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Gender Biases in Bank Lending: Lessons from Microcredit in France

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Keywords: Microcredit, bank, loan ceiling, gender, France

JEL Classifications: G21, J16, M13, L51, G28, O52, I38

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Abstract

The evidence on gender discrimination in lending remains controversial. To capture gender biases in banks' loan allocations, we observe the impact on the applicants of a microfinance institution (MFI) and exploit the natural experiment of a regulatory change imposing a strict EUR 10,000 loan ceiling on microcredit. Descriptive statistics indicate that the presence of the ceiling is associated both with bank-MFI co-financing and with harsher treatment of female borrowers. To investigate causal links, we develop an econometric approach that addresses the concerns of selection biases, multicollinearity, and endogeneity. Our empirical findings suggest that the change in the MFI's gender-related attitude was triggered by banks through co-financing. Hence, we speculate that co-financing pushes ceiling-constrained MFIs to import whatever biases in loan granting that the banks are prone to. Overall, this paper stresses that apparently benign regulations such as loan ceilings can significantly harm the women's empowerment efforts made by MFIs.

1 Introduction

Access to credit is still a challenging barrier for women entrepreneurs. There are grounds to suspect that unfair lending practices make it harder for women than for men to set up a business (Wilson, 2015). 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.[2] Our paper contributes to this stream of the literature by examining the fairness of French banks' loan granting process through its indirect impact on the applicants of a microfinance institution (MFI).

In France, women account for 47% of the workforce but only 30% of entrepreneurs (Brana, 2013) and, as elsewhere, commercial banks are the main providers of small-business finance (Berger and Udell, 2002; Cornée and Szafarz, 2013). Microfinance institutions (MFI) are new players in the field.[3] Licensed MFIs, i.e. those allowed to finance their activity through borrowing, are subject to a strict EUR 10,000 loan ceiling.[4] However, a significant percentage of entrepreneurs targeted by French MFIs[5] 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.

By imposing a low loan ceiling on MFIs, the French *Conseil d'Etat* (Council of State) sought to preserve banks' prerogative to provide small businesses with loans above EUR 10,000

[2] 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. More generally, Bagus *et al*. (2015) discuss the ethicality of banks' actions.

[3] According to Field *et al.* (2014, p.10) "much of today's microcredit arrangements bear little resemblance to loans offered by organizations such as the United States Small Business Administration (SBA), which are also designed, ostensibly, to support the kind of entrepreneurial risk-taking necessary for success."

[4] This ceiling is significantly lower than the EUR 25,000 threshold recommended by the European Commission.

[5] Most of them are unemployed people aiming at self-employment.

(Brabant *et al.*, 2009). In practice, however, French regulations have led to projects being co-financed by banks and MFIs. This outcome can be viewed as a somewhat unexpected byproduct[6] of the particularly low loan ceiling enforced by the French government (Cozarenco and Szafarz, 2013).[7] It can be rationalized by the fact that co-financing is profitable to credit providers in terms of information sharing and natural complementarities (Bennardo *et al*., 201). In India, ICICI Bank has entered into partnership arrangements with 30 MFIs (Ananth, 2005), whereby loan contracts are directly signed by the bank and the borrowers, and the MFI acts as guarantor against defaults. This solution reduces the MFI's cost of capital while preserving its incentive to monitor borrowers.

Under French regulations, business co-financing can be attractive to all the 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 start-ups with no credit history. Second, for borrowers lacking credit history, co-financing may be the only way to launch relatively large business projects at reasonable cost. Third, co-financing allows ceiling-constrained MFIs to attract entrepreneurs with above-ceiling projects and, to some extent, also offers MFIs an opportunity to free-ride on banks' screening processes.[8]

At the same time, co-financing implies that MFIs' pools of applicants become shaped by banks, at least partly. 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

[6] 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.

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

[8] In our dataset, 71% of the applicants with a secured bank loan ended up with a co-financing arrangement. Moreover, in three years out of four (2009, 2010, and 2011, but not 2012) the interest rates charged by the banks are significantly higher than the rate charged by the MFI.

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 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.

Co-financing is still understudied. While the literature cites evidence of 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.[9] In 2010, developed countries accounted for only 2.6% of the microfinance clients reported in the 2012 Microcredit Summit Campaign Report.[10]

Our results, based on double partial-least-square (2PLS) estimation and Heckman selection models, confirm that the loan ceiling has dramatically changed loan allocation in the MFI we have studied. Specifically, after the ceiling was brought in, the institution started to co-finance above-ceiling projects with mainstream banks and women received loans that were significantly smaller than in the first period, all else equal. Possibly, the new rule has led the MFI to partially surrender control of its loan allocation decision to mainstream banks, which screen their loan applicants in a way that puts women at a disadvantage. Our empirical results support this explanation.

The remainder of this paper is structured as follows. Section 2 provides an overview of the data. Section 3 introduces the econometric methodology and discusses the results. Section 4 tests the robustness of our findings. Section 5 concludes.

[9] As pointed out by Vanroose and D'Espallier (2013), microfinance reaches more clients in countries with low financial inclusion, which is not the case of developed countries in general, and France in particular.
[10] http://www.microcreditsummit.org/uploads/resource/document/web_socr-2012_english_62819.pdf

2 Data and Descriptive Statistics

Individual data on the applicants and borrowers of a French MFI set up in 2006 were hand-collected. 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. Regardless of repayment record, the MFI grants only one loan to each borrower. Its objective is to facilitate sustainable access to mainstream finance by allowing clients to build a credit history and improve business opportunities (Gutiérrez-Nieto *et al*., 2014). According to this view, microcredit is just a temporary solution to the lack of funding. Until April 2009, the institution operated under the unregulated non-governmental organization (NGO) status. As such, it was required to finance its activity through subsidies only, which restricted 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, it has been subject to the EUR 10,000 loan ceiling. Although the change of status enabled the MFI to grow significantly,[11] 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 duration is 51 months. Applications are examined by a loan officer, while the credit committee has the final say on approval. Typically, the decision is binary: the credit committee either approves or denies a loan of the size requested by the applicant. 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 determine their financial needs and

[11] In 2010, the MFI opened two new branches and its staff passed from six to ten employees.

offering them business development services.[12] The MFI has no commitment to these independent—and typically subsidized—NGOs.

The full sample period is split in two. The first sub-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 sub-period, the MFI received 227 applications and granted 100 loans. During the second, it received 871 applications and granted 519 loans.

From the client's perspective, the main difference between the two sub-periods is the emergence of co-financing. Figs. 1 and 2 illustrate the change that took place in May 2009. In the first sub-period (Fig. 1), the MFI financed projects up to EUR 40,000[13] without bank intervention. In the second sub-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 typically charges an interest rate that is lower than that of mainstream banks. Projects turned down 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 of and interest rates on these loans.

[12] The granted loan size was smaller than the requested one in just 7.6% of our sample. In contrast, most MFIs determine loan sizes in house (Agier and Szafarz, 2013b).
[13] This threshold was hardly binding.

