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The Impact of Interest Rate Cap Policy on the Lending Behavior of Microfinance Institutions in Cambodia: Evidence from millions of observations in the Credit Registry Database

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Abstract

In Cambodia, an interest rate cap policy was newly implemented on lending by microfinance institutions (MFIs) in April 2017. There was no restriction on lending rate before the policy implementation, and many of MFIs had been lending at more than 18%. Thus, there was a concern about the negative effect on outreach of MFIs by this interest rate cap policy. This paper explores the impact of the interest rate cap on MFIs, by accessing granular data from the credit registry database in Cambodia. We use 6,897,168 individual loans from all the regulated financial institutions, including commercial banks, specialized banks, and microfinance institutions in the period from January 2016 to March 2019. We find that that average loan size per loan jumped after the interest rate cap policy was introduced for MFIs. The largest increases in loans were observed for smaller-sized loans, group-lending schemes, KHR currency and non-collateral loans, which are typically more costly for both deposit-taking microfinance institutions (MDIs) and non-deposit-taking microfinance institutions (non-MDIs) to extend. In addition, we found that the interest rate cap policy had a negative impact on the number of loan disbursements for non-collateral loans, KHR currency, group-lending schemes, and agricultural loans. These findings suggest that non-MDIs and MDIs increased their loans to those costly borrowers to recover their fixed costs per loan in response to a decrease in the interest rate, but interest rate cap policy still negatively affects the outreach of MFIs. We also found that MDIs decreased or at least did not increase loan provision in both rural and urban areas. In the meantime, non-MDIs started increasing loan disbursements in urban areas and decreasing them in rural areas. Thus, even though the entire effects on lending of non-MDIs are not large, but the outreach of non-MDIs has been negatively affected by the interest rate cap policy. We further documented evidence that the interest rate cap policy indirectly affected the interest rates of commercial bank loans, suggesting

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that the competition between commercial banks and non-MDIs and MDIs was also intensive and customer segments overlap commercial banks and MFIs.

Keywords: Interest rate cap, Microfinance, Cambodia, Regulation, Bank Lending

JEL Classification: G21; G38; O16

1. Introduction

Financial regulation plays a crucial role in determining market structures and the behavior of financial institutions by limiting the amount of market power that these institutions can exercise over their customers. Thus, theoretically, an adequate level of regulation could improve market welfare by curbing the monopolistic behavior of financial institutions. However, implementing appropriate regulation requires careful investigation of the demand and supply sides of the financial market, and even after the implementation of policies, frequent adjustments to regulatory frameworks and complementary measures based on evidence are also required to mitigate the unanticipated side effects of policy measures.

Microfinance institutions (MFIs) in Cambodia are regulated and supervised by the National Bank of Cambodia (NBC), the central bank of Cambodia[2]. In April 2017, the NBC implemented an interest rate cap policy on the microfinance sector. This interest rate cap policy restricted interest rates on lending to no more than 18% on an annual basis (1.5% monthly), and it was applied to all the MFIs and credit operators. This policy was aimed at improving the operational efficiency of MFIs and at reducing the debt burden on consumers with over-indebtedness issues (NBC 2018; IMF 2017). However, before the interest rate cap policy was in effect some MFIs extended loans at more than 18%, particularly for customers whose credit risks were high and most of them were typically to the poor. Thus, there is a concern that the new policy curbed Cambodian MFI lending– particularly those with a focus on the poorest clients in remote regions. The problem is that such clients may lose access to formal financial institutions, and instead seek to borrow money from informal money lenders at less transparent rates. According to the experience of other countries, the introduction of interest rate cap policies leads to a reduction in loan supply (Helms and Rellie 2004), and further causes a rise in market interest rates for borrowers because of a rise in the number of informal lenders (Mamibo and Gallogos 2014). Specifically, even though Cambodian MFIs are regulated, entry barriers are low. In fact, the number of MFIs has been increasing in recent years. This high intensity of competitiveness in the Cambodian microfinance sector could drive MFIs to reduce loans to the poor in response to the introduction of an interest rate cap policy.

