significant.[14] As expected, the residual project size has a significantly positive impact on loan size. Several control variables are significant. The size of the microcredit was negatively impacted by the following: start-up, trade, services, construction, arts and entertainment sectors, unemployed for more than 6 months, single dummy and age. The loading of education has a positive sign. However, all these control variables become significant in the PLS estimation, whereas in the OLS model (Eq. (2)) they were not (we present the results for the OLS model in the Appendix C, Table 5, column (B)). This finding suggests that the relationships we find between loan size and the control variables are the result of the link between these variables and project size. More specifically, among selected applicants, start-ups, businesses in trade, services, construction and art sectors, long-term unemployed, single and older individuals receive less from the MFI because they undertake smaller projects rather than being directly attributable to the MFI's selection process.

Overall, we conclude that there is no evidence of discrimination against female applicants during the first period, i.e. when the MFI granted loans without bank co-financing.

[14] The OLS estimation for loan size (Appendix C, Table 5, column (B)) delivers a large and positive coefficient (2,444) for the female dummy but its significance level is low (15%).

4.2 Second-Period Estimations

In the second period (May 2009-June 2012), the MFI is regulated and subject to the EUR 10,000 loan ceiling. This period is characterized by the emergence of co-financing by the MFI and mainstream banks. The descriptive statistics in Table 1 provide evidence that the regime shift that occurred in May 2009 affected the pool of applicants considerably. The regression analysis in Table 3 confirms the preliminary findings. In addition, using the 2PLS estimation set out in Section 3 allows us to stress the impact of bank loans on the MFI's loan allocation process. Table 3 has four columns: Columns (A), (C) and (D) are similar to those in Table 2. The new column (B) explains the size of the bank loan. Naturally, the model in column (B) is estimated on the limited sample of MFI applicants who managed to secure a bank loan.

Column (A) in Table 3 presents the OLS regression for project size. The results show that the situation of women worsened in comparison with the first-period estimation. The implementation of the loan ceiling is concomitant with women applying for smaller projects than their male counterparts. In economic terms, the gender gap in project size is considerable since it amounts to EUR 8,922. Importantly, it is purely demand-side and can hardly be attributed to the MFI. Plausibly, it is attributable to the banks to which entrepreneurs apply for co-financing. Indeed, holders of large projects have to secure a bank loan before applying for microcredit. Given that we only observe applicants who either apply for below-ceiling loans or pass the banks' screening process, the facts are consistent with harsher loan granting by banks. Moreover, the first-period estimation results (column (A) in Table 2) corroborate the finding that the female applicants to the MFI do not spontaneously request smaller loans than men with similar characteristics. A competing scenario is self-selection, which may result from women downsizing their projects in response to the new loan ceiling without even

trying to obtain co-financing. However, this alternative scenario is also consistent with disparate gender treatment by banks. Spontaneous project downsizing could indeed be a rational response from women entrepreneurs to *expected* rejection by the banks. To avert a likely unsuccessful application, women would thus opt for second-best solutions in the form of smaller business projects.

Gender aside, column (A) reveals that the profiles of MFI's applicants changed in the second period. Specifically, the holders of larger projects have different characteristics than their first-period counterparts. In the second period, larger applications emanate from the food and accommodation sector and from households with larger incomes, while the impact of education on project size diminishes. In the second period, both the number of dependent children and the fact of being unemployed have significantly negative impacts on project size. In contrast, household income gains a significantly positive impact. Arguably, these changes could be linked to the disappearance and/or the downsizing of projects rejected by the banks.

In column (B), PLS estimation is used to explain the size of the bank loan. The sample is smaller since only 225 MFI applicants out of 799 secured a bank loan. The loading of the gender dummy is large and highly significant. On average, women's bank loans are EUR 6,774 lower than those of men with similar characteristics. Admittedly, we do not observe banks' loan granting process, so the fact that women come to the MFI for smaller bank loans does not directly prove that banks exercise gender discrimination. Still, put together, the project size regression in column (A) and the bank loan regression in column (B) raise serious concerns about the way mainstream banks treat female applicants. The presence of significantly negative gender impacts in both equations is consistent with the banks being at least partly responsible for the demand-side gender gap that appeared after the loan ceiling was introduced.