Figure 1: Loan Allocation Process in the First Period

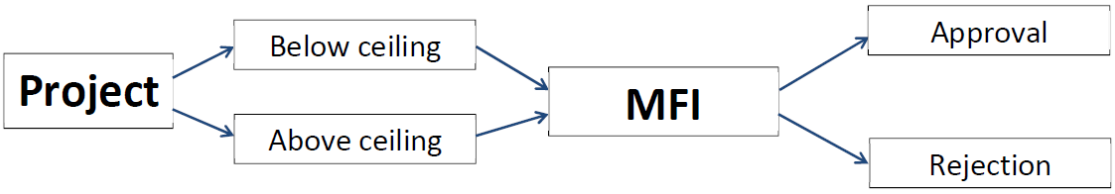

Figure 2: Loan Allocation Process in the Second Period

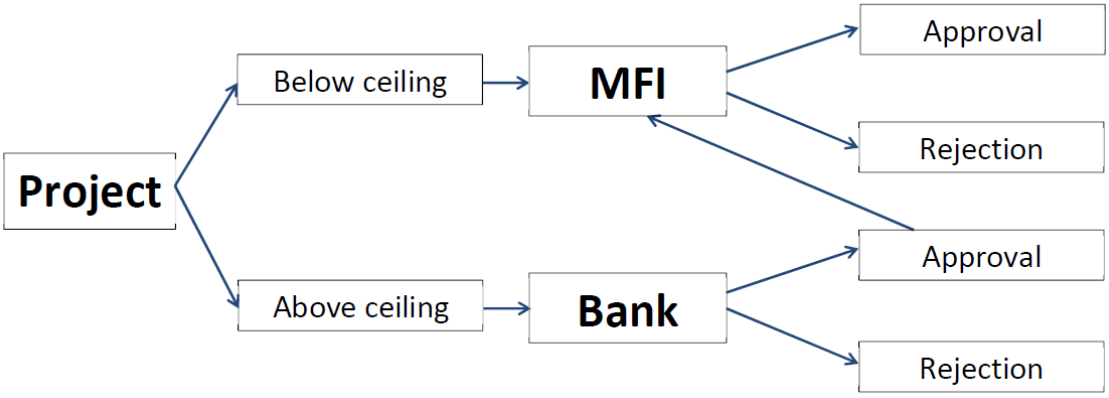

Table 1 displays descriptive statistics concerning the MFI's applicants, disaggregated by period and gender, together with t-tests for equal means between men and women.[14] To focus on the demand side of the market, Table 1 reports statistics for applicants rather than actual borrowers. The figures for borrowers alone are displayed in Table 2.

The proportion of female applicants is similar over the two sub-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 sub-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 2. In the first sub-period, the few applicants holding a bank loan (2.7% of the sample) were all rejected by the MFI. In the second sub-period, 27% of applicants and 33% of borrowers had previously secured a bank loan. Unarguably, co-financing went from being a liability for the MFI in the first sub-period to being an asset in the second.

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

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**
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 (%)[15]	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 (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 (# diplomas)	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.

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

[15] The other sectors (real estate, information technology, agriculture and fishing; education, health and social work, industry, and transportation) are grouped together because they correspond to few observations in our sample.

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).

Table 2: 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) [a]	00.00	00.00	00.00	45.96	37.72	8.25
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 (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 (# diplomas)	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	

[a] Computed only for non-zero points.

The average gap (EUR 12,890) represents 47% of the average project size for female applicants (EUR 27,590). Table 2 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 that 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, which made the sector less attractive. 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. The occurrence of bank loan holders among applicants, practically non-existent in the first period, 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 Methods and Results

Our aim is to compare the impacts of the applicant's gender on both loan approval and loan size before and after enforcement of the loan ceiling. This section describes and applies our empirical methodology in a progressive way. First, in Section 3.1 we estimate a Heckman model to take into account potential selection biases. The results reveal that the implementation of the loan ceiling coincided with a significant gender gap in loan size. To further explore the reasons for that gap, Section 3.2 turns to a 2PLS estimation design, which makes it possible to scrutinize changes in the demand and supply sides of the microcredit market. Finally, to further isolate the putative responsibility of the MFI in the detected gender gap, Section 3.3 uses a sample restricted to holders of relatively small projects, i.e. those least likely to be affected by the loan ceiling.

3.1. Addressing Selection Biases

Our sample can be affected by three selection biases. The first relates to the bank's selection process, and concerns second-period entrepreneurs with large projects, for whom the bank's approval is a pre-requisite for microcredit (see Fig. 2). The second bias is about ceiling-induced self-selection. The existence of a loan ceiling might discourage entrepreneurs with large projects from applying for credit. Third, loan size is observable only for the applicants who survive the MFI's selection process. While we have no information on credits denied by the banks or on abandoned projects, we do observe the characteristics of the MFI's unsuccessful applicants. Since our focus is on the MFI's loan allocation process, the potential bias originating from the MFI is the most disruptive to our analysis. Therefore, we use Heckman's (1979) estimation model. Selection is taken care of by a probit model explaining loan approval; the outcome variable is loan size:

$$LoanSize_i = \mu_0 + \mu_F Female_i + \mu_C Ceiling_i + \mu_{FC} Female_i * Ceiling_i + \mu_{BL} BankLoan_i + \mu_{PS} ProjectSize_i + \mu_x' \boldsymbol{X_i} + \varepsilon_i \quad (1)$$

$$Approval_i = \mathbb{1}[\lambda_0 + \lambda_F Female_i + \lambda_C Ceiling_i + \lambda_{FC} Female_i * Ceiling_i + \lambda_{BL} BankLoan_i + \lambda_{PS} ProjectSize_i + \lambda_x' \boldsymbol{X_i} + \lambda_z' \boldsymbol{Z_i} + v_i > 0] \quad (2)$$

where index i refers to loan applicants, $v \sim N(0,1)$ and $E(\varepsilon|v) \neq 0$. In Eq. (1) $LoanSize$ is observed for approved loans only. Loan approval is determined in Eq. (2), where $\mathbb{1}[Y > 0]$ is the dummy variable taking value 1 when *Y* is positive and 0 otherwise.

Eqs. (1) and (2) include the following key explanatory variables: the gender dummy (*Female*) taking value 1 when the applicant is a woman and 0 otherwise, the period dummy (*Ceiling*) taking value one in the ceiling period and 0 otherwise, and the interaction term (*Female*Ceiling*) that captures gender differences in loan granting across periods. The loading of this interaction term will indicate whether gender has heterogeneous effects across the two regulatory frameworks. This approach is inspired by the difference-in-differences method, which is not applicable here since we do not have appropriate control and treatment groups. Strictly speaking, observed differences between the two sub-periods in our framework cannot be attributed solely to the loan ceiling. Moreover, female and male applicants were all equally constrained by the enforcement of the ceiling.

The $\boldsymbol{X}$ vector is made up of control variables including the applicant's business characteristics (existing business or start-up, sector of activity) and individual characteristics (marital status, age, number of dependent children, education and household income), as well as a dummy variable taking value 1 if the applicant has already secured a bank loan. In addition, Heckman's methodology requires the introduction of the **Z** vector, made up of explanatory variables that are supposed to affect approval decision-making but not loan size. These variables are the sector-specific growth rate of default, and the sector-specific growth rate of start-ups at

three different points in time (the application date, one quarter before it, and two quarters before it). These variables act as proxies for the sensitivity of loan approval to business cycles.