In this study, we attempt to advance this debate by examining the effects of the newly introduced interest rate cap policy on the lending behavior of MFIs in Cambodia. We use the database of the Credit Bureau of Cambodia (CBC) as this provides us information on the disbursements of all individual loans. Our data spans from 2016M1 to 2019M3 on a monthly basis, and covers about 6,897,168 individual loans from all the regulated financial institutions. During the period of our analysis the regulated financial institutions included 42 commercial banks, 14 specialized banks,

[2] In Cambodia, microfinance institutions are categorized into two legal entities: deposit-taking microfinance institutions, and non-deposit taking microfinance institutions. The former are known as MDIs legally, and the latter are MFIs in the official documents of the NBC. However, throughout this paper, we label non-deposit taking microfinance as "Non-MDIs" to avoid confusion, and we label MDIs and Non-MDIs collectively as MFIs.

7 microfinance deposit-taking institutions (MDIs), and 80 microfinance non-deposit taking institutions (non-MDIs). The detail in the data allowed us to investigate the impact of policy implementation by exploiting variations across loan types, across financial institutions, and across regions. Using these data, we investigate which financial institutions are affected by the interest rate cap policy, whether loan provision is affected in rural areas, and which type of loans are affected by the policy.

In our analysis we found that average loan size per loan jumped after the interest rate cap policy was introduced for MFIs. The largest increases in loans were observed for smaller-sized loans, group-lending schemes, KHR currency and non-collateral loans, which are typically more costly for non-MDIs/MDIs to extend. The findings suggest that non-MDIs and MDIs increased their loans to those costly borrowers to recover their fixed costs per loan in response to a decrease in the interest rate. In addition, we found that the interest rate cap policy had a negative impact on the number of loan disbursements. This suggests that interest rate cap policy affects the outreach of MFIs. The decrease in the number of loan disbursements was severe for non-collateral loans, KHR currency, group-lending schemes, and agricultural loans. We found that MDIs decreased or at least did not increase loan provision in both rural and urban areas, and that the estimated impact of the interest rate cap policy was higher for MDIs than non-MDIs. In the meantime, non-MDIs started increasing loan disbursements in urban areas and decreasing them in rural areas. Thus, the entire effects on lending of non-MDIs are not significant, but the outreach of non-MDIs has been negatively affected by the interest rate cap policy.

Regarding gender, we also found that female-borrowers are not necessarily a cost factor for MFIs according to the analysis of the determinants of the nominal and effective interest rates of MFIs, and the interest rate cap policy does not necessarily affect lending to females according to the analysis on the impact of the interest rate cap. However, female-related loans tend to be non-collateral, in a group lending scheme, for an agricultural purpose, and be small; all of which are cost factors in MFI lending and are also impacted by interest rate cap policy. Thus, even though MDIs and non-MDIs did not decrease their loan provisions simply because borrowers were female, the loans for female borrowers were also negatively affected by the interest rate cap policy. However, we find that the number of borrowers increased in female-related loans after the interest rate cap policy. This suggests that MDIs and non-MDIs struggled to keep the number of female borrowers by increasing the number of borrowers per loan disbursement, while they reduced total loan disbursements.

We further documented evidence that the interest rate cap policy indirectly affected the interest rates of commercial bank loans. This impact was possibly channeled through the strong competition between the MFIs and the commercial banks. Since customer segments overlap commercial banks and MFIs, the commercial banks might face pressure to decrease the interest rate to keep their customers in response to the decrease in interest rates by non-MDIs and MDIs.

Our study contributes to the literature on the effect of interest rate cap policies by providing new evidence using detailed data from the loan accounts of all the formal financial institutions in Cambodia. Although interest rate cap policy (sometimes also referred to as interest rate ceiling or usury laws) is a widely common practice in both of developed and developing countries, a strand of the literature presents mixed results of real effects of this policy on financial institutions and accumulation of evidence is not sufficient. Alessie et al. (2005) found a positive impact on credit supply in Italian consumer markets, while Benmelech and Moskowitz (2010) and Rigbi (2013) found a negative impact in U.S. loan markets on firms and consumers. The theoretical argument

of the regulation of the banking sector suggests that an interest rate cap policy could have positive and negative effects, although these would depend on the competitiveness of loan markets and current regulatory conditions. Thus, further empirical investigation into the effects of interest rate cap is needed in the literature of interest rate cap policy. Since microfinance sectors are less likely to be strictly regulated and microfinance loans are typically extended by small NGOs, data from the microfinance sectors are generally not available in developing countries, and previous studies suffer from identification of impact of the interest rate cap policy. In this regard, our study provides clear evidence using unique credit registry data, which comprehensively covers the individual loan disbursements of all the microfinance institutions and the traditional commercial banks in Cambodia.