Table 3: Second Period: Project Size, Bank Loan, Loan Approval, and Loan Size

	(A)	(B)	(C)	(D)
Explained variable	Project size	Bank loan	Approval	Loan size
Estimation method	OLS	PLS	Probit/2PLS	2PLS
Female	-8,922***	-6,774***	0.0283	-589.6***
	(2,622)	(1,576)	(0.0384)	(210.4)
Residual project size		0.745***	1.82e-06***	0.0237***
		(0.0161)	(5.94e-07)	(0.00261)
Residual bank loan			-3.19e-06	-0.0885***
			(2.17e-06)	(0.0107)
Start-up	-15,985***	-13,364***	-0.101**	-1,211***
	(3,441)	(1,730)	(0.0477)	(260.0)
Food and accommodation	22,423***	18,001***	-0.193**	567.0
	(4,982)	(2,993)	(0.0778)	(387.6)
Trade	6,806	6,482**	-0.183***	452.3
	(4,142)	(2,782)	(0.0639)	(314.7)
Services	-7,520*	-1,334	-0.129**	-417.3
	(4,163)	(3,138)	(0.0647)	(311.2)
Construction	-14,482***	-7,310	-0.114	-375.5
	(5,056)	(7,164)	(0.0791)	(384.8)
Arts and entertainment	7,101	5,167	-0.109	222.0
	(6,937)	(3,865)	(0.108)	(532.2)
Unemployed for at least 6 months	-6,316**	-9,618***	-0.0505	-28.41
	(2,558)	(1,585)	(0.0376)	(201.6)
Single	-3,896	-5,266***	-0.0960**	-55.29
	(2,932)	(1,907)	(0.0432)	(234.2)
Age (in years)	39.36	-200.2**	-0.00199	14.56
	(123.8)	(82.45)	(0.00186)	(10.15)
Dependent children	-2,712**	-2,110***	-0.0410**	-214.8**
	(1,281)	(811.1)	(0.0188)	(106.2)
Education (# qualifications)	1,371*	-485.2	0.0173	183.7***
	(812.5)	(530.5)	(0.0121)	(65.98)
Household income	5,505***	3,169***	0.060***	235.7**
	(1,261)	(722.9)	(0.02)	(93.6)
Constant	41,089***	37,167***		6,643***
	(7,451)	(4,745)		(581.8)
Observations	799	225	799	492
(Pseudo) R-squared	0.186	0.924	0,0645	0.362

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Moreover, column (B) shows that the correlation between project size and bank loan size is both high and significant. This correlation explains the strong match (R-squared is equal to 92.4%). To assess the plausibility of the bank-related explanation for the sudden appearance of a gender gap in demand for micro-loans, Appendix D shows two additional estimations explaining the amount requested from the MFI. First, in the

OLS estimation (column (A) in Table 6) the female dummy is insignificant. Second, the 2PLS estimation (column (B) in Table 6) shows that accounting for the links between both project size and bank loan as well as other covariates renders the loading of the female dummy significantly negative. This result reinforces the argument that the negative impact of gender on the size of the requested microloans is bank-driven.

Together, columns (A) and (B) describe demand to the MFI. Although the samples are different, the project-size and bank-loan equations deliver a consistent picture. This is comforting since the causality between project size and bank loan is tricky to establish. Women-owned businesses and start-ups exhibit smaller applications and get smaller loans from banks while both project size and bank loans are the largest for the food and accommodation sector. Still, a few minor differences are worth mentioning. In particular, both being single and being older than average reduce the size of the granted bank loan, which seems contradictory. Actually, the loading associated with age is small, and age has a low dispersion. The average age of bank loan holders is 38 and the standard error is low (0.61). Therefore, the significance of the impact of age on loan size could be due to a few outliers.

Columns (C) and (D) are devoted to supply-side estimations. The probit/2PLS estimation in column (C) investigates the MFI's approval decisions. The results show that the female dummy is insignificant. This suggests that, as in the first period, the MFI applies a gender-blind approval process. However, in contrast with the first period, the ceiling-constrained MFI exhibits a preference for larger projects. Consistent with this preference, the MFI views a bank loan as an asset. The attraction of co-financing, as opposed to single financing, supports the free-riding hypothesis that the MFI finds it profitable to build on the banks' screening process (Cozarenco and Szafarz 2013). Noticeably, a start-up status, being single, and the number of dependent children have

negative impacts on the probability of receiving a microloan, whereas these effects were absent in the first period.