In both equations, the coefficients of the interaction term will capture changes in the MFI's attitude to women, if any. A significantly negative value in Eq. (1) would mean that credit granting became harsher to female applicants after the loan ceiling was introduced. Likewise, a negative value in Eq. (2) would testify to smaller loans granted to women by the ceiling-constrained MFI, all else equal.

The estimation results for Eqs. (1) and (2) are presented in Table 3. Columns (1) and (2) are obtained using the full sample while columns (3) and (4) feature estimation performed on small projects only. We single out small projects in order to check whether the impact of the ceiling, if any, is visible on the projects that would not necessarily require bank co-financing. In this way, we assess the banking-channel hypothesis in the MFI's change of attitude toward women.

Small projects are defined as those below EUR 25,000. We apply a threshold higher than the EUR 10,000 ceiling because French applicants for microcredit have easy access to several sources of extra financing, such as state-subsidized loans, and use them abundantly (see Table A2 in Appendix). As a result, the actual constraint imposed by the ceiling on project size (rather than loan size) is likely closer to EUR 25,000 than to EUR 10,000 (see Cozarenco and Szafarz, 2013). Additionally, a less stringent threshold allows us to keep more observations and so improve the statistical accuracy of the regressions.

Columns (1) and (3) in Table 3 show that gender has no significant impact on loan approval in either sample and in either period, suggesting that the MFI's approval process is free from gender discrimination over the entire observation period. In contrast, in column (2) the loading of the gender dummy is significantly positive (point estimate: 2,072) while the loading

of the *Female*Ceiling* interaction term is significantly negative with a roughly similar absolute value (point estimate: - 2,184).

The figures from loan size estimation are provided in columns (2) and (4) of Table 3. 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 in developing countries, the French institution does not ration the credit provided to its selected borrowers. This lending strategy was unaffected by the regulatory regime shift. The results in column (2) suggest that in the ceiling-free period, the MFI granted larger loans to women than to men. This is in line with a women-friendly orientation of the MFI, a typical feature of microcredit. This effect, however, disappears with the introduction of the loan ceiling, which is concomitant with the MFI offering smaller loans to women.

The picture is different when the sample comprises small projects only (column (4)). Both gender-sensitive variables are insignificant. A possible explanation could stem from the reduction of the sample size (passing from 985 to 631). However, two arguments make this explanation unlikely. First, the reduced sample is still conveniently large since it covers more than 62% of the initial sample. Second, the loading of the interaction term in column (4) is four times as small as in column (2), with a similar standard error.

Together the results from columns (2) and (4) give credence to the idea that the loan ceiling affected the MFI's clientele because it led to the emergence of co-financing schemes. Accordingly to this argument, the MFI's applicant pool was partly shaped by the banks since most large projects received by the institution first needed to survive a bank screening process. This theory is corroborated by the highly significant impact of the bank loan in column (2), which contrasts with no such significance in column (4). The loading of the bank loan in column (2) is negative, meaning that a smaller bank loan is associated with a larger microcredit from the

MFI. One can think of two different reasons for this counter-intuitive result. First, from a supply-side perspective, the MFI could feel committed to ease funding for those finding it difficult to access traditional finance. Second, from the demand side, the applicants who are more confident in their own creditworthiness might prefer to apply for larger loans from the MFI, from which they expect better conditions.

Our results thus suggest that the ceiling-constrained MFI lost some control over its loan allocation process, which translated into abandoning its women-friendly bias. This interpretation is speculative, however, since several other factors concomitant with the implementation of the loan ceiling might be involved in a shift in the gendered allocation of microcredit. Section 3.2 will address this issue.

The impacts of the control variables provide valuable insights. The period dummy is strongly significant in the two loan size equations, regardless of the sample. This was to be expected since the ceiling automatically decreases the size of the loans the MFI is allowed to grant. Evidently, project size has a significantly positive impact on loan size. Regarding the sector of activity, applicants from services, trade, and the food and accommodation sector suffer from lower credit approval rates than those from the other sectors (mainly agriculture and industry), all else equal. Logically, household income has a positive effect on the probability of approval while being unemployed for at least six months and having dependent children decrease this probability. Start-ups and older entrepreneurs receive smaller loans from the MFI.

Finally, the inverse of the Mills ratio is not significant, suggesting that the MFI's approval decision creates no selection bias on the estimation of loan size. In the next section, we seek to identify the determinants of the change in the MFI's gender-related attitude to loan granting. Despite the insignificance of the inverse of the Mills ratio, we keep using the Heckman approach for the sake of consistency with our estimation strategy.

Table 3: Heckman Selection Model

Explained variable	**Approval**	**Loan Size**	**Approval**	**Loan Size**
	(1)	(2)	(3)	(4)
	Full sample (N = 985)		Small projects[a] only (N = 613)	
Female	-0.0937	2,072**	-0.379	194.7
	(0.200)	(884.7)	(0.298)	(769.2)
Ceiling	0.211	-6,579***	-0.151	-2,056***
	(0.150)	(626.9)	(0.201)	(457.7)
Female*ceiling	0.157	-2,184**	0.478	-511.2
	(0.219)	(951.6)	(0.311)	(826.8)
Project size	0.00123	211.4***	0.000283	242.0***
	(0.00315)	(12.43)	(0.0100)	(23.45)
Bank loan	-8.92e-08	-0.251***	4.45e-05	-0.165
	(4.58e-06)	(0.0172)	(6.92e-05)	(0.136)
Having a bank loan	0.269*	602.6	-0.391	-919.2
	(0.146)	(569.2)	(0.548)	(1,187)
Start-up	-0.195	-1,684***	-0.295	-2,111***
	(0.122)	(482.0)	(0.186)	(449.6)
Services	-0.291**	-32.97	-0.356*	-19.70
	(0.146)	(566.2)	(0.186)	(440.2)
Trade	-0.441***	-509.5	-0.580***	-216.4
	(0.149)	(642.0)	(0.193)	(561.5)
Food and accommodation	-0.584***	-171.2	-0.700**	-216.1
	(0.174)	(838.5)	(0.277)	(851.1)
Construction	-0.154	274.9	-0.258	-30.05
	(0.181)	(653.7)	(0.217)	(472.7)
Arts and entertainment	-0.382	-933.8	-0.514*	-779.9
	(0.234)	(938.6)	(0.311)	(788.0)
Unemployed for at least 6 months	-0.179**	-610.5*	-0.167	-445.8
	(0.0897)	(366.7)	(0.115)	(284.3)
Single	-0.142	-441.9	-0.0307	-51.54
	(0.102)	(423.9)	(0.129)	(304.5)
Age	-0.00375	-29.81*	-0.00290	2.525
	(0.00428)	(17.14)	(0.00543)	(12.92)
Dependent children	-0.0870**	-251.1	-0.0460	-126.0
	(0.0439)	(197.1)	(0.0538)	(140.2)
Education (#diplomas)	0.0369	97.99	0.0389	0.295
	(0.0284)	(117.6)	(0.0362)	(91.34)
Household income	0.132***	-219.4	0.171***	10.40
	(0.0453)	(201.5)	(0.0657)	(196.1)
Inverse of Mills ratio	47.40		-157.2	
	(1,730)		(1,287)	
Constant	0.605**	12,928***	0.905**	7,135***
	(0.303)	(1,436)	(0.420)	(1,022)
Business cycles	Yes		Yes	

[a]: Small projects are defined as being below EUR 25,000

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

3.2. Addressing Multicollinearity

The results from the previous subsection lead us to further investigate why the MFI became less women-friendly after the loan-ceiling was put in place. We use PLS estimation to address the issue of multicollinearity, which could originate from high correlations between project size, bank loan, and other covariates used in the regressions. In both periods, the project size depends on the applicant's characteristics, possibly including gender. In addition, entrepreneurs with a bank loan have successfully passed the bank's screening process. Their loan size thus depends on both their project size and characteristics.