The rest of the paper is structured as follows. Section 2 describes the institutional background of the Cambodian microfinance sector and the implementation of interest rate cap policy. Section 3 introduces some theories and frameworks regarding the effects of interest rate cap policy and provides hypotheses for this study. Section 4 presents the empirical results from our MFI side analysis. Section 5 presents the preliminary results from a survey of borrower households. Section 6 concludes this study with some policy recommendations.

2. Theories of the Effect of Interest Rate Cap Policy on Lenders

2.1 Cross-subsidization and the interest rate cap

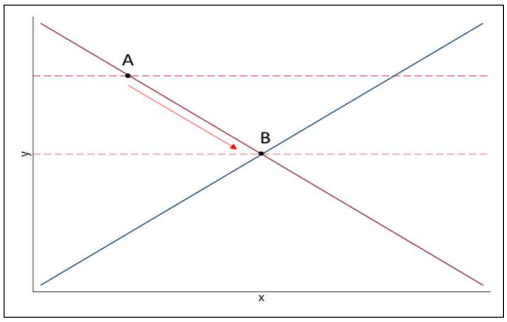
Theoretically, the effects of lowering interest rates using interest rate cap policy depend on several factors, such as the extent of market competition, the level of the interest rate cap, and the business models of financial institutions. In terms of business models, MFIs are different from traditional financial institutions that aim to maximize a profit from their lending operations, such as commercial banks. MFIs were originally established to extend financial services to the poor on preferred conditions for them. In contrast to traditional banks, MFIs are aimed at serving the number of borrowers who are generally un-bankable by commercial banks. In the literature, there is a paucity of studies on the effect of interest rate cap policy on MFI behavior given that MFIs have the objective to increase their outreach while they have to protect their sustainability at the same time.

Generally, traditional financial institutions set interest rates based on: (1) cost structures, such as funding costs and operational costs; and (2) the characteristics of their loan portfolios. Credit risk and maturity structures also affect the optimal interest rate of financial institutions (Entrop et al. 2015). In addition, similarly to other ordinary industries, market condition also matters in the banking sector. The market power of financial institutions (i.e., competitiveness) determines how much financial institutions make profit by setting high interest rates (Saunders et al. 2000; Maudos et al. 2004; Gambacorta 2008). Furthermore, Saunders et al. (2000) empirically found that, apart from credit risks, the intensity of regulations on financial institutions also affects interest rates.

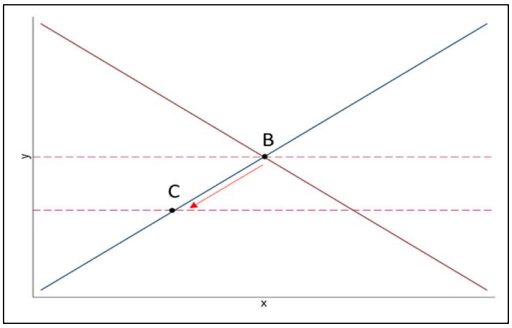
In the case that financial institutions have market power, financial institutions will set the interest rate higher than the market rate. Figure 1 illustrates the expected impact of interest rate cap policy on the traditional banking sector depending on market competitiveness. Panel A shows the case that financial institutions have market power (Point A is the level of loan provision and interest rates when financial institutions have market power). If financial institutions have market power, they behave as price-makers so that they can control the interest rate to maximize their profit. If

financial institutions have large market power, an intervention to lower the interest rate to near the market rate could increase loan provision by reducing their market power (Point B). If this is the case, an interest rate cap would increase the social welfare of borrowers by increasing financial access for more borrowers. However, if the market is competitive, an interest rate cap could result in decreasing lending by excluding potential borrowers from the loan market. Panel B illustrates this case. If MFIs originally set the interest rates at the market rate (Point B), a lower interest rate cap than the market rate could result in MFI lending (Point C). In this case, MFIs could not make sufficient profits to cover the cost of providing loans, and this would reduce loan provision. If this is the case, the interest rate cap policy would distort the social welfare of borrowers.