Column (D) features the 2PLS estimation results for loan size. The estimation is performed on the sample of actual borrowers. Importantly, loan size should be regarded as an outcome variable rather than a decision variable. Indeed, the MFI typically makes an approval/denial decision, and subsequently grants the requested amounts to successful applicants. In contrast with most MFIs active in developing countries, the French institution does not ration the credit provided to its selected borrowers. This lending strategy remained unaffected by the regulatory regime shift.

In column (D) the female dummy has a negative loading, significant at the 1% level. Thus, when the dependence of project size and bank loan on the borrowers' characteristics are accounted for, it appears that second-period female applicants receive smaller loans than their male counterparts. Female borrowers are thus worse off under the loan ceiling regime. Moreover, in the OLS model (Column (D), Table 5 in Appendix C), the gender dummy has a lower impact, which is significant at the 10% level only. This suggests that women get smaller loans from the MFI in the second period than in the first. Table 3 reveals the loading of the female dummy in the loan size equation (column (D)) equals -589.6, more than ten times smaller than its counterparts in the project size equation (-8,922 in column (A)) and in the bank loan equation (-6,774, in column (B)). Therefore, the disparate treatment, if any, is not caused by the MFI. Rather, it is already present in the demand function, which emanates from the second-period applicants. If anything, the MFI tries to correct the bank-driven bias. The higher the residual bank loan, the lower the loan size.[15] However, although significant,

[15] In addition, the impact of the residual bank loan on the MFI loan size (column (D)), is much smaller than its impact on project size (column (B)). Namely, the first coefficient is 0.0237, while the second is 0.745, both being significant at the 1% level.

the estimated coefficient is small. It is far from sufficient to neutralize the gendered impact of co-financing on loan size.

As expected, start-ups receive smaller loans. In contrast to the results for the bank loan, there is no clear pattern for the relationship between the MFI loan size and the borrower's business sector. While the age of the borrower does not seem to influence the MFI, his/her education level and household income have positive impacts on loan size.

In sum, the second-period estimation of the approval rate confirms the first-period results showing that the MFI makes gender-neutral decisions. However, the second-period loan size regression suggests that the MFI's interest in co-financing leads it to grant smaller loans to female borrowers. Rather than correcting the gender gap in loan size imported from banks, the MFI reinforces it. Importantly though, this move seems involuntary, since the MFI's only real decision variable is loan approval/denial, and this variable is not affected by the borrower's gender. Moreover, the first-period estimations show that the gender gap in loan size was absent before the introduction of the loan ceiling and the subsequent emergence of co-financing. Overall, the loan ceiling appears to have a detrimental impact on the size of the loans granted to female borrowers.

5 Conclusion

Gender-neutral regulations can result in gender-sensitive outcomes (Johnson and Nino-Zarazua, 2011). Cull *et al*. (2011) show that profit-oriented MFIs respond to supervision by serving fewer women in order to maintain profit rates. Our paper confirms that apparently benign microcredit regulations, such as a loan ceiling, can significantly affect access to credit for women entrepreneurs. Specifically, we provide evidence that

female micro-borrowers are harmed by the loan ceiling imposed on licensed MFIs by the French regulator. We also offer a possible rationale for the mechanism underpinning this unexpected outcome. A low loan ceiling leads to the development of co-financing schemes between MFIs and mainstream banks. In turn, the MFIs are bound to import whatever biases in loan granting the banks are prone to. Our empirical findings point out the presence of such a bias against female borrowers.

Women are known to start businesses with smaller external finance than men (Coleman, 2000). However, the evidence on gender discrimination in lending remains controversial. According to Carter *et al.* (2007), many of the differences in the bank loans granted to male and female entrepreneurs are attributable to structural dissimilarities. Therefore, any econometric analysis that finds gender discrimination is suspected of having missed relevant variables. In this paper, we get around this issue by using an indirect identification technique and by taking advantage of a natural experiment. We detect gender biases in banks' loan allocation by observing their impact on the applicants of an MFI which proved to be gender-neutral before co-financing with mainstream banks was introduced.