Table A1 in Appendix A gives us good reason to fear that multicollinearity plagues the estimates in Table 3. Both project size and bank loan are significantly correlated to many other explanatory variables. The PLS estimation strategy, suggested by Agier and Szafarz (2013a) in a similar context, allows us to disentangle the impacts of demand-side and supply-side factors on both the requested amount and the loan size. The strategy mimics the sequential loan granting process that takes place in the MFI (see Figs. 1 and 2). Intuitively, the idea is to disentangle "pure" gender impacts from the impacts of other characteristics that are not gender-neutral. In particular, the microfinance literature has amply documented that women tend to undertake smaller projects than men. To acknowledge this possibility, PLS estimation will allow us to make a clear distinction between the impacts of gender and of project size.[16]

In the situation under review, the presence of bank loans leads us to run 2PLS estimation. First, the project size is chosen by the applicant (OLS estimation), then the bank loan is revealed (PLS estimation), and lastly the MFI makes its decision on loan approval and loan size (Heckman-2PLS estimation). The third leg of this process is captured by Eqs. (1) and (2) in Section 3.1. We now introduced the two steps that predate the MFI decision process in our more

[16] However, as pointed out by Johnson (2014), characteristics that are highly correlated with gender can hide an underlying reality involving gender discrimination.

comprehensive estimation design. In the first step, the project size is regressed on gender, period, their interaction, and the control variables. The estimated model is given by:

$$ProjectSize_i = \gamma_0 + \gamma_F Female_i + \gamma_C Ceiling_i + \gamma_{FC} Female_i * Ceiling_i + \boldsymbol{\gamma}_x' \boldsymbol{X_i} + ResidualProjectSize_i \quad (3)$$

where the residual project size is the project size net of the influence of both the applicant's characteristics (including gender) and the period effect. Vector X is the same as in Eq. (1), except for the bank-related variables, which are excluded in order to comply with our temporal pattern. Coefficient γ_{FC} of the interaction term in Eq. (3) will indicate whether women undertake projects of different sizes in the second period.

In the second step, we explain the size of the bank loan (which equals zero if there is no bank loan) with gender, period,[17] residual project size, and the controls. The OLS regression for the bank loan would written:

$$BankLoan_i = \delta_0 + \delta_F Female_i + \delta_C Ceiling_i + \delta_{PS} ProjectSize_i + \boldsymbol{\delta}_x' \boldsymbol{X_i} + ResidualBankLoan_i$$

However, in order to address the multicollinearity concern, we take into account Eq. (3) and obtain the following PLS estimation for the bank loan:

$$BankLoan_i = \delta_0 + \delta_{PS}\gamma_0 + (\delta_F + \delta_{PS}\gamma_F) Female_i + (\delta_C + \delta_{PS}\gamma_C) Ceiling_i + \delta_{PS} ResidualProjectSize_i + (\boldsymbol{\delta}_x' + \delta_{PS}\gamma_X) \boldsymbol{X_i} + ResidualBankLoan_i \quad (4)$$

where the residual bank loan is the bank loan net of the influence of all explanatory variables, including gender and residual project size.

[17] Due to the specific nature of our sample, introducing the interaction term in Eq. (4) would make little sense. During the ceiling-free period, only six applicants came to the MFI with a bank loan and none of them ended up with a loan from the institution.

In addition to addressing multicollinearity, estimating Eq. (4) will reveal information on the screening process taking place in banks. The interpretation exercise should be performed with care, however, since we observe only the bank loans of successful applicants who subsequently applied to the MFI.

Combining the 2PLS model in Eqs. (3) and (4) with the Heckman model in Eqs. (1) and (2) yields the following specification:

$$LoanSize_i =$$

$$\mu_0 + \mu_F Female_i + \mu_C Ceiling_i + \mu_{FC} Female_i * Ceiling_i + \mu_{BL} ResidualBankLoan_i +$$

$$\mu_{PS} ResidualProjectSize_i + \boldsymbol{\mu_x'} \boldsymbol{X_i} + \varepsilon_i \quad (5)$$

$$Approval_i =$$

$$\mathbb{1}[\lambda_0 + \lambda_F Female_i + \lambda_C Ceiling_i + \lambda_{FC} Female_i * Ceiling_i + \lambda_{BL} ResidualBankLoan_i +$$

$$\lambda_{PS} ResidualProjectSize_i + \boldsymbol{\lambda_x'} \boldsymbol{X_i} + \boldsymbol{\lambda_z'} \boldsymbol{Z_i} + v_i > 0] \quad (6)$$

Both Eqs. (5) and (6) use residual project size and residual bank loan as explanatory variables. These variables are estimated from Eqs. (3) and (4), respectively. With the 2PLS approach, each $\mu_.$ loading in Eq. (5) encompasses four different effects. For instance, μ_F, the loading of the female dummy in Eq. (5), can be decomposed into:

$$\mu_F = \alpha_F + \alpha_{PS}\gamma_F + \alpha_{BL}\delta_F + \alpha_{BL}\delta_{PS}\gamma_F \quad (7)$$

The four right-hand-side terms in Eq. (7) represent respectively:

- the direct gender effect (α_F)
- the indirect gender effect *via* project size ($\alpha_{PS}\gamma_F$)
- the indirect gender effect *via* bank loan ($\alpha_{BL}\delta_F$)
- the indirect gender effect *via* the impact of project size on bank loan ($\alpha_{BL}\delta_{PS}\gamma_F$).

The full gender gap in loan size is split into four components, each representing a specific channel of influence on the loan size determined by the MFI. When making its decision, the MFI takes into account the applicant's characteristics as well the project size and the size of a potential bank loan. In turn, the bank loan depends on the borrower's characteristics and project size. Each step might be the source of a gender gap that would ultimately appear in the MFI's final decision. The decomposition in Eq. (7) also indicates the party responsible for a potential gender gap in loan size. Obviously, the direct effect comes from the MFI, the indirect gender effect *via* project size is due to the applicant, while the bank has a clear share of responsibility in the two remaining effects where its loan is concerned. Therefore, using 2PLS estimation allows us to differentiate demand-side and supply-side impacts on loan size. This is crucial as we are tracking a change in loan allocation, which is supply-side concept. Table 4 presents the full-sample estimations of the Eqs. (3) to (6) in columns (1) to (4), respectively.