Figure 1. Illustration of the impact of interest rate cap policy



Panel A. Market power exists



Panel B. Market is competitive

Interest rate caps could have a negative effect on the MFIs incentive to provide loans to the poor. Borrowers in the microfinance sector are unbanked by traditional banks and are of typically high-risk profile and costly to extend loans to. Financial institutions are usually screening customers, and will ration credits from risky customers, so that the supply-curve is back-ward bending (Stiglitz and Weiss 1981). If this is the case, loan provision is determined at the optimal level in terms of the return and risks for financial institutions, not at the intersection with the demand curve. In other words, too much loan provision reduces the profits of financial institutions, and too little loan provision also reduces profit. In this case, the deviation from the market interest rate could reduce loan provision since financial institutions ration credit to risky and costly borrowers to maintain their profit.[3]

In the meantime, outreach-oriented MFIs might cross-subsidize clients to extend loans to the poor at lower interest rates.[4] Financial institutions need to sustain their business by keeping non-negative profits, but lending to the poor is costly due to the high risk of defaults and the physical cost of a visit to customers in distant areas, and those high cost factors make it difficult to increase outreach to the poor. In this situation cross-subsidization is one of the strategies to reach the poor. Panel I of Figure 2 illustrates the cross-subsidization by MFIs.[5] Here, we assume that MFIs serve

[3] Helms and Reille (2004) reported that developing countries with interest rate cap policies had a lower market penetration rate of MFIs.

[4] McInctosh (2005) developed a theoretical model to explain cross-subsidization in MFI lending. According to his model, competition with profit-oriented financial institutions would also reduce loan provision to the poor by reducing profits from non-risky borrowers.

[5] For a detailed theoretical argument on the cross-subsidization and the predicted effects of an interest rate cap on the MFIs see the Appendix.

two different types of borrowers: high-risk profile (Market 1) and low-risk profile borrowers (Market 2). MFIs have a subsidizing role between less-risky borrowers and risky borrowers, by making a profit in lending to the less risky borrowers (Area A in Panel I of Figure 2), and by extending loans to risky borrowers (the poor) at a favorable interest rate (Area B in Panel I of Figure 2).

In the case of cross-subsidization, interest rate cap policy could negatively affect the cross-subsidization activities of MFIs. As illustrated in Panel II of Figure 2, the interest rate cap policy would reduce the profit of MFIs by curbing the market power of MFIs, and then MFIs would reduce loan provision to the poor as the budget for serving the poor decreases.

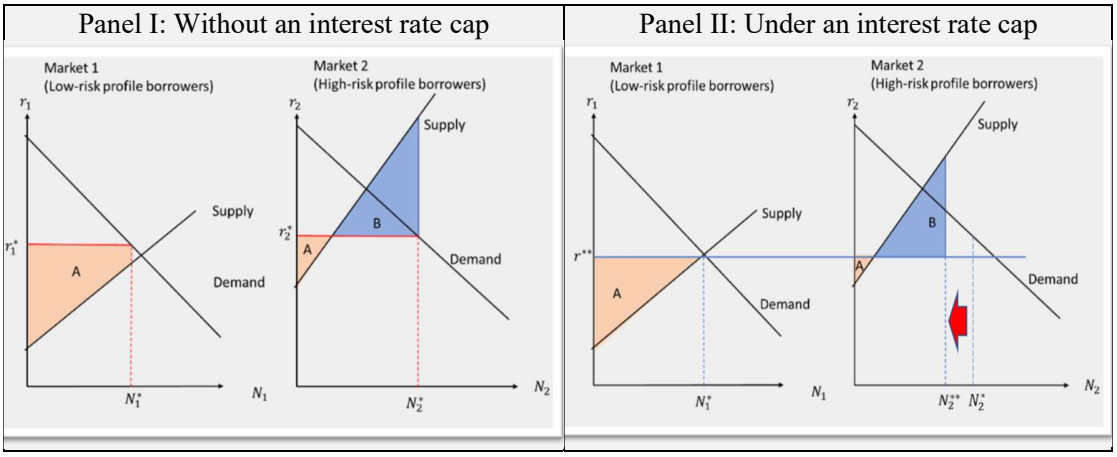
Hypothesis 1 : loan provision will decline for those loans that are high-risk profile and costly.

In addition, the impact of interest rate cap policy is supposed to be higher for microfinance institutions with higher pre-regulated interest rates since the reduction of profit is higher for those microfinance institutions.

Hypothesis 2: Microfinance institutions with higher pre-regulated interest rates will reduce loans more than those with lower pre-regulated interest rates.