The main limitation of our approach is the impossibility of estimating–and subsequently correcting for–a self-selection bias that might have appeared in the pool of microcredit applicants after the loan ceiling came into force. In addition, we cannot fully exclude that internal or external factors neglected in this study interfere with the change of the MFI's attitude toward female borrowers. Among the external factors, one can think of the financial crisis, which overlaps the first period of our sample. Among the internal factors, we can mention the growth of the institution, which could have affected its governance. Although neither of these factors alone could have generated

the observed gender-sensitive change of attitude, it may well be that they affected the loan granting strategy of the MFI.

Further research could build on our innovative methodology and investigate whether biases also exist in bank lending against other discriminated-against segments of the population. Access to MFIs' databases could make it easier to check whether banks exert disparate treatment based on race and ethnicity. The literature finds that non-white applicants can indeed be discriminated against in lending (Storey, 2004; Blanchard *et al.*, 2008; Blanchflower *et al.*, 2003).

The success of the worldwide microcredit industry is at least partly attributable to its focus on poor female entrepreneurs who desperately need funds to launch their businesses (Garikipati, 2008; Guérin, 2011). It is therefore important to avoid introducing regulations that can counteract the women's empowerment efforts made by MFIs (Hudon and Sandberg, 2013). If the aim of the French regulator is to segment the credit market, then co-financing arrangements should be prohibited. However, ruling out co-financing while maintaining a very low loan ceiling could compromise the sustainability of the microfinance industry, especially if subsidies dry up (Hudon and Traca, 2011). In any case, forcing MFIs to accept a loan ceiling that is too low to meet the needs of micro-businesses is counterproductive. Evidently, the EUR 25,000 ceiling suggested by the EU makes more sense than the EUR 10,000 cap introduced in France.

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Appendix A

Table 4: Descriptive Statistics on Borrowers

	First period: No ceiling			Second period: Ceiling		
	Male	**Female**	**t-test**	**Male**	**Female**	**t-test**
Financial Characteristics						
Requested amount (EURk)	16.27	17.30	-1.03	7.25	6.73	0.52**
Granted loan size (EURk)	15.08	17.01	-1.93	7.12	6.55	0.57**
Project size (EURk)	26.58	26.47	0.11	36.77	32.10	4.67
Has bank loan (%)	0.00	0.00	0.00	0.32	0.33	0.00
Bank loan (EURk)	00.00	00.00	00.00	45.96	37.72	8.25
Has personal investment (%)	0.86	0.76	0.10	0.87	0.85	0.02
Personal investment (EURk)	54.44	48.73	5.71	7.56	6.59	0.98
Business Characteristics						
Start-up (%)	0.82	0.74	0.08	0.82	0.80	0.02
Food and accommodation (%)	0.07	0.24	-0.17**	0.12	0.10	0.02
Trade (%)	0.18	0.35	-0.17*	0.23	0.37	-0.14***
Services (%)	0.30	0.24	0.06	0.25	0.39	-0.14***
Construction (%)	0.17	0.00	0.17**	0.19	0.01	0.18***
Arts and entertainment (%)	0.08	0.00	0.08*	0.05	0.04	0.01
Other sectors (%)	0.20	0.18	0.02	0.17	0.10	0.07**
Individual Characteristics						
Unemployed for at least 6 months (%)	0.50	0.47	0.03	0.55	0.56	-0.02
Single (%)	0.59	0.71	-0.11	0.46	0.45	0.00
Age (in years)	40.92	35.74	5.18**	38.35	38.40	-0.05
Dependent children	0.80	1.00	-0.20	0.78	0.98	-0.20**
Education (# qualifications)	2.71	3.09	-0.38	2.66	3.29	-0.63***
Household income (EURk)	1.14	1.33	-0.19	1.54	1.78	-0.24**
Observations	66	34		309	210	

Appendix B

The coefficients in Eq. (7) are given by:

$$\lambda_F = \beta_F + \beta_{PS}\gamma_F + \beta_{BL}\delta_F + \beta_{BL}\delta_{PS}\gamma_F$$

$$\lambda_{PS} = \beta_{PS} + \beta_{BL}\delta_{PS}$$

$$\lambda'_X = \beta'_X + \beta_{PS}\gamma'_X + \beta_{BL}\delta_{PS}\gamma'_X + \beta_{BL}\delta'_X$$