Column (1) in Table 4 shows that gender has a significant impact on project size. The coefficient of the interaction term is insignificant, suggesting that women's project sizes and the MFI's status (without or with loan ceiling) do not interact. Indirectly, this is also evidence against potential endogeneity stemming from the non-randomness of the MFI's change of status. The figures indeed suggest that the timing of the regulatory regime shift does not coincide with any major change regarding female projects.

Column (1) in Table 4 also reveals that women tend to undertake smaller projects than men, all else equal. In economic terms, the gender gap in project size is considerable, amounting to EUR 9,078 in the first sub-period and EUR 8,389 in the second. Using the PLS approach will thus prevent us from erroneously attributing this demand-sided gender effect to the supply side, be it with the bank or the MFI. The other characteristics that have a significantly positive influence on project size are: food and accommodation sector, education, and household income.

A negative influence is observed for two activity sectors: services and construction. Likewise, start-ups and long-term unemployed individuals undertake smaller projects.

Table 4: Full Sample Results: 2PLS Estimation

Explained variable	**Project size**	**Bank loan**	**Approval**	**Loan size**
	(1)	(2)	(3)	(4)
Estimation method	OLS	PLS	Heckman-2PLS	
Female	-9.078*	-5,101***	-0.104	1,433
	(5.051)	(687.5)	(0.200)	(885.3)
Ceiling	-1.141	10,082***	0.208	-9,351***
	(3.432)	(820.3)	(0.145)	(615.6)
Female*ceiling	0.689		0.158	-2,038**
	(5.510)		(0.219)	(951.7)
Residual project size		662.6***	0.00117	45.05***
		(9.690)	(0.00169)	(5.570)
Residual bank loan			-8.92e-08	-0.251***
			(4.58e-06)	(0.0172)
Having a bank loan			0.269*	602.6
			(0.146)	(569.2)
Start-up	-12.98***	-9,491***	-0.210*	-2,046***
	(2.935)	(885.0)	(0.122)	(484.7)
Services	-9.752***	-3,939***	-0.303**	-1,105*
	(3.500)	(1,055)	(0.146)	(565.7)
Trade	3.229	4,387***	-0.437***	-928.1
	(3.521)	(1,062)	(0.149)	(641.0)
Food and accommodation	17.31***	10,950***	-0.563***	738.5
	(4.167)	(1,255)	(0.176)	(831.1)
Construction	-16.03***	-9,233***	-0.173	-795.7
	(4.350)	(1,312)	(0.181)	(655.1)
Arts and entertainment	-0.839	2,887*	-0.384	-1,836*
	(5.655)	(1,706)	(0.233)	(940.6)
Unemployed for at least 6 months	-6.187***	-7,054***	-0.186**	-147.8
	(2.198)	(663.0)	(0.0894)	(366.9)
Single	-4.664*	-3,964***	-0.148	-432.9
	(2.521)	(758.4)	(0.102)	(424.0)
Age	-0.0432	-42.80	-0.00380	-28.19
	(0.107)	(32.13)	(0.00428)	(17.17)
Dependent children	-2.658**	-1,437***	-0.0901**	-452.3**
	(1.093)	(329.7)	(0.0438)	(197.7)
Education (#diplomas)	1.754**	588.0***	0.0391	321.1***
	(0.707)	(213.1)	(0.0282)	(117.1)
Household income	4.444***	1,978***	0.137***	223.5
	(1.076)	(324.7)	(0.0453)	(201.7)
Inverse of Mills ratio			47.40	
			(1,730)	
Constant	46.41***	15,289***	0.661**	18,900***
	(6.975)	(2,015)	(0.290)	(1,408)
Business cycles			Yes	
Observations	985	985	985	985
R-squared	0.167	0.856		

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

Column (2) in Table 4 explains the size of the bank loan, using the PLS model in Eq. (4). The loading of the female dummy is negative and highly significant. Moreover, the effect is large since the gender gap in the bank loan reaches EUR 5,101. Again, this result should be interpreted with care since we observe only holders of bank loans who later applied to the MFI. The strongly positive impact of the period dummy on the bank loan testifies to the presence of co-financing arrangements during the second sub-period. Moreover, the correlation between project size and bank loan size is both high and significant, which explains the high value of R-squared (86%). Project size aside, businesses from the service sector receive smaller loans from banks, while higher levels of education and household income are associated with larger bank loans.

Column (3) in Table 4 estimates the probability of approval with the 2PLS approach. Except for the now-borderline impact of the start-up dummy, there is no noticeable difference with Table 3.

Table 5: Disentangling Gender Effects

Type of effect / **Explained variable**	**Project size**	**Bank loan**	**Loan size**
Impact of the gender dummy (*Female*)			
Direct effect (OLS estimation)	-9,078*	540	2,072**
Indirect effect *via* Project Size (PLS estimation)		-5,101***	153
Indirect effect *via* Project Size and Bank Loan (2PLS estimation)			1,433
Impact of the interaction term *(Female*ceiling)*			
Direct effect (OLS estimation)	689	Not	-2,183**
Indirect effect *via* project size (PLS estimation)		Applicable	-2,038**

*** p<0.01, ** p<0.05, * p<0.1

Column (4) in Table 4 presents the results from the Heckman-2PLS estimation of the loan size equation. Comparing the new estimates with those derived from the former Heckman-

OLS estimation (column (2) in Table 3) shows the usefulness of the PLS approach. To get a better idea of the specific impacts of gender on both bank loan and loan size, we exploit the coefficient decomposition presented in Eq. (7). Table 5 details the decompositions associated with the estimates featured in Table 4. While OLS estimation indicates that gender does not matter for the size of bank loans, PLS estimation suggests that women receive significantly less than men with similar characteristics. The difference is interpreted as evidence that women ask for smaller loans than men do. In other words, women indeed receive smaller loans from banks than men, but the main reason is that they undertake smaller projects. Likewise, the OLS estimation suggests that the MFI's loan size is significantly titled toward female applicants, but the PLS estimation refines the analysis by revealing that the observed effect is not purely gender-based. Altogether, our results suggest that the MFI is a gender-neutral lender that not only observes that women undertake smaller projects but also attempts to correct for biases in bank loans. One can imagine that when the MFI came to realize that women entrepreneurs are more conservative in their requests for funding, it adapted its loan allocation process accordingly. Following this interpretation, the ceiling-free MFI was willing to grant larger loans to women than to men with similar characteristics not because of a gender bias in favor of women, but because the MFI was aware that among the male and female applicants with similar projects, women would request smaller loans and thus possibly entail lower credit risk. [18]

Interestingly, the impact of the gender-period interaction term on the MFI's loan size is significantly negative, regardless of the estimation method used. This adds credence to the scenario involving banks as drivers of the MFI's gendered loan allocation in the second sub-period. The loading of the interaction term in column (4) in Table 4 shows that the ceiling-constrained MFI imposed a cut of EUR 2,038 on loans to women relative to loans granted by the same but ceiling-free institution to women with similar characteristics. This amount is

[18] This argument involving credit risk is speculative since we do not observe the outcomes of the loans. This being said, the literature amply documents that women are more creditworthy than men, all else equal (D'Espallier *et al*. 2011).

economically meaningful because it represents more than 20% of the EUR 10,000 ceiling. The PLS approach detailed in Table 5 delivers a picture showing a first-period gender-neutral MFI that unexpectedly moved to harsher treatment toward women after the loan ceiling was enforced. This suggests the emergence of an involuntary underlying mechanism. It could be that in the first period the MFI had full control over its pool of applicants, while in the second period the emergence of co-financing schemes made the institution's loan allocation closer to that of mainstream banks. The underlying mechanism could originate from the fact that a significant portion of its applicants were pre-screened by banks, which in turn created a free-riding opportunity for the MFI. Since banks tend to screen their applicants more harshly than MFIs, having to deal with pre-screened applicants could have been a godsend for the MFI. However, our results reveal that there can be a hidden cost associated with this apparent free-riding opportunity, namely becoming dependent on the banks means inheriting whatever biases and preferences bankers embed in their screening process. In this respect, the gender lens is a meaningful example.