Previous empirical findings have also confirmed this theory. Capera, Murcia, and Estrada (2011) found a negative correlation between interest rate cap policy and financial depth in 18 Latin American countries from 1980-2008. Similarly, using data from the online lending marketplace in the USA, Rigbi (2013) estimates the effects of changes in usury laws that increased to 36% the maximum interest rate charged to borrowers. His data show that the increase in the interest rate cap was correlated with an increase in the probability of being funded, especially for borrowers who were not funded previously, suggesting that the potential borrowers were excluded from the loan market under the previous low interest rate cap policy.

Figure 2: Cross-subsidization and the profits of MFIs



2.2 Transaction costs of lending

Transaction cost is also a significant factor in the determination of the interest rate on MFI loans.[6] Generally, the targets of MFI clients are living in rural areas, and the information asymmetry is intense between lenders and borrowers due to a lack of hard information and credit history. Thus, loan officers need to visit and evaluate borrowers, which adds to the operational costs of extending a loan. These operational costs are imposed on MFIs as fixed cost in each loan. The nature of MFI lending requires increased interest rates on loans in rural areas, especially for smaller sized loans. Therefore, interest rate cap policy could affect the average loan sizes of MFIs, since MFIs need to maintain a certain profit from loan per borrower, and one of the possible ways to keep lending to the poor at lower interest rates is to decrease the proportion of fixed costs to a loan by increasing loan size.

Hypothesis 3: Small loans are more affected by interest rate cap policy.

Furthermore, the maturity structure of a loan portfolio also influences the interest rate charged on loans. Since short-term loans impose costs of negotiations and writing of the contracts, a high proportion of short-term loans in a loan portfolio will increase the average interest rate on loans. Thus, the interest rate cap policy will affect the maturity structure of an MFI loan portfolio.

Hypothesis 4: Short-term loans will decrease after interest rate cap policies are imposed.

[6] In the Appendix we discuss the effect of interest rate caps on average loan size by constructing a theoretical model of the cross-subsidization behavior of MFIs.

3. Empirical Analysis

3.1. Changes in interest rates and effective interest rates

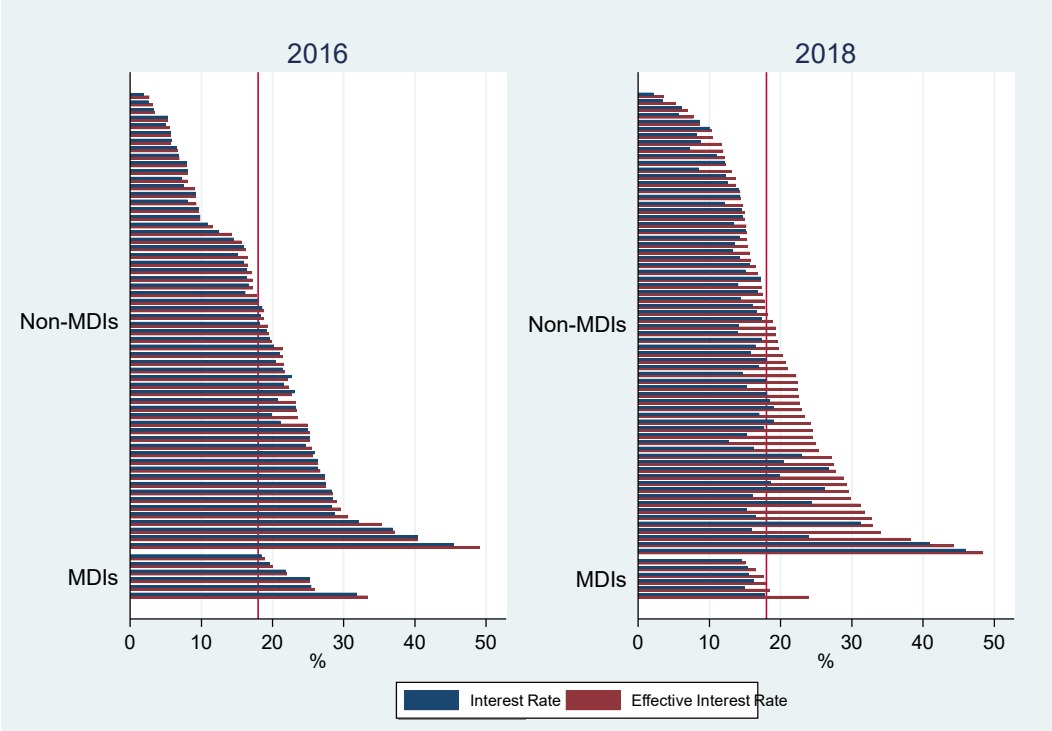
After an interest rate cap policy is introduced, discrepancies between effective interest rates and nominal interest rates start to appear.