The coefficients in Eq. (8) are given by:

$$\theta_F = \alpha_F + \alpha_{PS}\gamma_F + \alpha_{BL}\delta_F + \alpha_{BL}\delta_{PS}\gamma_F$$

$$\theta_{PS} = \alpha_{PS} + \alpha_{BL}\delta_{PS}$$

$$\theta'_X = \alpha'_X + \alpha_{PS}\gamma'_X + \alpha_{BL}\delta_{PS}\gamma'_X + \alpha_{BL}\delta'_X$$

Appendix C

Table 5: Simple Probit and OLS Estimations

Period	**First period: No ceiling**		**Second period: Ceiling**	
	(A)	(B)	(C)	(D)
Explained variable	Approval	Loan size	Approval	Loan size
Estimation method	Probit	OLS	Probit	OLS
Female	-0.0846	2,444	0.0440	-389.7*
	(0.0893)	-1,672	(0.0386)	(211.4)
Project size	-4.55e-06**	0.516***	4.20e-06**	0.090***
	(1.95e-06)	(0.409)	(1.66e-06)	(0.008)
Bank loan			-3.19e-06	-0.0885***
			(2.17e-06)	(0.0107)
Start-up	-0.0494	-2,477	-0.0784	-961.0***
	(0.106)	-1,821	(0.0495)	(265.7)
Services	-0.0824	1,195	-0.101	138.4
	(0.116)	-2,049	(0.0643)	(311.4)
Trade	0.0665	-1,031	-0.191***	416.1
	(0.124)	-2,202	(0.0638)	(315.5)
Food and accommodation	-0.116	737.5	-0.231***	151.0
	(0.134)	-2,478	(0.0776)	(393.5)
Construction	0.0391	1,93	-0.0747	275.2
	(0.164)	-2,702	(0.0785)	(386.5)
Arts and entertainment	-0.217	-406.0	-0.123	43.10
	(0.150)	-3,393	(0.108)	(532.5)
Unemployed for at least 6 months	-0.194**	-1,641	-0.0547	-313.6
	(0.0784)	-1,403	(0.0379)	(201.3)
Single	0.0744	-558.2	-0.0965**	-172.2
	(0.0927)	-1,622	(0.0429)	(235.5)
Age (in years)	0.00252	-40.63	-0.00279	-6.679
	(0.00387)	(73.45)	(0.00181)	(9.982)
Dependent children	-0.0254	112.5	-0.0363*	-158.5
	(0.0382)	(731.8)	(0.0189)	(106.4)
Education (# qualifications)	0.0438	-129.3	0.00995	17.96
	(0.0279)	(544.0)	(0.0119)	(65.22)
Household income	0.0438	-861.3	0.0474**	22.93
	(0.0363)	(750.1)	(0.0199)	(95.47)
Constant		6,753		6,250***
		(5,03)		(580.0)
Observations	186	88	799	492
(Pseudo) R-squared	0.09	0.753	0.0645	0.362

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix D

Table 6: Second Period: Requested Amount

Explained variable	(A) Requested Amount	(B) Requested Amount
Estimation method	OLS	2PLS
Female	-189.4	-380.5**
	(171.0)	(170.0)
Project size	0.0835***	
	(0.007)	
Residual project size		0.023***
		(0.002)
Bank loan	-0.0817***	
	(0.00896)	
Residual bank loan		-0.0817***
		(0.00896)
Start-up	-902.5***	-1,145***
	(226.5)	(222.7)
Services	-50.18	-568.9**
	(270.3)	(270.4)
Trade	89.50	127.9
	(268.5)	(268.4)
Food and accommodation	451.5	852.0***
	(326.7)	(323.6)
Construction	69.43	-542.1*
	(328.9)	(327.9)
Arts and entertainment	-60.66	109.8
	(449.2)	(448.9)
Unemployed for at least 6 months	-450.3***	-191.4
	(168.1)	(166.9)
Single	-126.3	-21.11
	(190.1)	(190.4)
Age (in years)	-8.077	11.57
	(8.024)	(8.172)
Dependent children	-15.11	-69.02
	(83.16)	(82.93)
Education (# qualifications)	-33.40	120.7**
	(52.78)	(53.50)
Household income	13.57	214.1***
	(83.18)	(81.67)
Constant	6,805***	7,197***
	(492.2)	(492.0)
Observations	799	799
(Pseudo) R-squared	0.287	0.287

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1