An alternative argument could be that the MFI consciously changed its attitude to women. In this perspective, co-financing would be the consequence rather than the cause of the gender gap. Although the MFI repeatedly claimed that its change of status had no influence on its social orientation, complying with the regulation was a voluntary act motivated by its willingness to grow and access new funding opportunities. Hence, at this point we cannot exclude that the observed change in loan granting is a willful act by the MFI's managers. Regardless, our results show that under the loan-ceiling regulation, the situation of women requesting microcredit has worsened in comparison with the unregulated period. By focusing on regressions run on our restricted sample of small projects, the next regressions will help us investigate the actual agenda of the newly regulated MFI.

Overall, when differences in gendered demand for credit are properly accounted for, the MFI appears to treat men and women equally. By disentangling the two (correlated) key variables, gender and project size, the PLS approach has allowed us to clean the gender effect from the project-size effect.

3.3. Focus on Small Projects

Table 6 presents the results of the Heckman-2PLS estimations run on a sample restricted to projects below EUR 25,000. This threshold acts as a proxy for the size limit below which most borrowers do not need a bank loan to build a viable funding plan.[19] The idea behind the current exercise is the following. If the findings of the previous subsection resist the sample restriction, then we should exonerate the banks from any responsibility in the observed downsizing of female loans after the regulation was implemented. Alternatively, the fading-out of the impact of the *Female*ceiling* interaction would suggest that the previous evidence is intertwined with the emergence of bank co-financing.

Columns (3) and (4) in Table 6 show that the loadings of the interaction term do not significantly impact the MFI's granting process. Its attitude seems stable toward female entrepreneurs who have small projects (and generally no bank loan). Globally, Table 6 points to the argument that the change in the MFI's lending strategy was triggered by co-financing schemes.

Gender aside, several specific figures from Table 6 are worth mentioning. First, the loading of the ceiling dummy becomes significantly negative in the project size estimation (column (1)). The presence of the ceiling is thus associated with applicants for microcredit undertaking smaller projects. From this perspective, the regulator seems to have reached its

[19] This approach is consistent with the 2PLS estimation sequence that starts with project size. Another option would be to select only the applications involving no bank loan. In addition to making a break with our estimation strategy, this option would likely introduce a massive selection bias.

stated objective of making MFIs target smaller projects. Interestingly, both the gender dummy and the interaction term have a highly significant on project size, but with opposite signs (-4.334 and +3.391, respectively). This combination suggests that the ceiling forced women with large projects (higher than EUR 25,000) to downscale them to the maximal amount affordable without financing from traditional banks.

The bank loan regression in column (2) in Table 6 has limited interpretation since less than 6% of applicants with a small project held a bank loan. Unsurprisingly, the variables related to mainstream banking (bank loan and having a bank loan) are insignificant in both the approval (column (3)) and the loan size equations (column (4)). Importantly, no gender-related variable shows any significant impact on the MFI's decision variables, confirming that evidence on the second-period gender gap found in Section 3.2 (Table 4) is driven by applicants seeking funding for large projects, and subsequently having bank loans.

Overall, our results suggest that the MFI's approval process is gender-blind, while loan size seems fairly gender sensitive, at least as far as large projects are concerned. This confirms previous evidence on Brazilian microfinance (Agier and Szafarz, 2013a). Regarding the interplay of gender concern and regulation change, our findings are the following. First, the introduction of a loan ceiling had little effect on the sizes of the investment projects presented by women micro-entrepreneurs. Second, compliance with the loan ceiling triggered co-financing with mainstream banks. As a result, these banks became not only new players in the MFI's loan allocation process, but also first movers. And our regressions reveal that they might well be biased against holders of relatively small projects, among which a majority of women. Likewise, Heckman-2PLS estimations corroborate that the loan sizes granted to female borrowers by the MFI shrank after the new regulation came into effect. Moreover, the loan sizes granted to holders of small projects were not affected. This evidence confirms the hypothesis that banks bear some responsibility in the MFI's gender-related change of attitude.

Our results show that two key factors influenced the MFI's change of attitude to women. The first is the intervention of banks through co-financing schemes, embedding the option for the MFI to free-ride on banks' screening processes. The second originates from the tendency women exhibit toward launching smaller projects than those of their male counterparts. Although some previous literature finds direct gender bias in loan allocation by commercial banks (Ladd, 1998; Blanchflower *et al*. 2003; Cavalluzzo and Wolken, 2005), our results suggest that the bias is not direct. Instead, banks apparently exhibit a preference for applicants with larger projects, all else equal. The motivations behind women's preference for smaller projects are still not clear-cut, but the microfinance literature offers some clues relating to social norms and women's financial vulnerability (Garikipati, 2008; Guérin *et al*., 2009). Whether these arguments also apply to a developed country such as France is an open question beyond the scope of this paper.

Table 6: Small Projects Sample Results

Explained variable	**Project size**	**Bank loan**	**Approval**	**Loan size**
	(1)	(2)	(3)	(4)
Estimation method	OLS	PLS	Heckman-2PLS	
Female	-4.334***	212.7	-0.371	-889.0
	(1.238)	(162.3)	(0.295)	(762.2)
Ceiling	-2.728***	401.9*	-0.133	-2,782***
	(0.799)	(205.1)	(0.202)	(453.8)
Female*ceiling	3.391***		0.479	309.3
	(1.302)		(0.310)	(826.5)
Residual project size		81.97***	0.00393	228.5***
		(13.20)	(0.0109)	(24.75)
Residual bank loan			4.45e-05	-0.165
			(6.92e-05)	(0.136)
Having a bank loan			-0.391	-919.2
			(0.548)	(1,187)
Start-up	2.054***	264.7	-0.283	-1,658***
	(0.760)	(245.2)	(0.186)	(443.7)
Services	-0.919	240.4	-0.346*	-281.6
	(0.743)	(239.5)	(0.185)	(437.9)
Trade	-0.339	329.7	-0.566***	-352.6
	(0.769)	(248.0)	(0.195)	(558.4)
Food and accommodation	2.667**	923.1**	-0.658**	277.3
	(1.138)	(366.9)	(0.281)	(833.9)
Construction	-1.027	42.10	-0.257	-285.6
	(0.874)	(281.9)	(0.216)	(473.1)
Arts and entertainment	-1.010	814.9**	-0.478	-1,158
	(1.276)	(411.7)	(0.315)	(786.8)
Unemployed for at least 6 months	0.826*	-293.8*	-0.180	-197.6
	(0.482)	(155.6)	(0.115)	(285.2)
Single	0.186	20.23	-0.0297	-9.959
	(0.542)	(174.1)	(0.129)	(304.0)
Age	-0.0419*	-15.70**	-0.00361	-5.026
	(0.0229)	(7.323)	(0.00550)	(13.12)
Dependent children	-0.266	-43.28	-0.0480	-183.2
	(0.229)	(73.75)	(0.0538)	(140.1)
Education (#diplomas)	0.189	-12.49	0.0384	48.01
	(0.153)	(49.31)	(0.0361)	(91.12)
Household income	0.916***	159.8*	0.178***	205.7
	(0.269)	(86.57)	(0.0667)	(200.3)
Inverse of Mills ratio			-157.2	
			(1,287)	
Constant	14.40***	110.3	0.914**	10,602***
	(1.612)	(496.7)	(0.396)	(977.7)
Business cycles			Yes	
Observations	613	613	613	613
R-squared	0.091	0.110		

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

4 Robustness Check

To check the robustness of our results, we relax the assumption that the lending technology of the MFI is constant over time. We run Heckman-PLS regressions on each sub-period (without and with loan ceiling), separately. In this way, the estimation may possibly reflect changes in screening and loan allocation by the MFI. Any changes could be due to various endogenous factors since the regulatory change was the consequence of a decision by the MFI's management. The estimation strategy is thus meant to address endogeneity concerns. Moreover, splitting the period is a way to address the issue that the two sub-periods have different lengths. Comparing the outcomes of two sets of independent regressions is thus a way to restore symmetry between the two regulatory regimes.

4.1. Ceiling-Free Period

In the first period (April 2008-April 2009), the MFI had the legal status of an unregulated NGO. There was no loan ceiling or co-financing with banks. Therefore, the model boils down to a three-equation specification free of the bank loan equation (see Fig. (1)). The estimation methodology follows the lines set out in Section 3.2, but with two notable simplifications. First, we use the Heckman-PLS estimation instead of Heckman-2PLS. Second, there is no period dummy and no interaction term in the regressions.

Column (1) in Table 7 reports the OLS regression for project size (Eq. (3)). Contrasting with the full-sample results (column (1) in Table 5), the gender loading is insignificant, suggesting that women did not undertake smaller projects than men in the first sub-period. Accordingly, Bernard *et al*. (2013) claim that there is no gender gap in small start-up financing

in France.[20] However, we cannot rule out that statistical insignificance is partly due to a small-sample effect since we are dealing here with 186 observations only.

Column (2) in Table 7 concerns loan approval. As expected, 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, education and some of the business cycles variables stand out with a significantly negative impact on the probability of loan approval.

Column (3) in Table 7 uses PLS estimation for loan size. Again, gender is not significant. Unsurprisingly, the residual project size has a significantly positive impact on loan size. Several control variables are significant. Overall, the results confirm that there is no gender bias during the first sub-period, i.e. before the introduction of the loan ceiling.

[20] However, the authors detect a gender gap for loans exceeding EUR 25,000.

Table 7: Ceiling-Free Period: April 2008-April 2009

Explained variable	**Project size**	**Approval**	**Loan size**
	(1)	(2)	(3)
Estimation method	OLS	Heckman-PLS	
Female	-6.030	-0.122	-659.7
	(4.286)	(0.237)	(1,517)
Residual project size		-0.0113**	516.5***
		(0.00521)	(40.80)
Start-up	-4.515	-0.126	-4,792***
	(5.002)	(0.280)	(1,679)
Services	-13.77**	4.66e-05	-5,906***
	(5.584)	(0.335)	(1,831)
Trade	-10.46*	0.0302	-6,443***
	(5.987)	(0.358)	(2,031)
Food and accommodation	4.202	-0.177	2,931
	(6.576)	(0.375)	(2,322)
Construction	-14.56*	0.444	-5,606**
	(7.868)	(0.444)	(2,504)
Arts and entertainment	-21.39***	0.0356	-11,411***
	(8.191)	(0.499)	(3,116)
Unemployed for at least 6 months	-3.149	-0.552***	-3,236**
	(3.857)	(0.212)	(1,451)
Single	-6.650	0.211	-3,995***
	(4.470)	(0.251)	(1,492)
Age	-0.317*	0.0131	-205.2***
	(0.186)	(0.0104)	(69.62)
Dependent children	-1.432	-0.0599	-615.9
	(1.838)	(0.0978)	(700.5)
Education (#diplomas)	3.734***	0.0937	1,791***
	(1.288)	(0.0727)	(503.7)
Household income	0.901	0.0675	-401.8
	(1.834)	(0.0934)	(692.4)
Inverse of Mills ratio		-114.8	
		(2,632)	
Constant	53.35***	-0.450	34,390***
	(11.38)	(0.640)	(5,105)
Business cycles		Yes	
Observations	186	186	186
R-squared	0.189		

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

4.1. Ceiling-Constrained Period

In the second period (May 2009-June 2012), the MFI was regulated and subject to the EUR 10,000 loan ceiling. This period was characterized by the emergence of co-financing by the MFI and mainstream banks. The regression analysis in Table 8 confirms the previous findings. In addition, the Heckman-2PLS estimation allows us to highlight the impact of bank loans on the MFI's loan allocation process during the second period.

From column (1) in Table 8 we see that the implementation of the loan ceiling is concomitant with women applying for smaller projects than their male counterparts with similar characteristics. The gender gap amounts to EUR 8,922. This demand-side gap can hardly be attributed to the MFI. More plausibly, it could be due to the banks to which entrepreneurs apply for co-financing. Indeed, most second-period holders of large projects have to secure a bank loan before applying for microcredit. Given that our sample is mostly made up of applicants who either hold small projects (and need no bank loan) or have already passed the banks' screening process, the facts are consistent with harsher loan granting by the banks. Moreover, the first-period estimation results (column (1) in Table 7) suggest that female applicants to the MFI do not spontaneously undertake smaller projects than men with similar characteristics. We see two possible scenarios that rationalize the observed shock in female demand for microcredit concomitant with the regulation change. The first is self-selection, i.e. women downsizing their projects without even trying to obtain partial bank funding. The second is disparate gender treatment by the banks. Actually, the two scenarios are compatible. Spontaneous project downsizing could indeed be a rational response by 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, the project size estimations in Tables 6 and 7 reveal 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 come 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. Arguably, these changes could be linked to the disappearance and/or the downsizing of projects rejected by the banks.

In column (2) of Table 8, PLS estimation is used to explain the size of the bank loan. The loading of the gender dummy is large and highly significant. On average, women's bank loans are EUR 5,575 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 (1) and the bank loan regression in column (2) 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. Moreover, columns (1) and (2) in Table 8 show 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 90%).

In sum, 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. Conversely, being single reduces the size of the bank loan granted and has no influence on project size.

Columns (3) and (4) in Table 8 are devoted to the MFI's supply estimations. Gender has no impact on loan approval, which suggests that, as in the first period, the institution applies a gender-blind approval process. The ceiling-constrained MFI exhibits a preference for applicants having a bank loan. 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). Interestingly, the residual project size loses its first-period significance in the approval equation, suggesting that the ceiling-constrained MFI no longer favors small projects.

Column (4) in Table 8 features the Heckman-2PLS estimation results for loan size. 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 is accounted for, second-period female applicants appear to receive smaller loans than their male counterparts. Female borrowers are thus worse off under the loan-ceiling regime. The loading of the female dummy in the loan size equation equals -676, substantially smaller than its counterparts in the project size equation (-8,922 in column (1)) and in the bank loan equation (-5,575, in column (2)). Therefore, any disparate treatment 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. However, although significant, the estimated coefficient of the bank loan amount is small. It is far from sufficient to neutralize the gendered impact of co-financing on loan size. Conversely, having a bank loan positively impacts loan size, confirming that co-financed projects are large and require more resources from both the bank and the MFI.

In sum, the second-period estimation of the loan size equation is in line with the baseline results from Section 3 showing that women are worse-off under the ceiling regime. In the second period the MFI showed strong interest in co-financing opportunities, and its loans to female

borrowers became smaller than in the first period, all else equal. The first-period estimations suggest that there was no gender gap in loan size before the introduction of the loan ceiling and the subsequent emergence of co-financing. But in the second period, rather than correcting the new gender gap, possibly imported from banks, the MFI reinforced it. Importantly, though, this move seems involuntary, since the MFI's only real decision variable is loan approval/denial, which does not seem to be gender-sensitive. Overall, evidence suggests that the loan ceiling had a detrimental impact on the size of the loans the MFI granted to female borrowers.

Table 8: Ceiling-Constrained Period: May 2009-June 2012. N=799

Explained variable	**Project size**	**Bank loan**	**Approval**	**Loan size**
	(1)	(2)	(3)	(4)
Estimation method	OLS	PLS	Heckman-2PLS	
Female	-8.922***	-5,575***	0.0525	-675.7***
	(2.622)	(676.2)	(0.103)	(212.9)
Residual project size		711.0***	0.00290	18.69***
		(9.206)	(0.00187)	(3.337)
Residual bank loan			-1.11e-05*	-0.0904***
			(5.90e-06)	(0.0121)
Start-up	-15.98***	-13,374***	-0.239*	-904.8***
	(3.441)	(887.6)	(0.141)	(289.1)
Services	-7.520*	-3,899***	-0.396**	-25.99
	(4.163)	(1,074)	(0.173)	(354.5)
Trade	6.806	4,931***	-0.622***	691.6
	(4.142)	(1,068)	(0.175)	(427.4)
Food and accommodation	22.42***	14,929***	-0.654***	757.6
	(4.982)	(1,285)	(0.210)	(508.8)
Construction	-14.48***	-9,678***	-0.368*	160.2
	(5.056)	(1,304)	(0.209)	(409.1)
Arts and entertainment	7.101	5,321***	-0.404	31.62
	(6.937)	(1,789)	(0.285)	(565.9)
Unemployed for at least 6 months	-6.316**	-7,264***	-0.128	-102.1
	(2.558)	(659.9)	(0.101)	(205.7)
Single	-3.896	-3,553***	-0.238**	-32.98
	(2.932)	(756.3)	(0.116)	(278.2)
Age	0.0394	-20.39	-0.00581	6.815
	(0.124)	(31.93)	(0.00484)	(10.58)
Dependent children	-2.712**	-1,938***	-0.101**	-149.3
	(1.281)	(330.5)	(0.0502)	(117.5)
Education (#diplomas)	1.371*	614.2***	0.0357	72.09
	(0.813)	(209.6)	(0.0317)	(67.29)
Household income	5.505***	2,813***	0.151***	147.7
	(1.261)	(325.3)	(0.0536)	(116.3)
Having a bank loan			0.300**	942.0***
			(0.150)	(323.2)
Inverse of Mills ratio			-866.8	
			(1,010)	
Constant	41.09***	26,264***	1.103***	7,154***
	(7.451)	(1,922)	(0.311)	(645.6)
Business cycles			Yes	
Observations	799	799	799	799
R-squared	0.186	0.904		

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

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 the fairness of credit allocation to women entrepreneurs. Specifically, we provide evidence that female micro-borrowers are harmed by the loan ceiling imposed on licensed MFIs by the French regulator.[21] We also offer a possible rationale for the mechanism underpinning this unintended 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 suggest that the regulatory change triggered harsher treatment of female borrowers by the ceiling-constrained MFI.

Women are known to start businesses with less 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 gaps in loan characteristics is suspected of having missed relevant variables.[22] In this paper, we get around this issue by using an indirect identification technique and taking advantage of a natural experiment. To capture gender biases in banks' loan allocation, we observe the impact of this allocation on the applicants of an MFI. The bank-MFI interaction appeared only in the second sub-period, when the regulatory loan ceiling on the MFI triggered co-financing. At the same time, the MFI started to become less women-friendly. We speculate that the change occurring in the second period relates to the influence exerted by banks. Put differently, in the loan ceiling-free environment, the credit market was segmented between banks

[21] Conversely, reforms aiming at gender equality can also backfire (Bøhren and Staubo, 2014).
[22] In contrast, experimental data addresses the problem of unobservable characteristics (Beaman *et al*., 2009).

tough on women and MFIs friendly to them. In contrast, the loan-ceiling imposed on microcredit made room for market de-segmentation and the existing bias against women entrepreneurs intensified.

However, 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 totally rule out 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, together, 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 loan applicants can indeed be discriminated against (Storey, 2004; Blanchard *et al.*, 2008; Blanchflower *et al.*, 2003). Since a large proportion of loan applicants in our database are immigrants, we could use their names to detect discrimination based on race and/or ethnicity.[23]

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. If the aim of the French regulator is to segment the credit market, then co-financing arrangements should be prohibited. However,

[23] This approach is used by Bertrand and Mullainathan (2004) on the labor market.

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 Traça, 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 European Commission makes more sense than the EUR 10,000 cap introduced in France.

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Appendix A

Table A1: Correlations of Project Size and Bank Loan with other Covariates

	Project size	Bank loan
Bank loan	0.90***	
Loan size	0.26***	0.05
Female	-0.06*	-0.04
Start-up	-0.2***	-0.2***
Services	-0.16***	-0.12***
Trade	0.09***	0.12***
Food and accommodation	0.18***	0.13***
Construction	-0.14***	-0.12***
Arts and entertainment	0.02	0.02
Unemployed at least 6 months	-0.15***	-0.18***
Single	-0.12***	-0.13***
Age	-0.03	-0.03
Dependent children	-0.04	-0.02
Education	0.11***	0.06**
Household income	0.17***	0.15***

*** p<0.01, ** p<0.05, * p<0.1

Table A2: Descriptive Statistics on Other Financial Characteristics

	First period: No ceiling			Second period: Ceiling		
	Male	Female	t-test	Male	Female	t-test
Having personal investment (%)	84%	77%	7%	83.01%	83.43%	-0.42%
Personal investment (kEUR)[a]	67.86	52.39	15.47	66.22	55.41	10.81
Having funds from other sources (%)	54.29%	56.10%	-1.81%	70.31%	67.43%	2.88%
Funds from other sources (kEUR)[a]	97.77	85.98	11.79	96.23	92.40	3.83
Observations	140	82		512	350	

[a] Computed only for non-zero points.