Loopholes might exist and allow MFIs to circumvent the restrictions imposed by central bank interest rate cap policies. For example, Microfinance institutions may move to charge regular fees to cover the administration costs of loans, since the restriction only caps nominal interest rates. Figure 3 shows the levels of estimated average interest rates and effective interest rates of MFIs. We collected these data from NBC Annual Supervision Reports, and we calculated interest rates and effective interest rates for each of the MFIs in the reports. The interest rates are defined as interest income divided by the amount of loans. Effective interest rates are defined as the sum of interest and non-interest incomes divided by the amount of loans. However, there are caveats in the interpretation of these measures of the average interest rates of each MFI, even though the measure is easy to obtain from public open data sources. If loan amounts increase in a year, this measure would under-estimate the actual interest rate.[7] On the other hand, if loans decrease in a year, this measure would over-estimate the actual interest rate.

Figure 3 shows that average interest rates were higher than 18% for half of the MFIs in 2016, while most of them lowered average interest rates to below 18% in 2018. In 2016, there was no huge difference between nominal interest rates and effective interest rates, suggesting that MFIs made revenue mainly through interest income before the interest rate cap policy was implemented. However, in 2018, the nominal interest rates and effective interest rates started decoupling for most non-MDIs. Even after the implementation of the interest rate cap policy, some non-MDIs kept effective interest rates at the same level by increasing non-interest income. The results suggest that non-MDIs seem to try to offset the impact of interest rate cap policy by increasing fee charges on loans. There is much anecdotal evidence suggesting such a practice by non-MDIs. In addition, the NBC has announced it will be conducting on-site audits of the fees charged to ensure the fees are not "unfairly" high (NBC 2018).

[7] This deviation from actual average interest rates comes from the difference in definition between interest income in an income statement and loans outstanding in a balance sheet. The income statement presents total amounts of income and expenses during a year, while the balance sheet presents the amount of assets and liabilities at the end of the financial year.

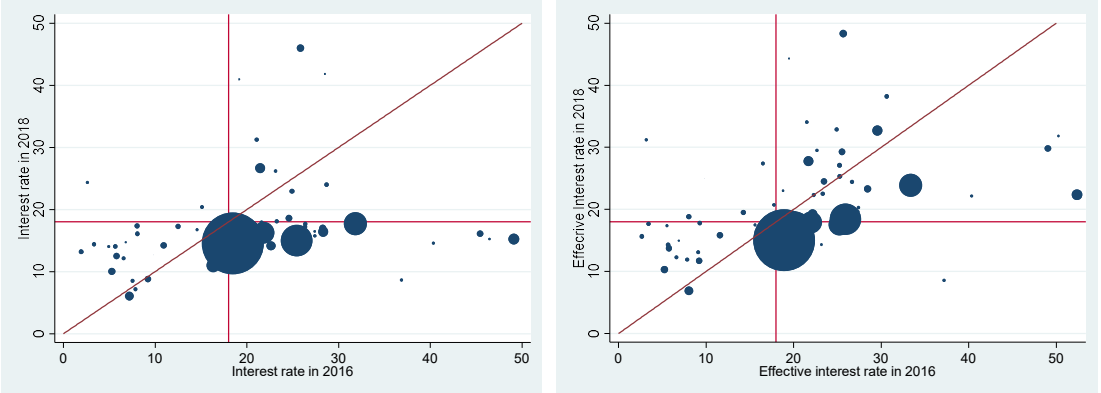
Figure 3: Average interest rate and average effective interest rate before and after the policy introduction



Source: Authors' calculations using the NBC supervisory annual report 2006-2018.
Note: The estimation of average interest rates sometimes deviates from the actual interest rate they impose on consumers if loan amounts change a lot within a year. To avoid misleading readers, we removed those MFIs whose average interest rates exceeded 50% in both 2016 and 2018.

Figure 4 presents the comparison of average nominal interest rates and effective interest rates between 2016 and 2018. This shows that changes in effective interest rates varied across MFIs. The results might suggest that some MFIs could not offset the reduction in interest rates by charging additional fees.

Figure 4: Scatter plots of Average Interest Rate and Average Effective Interest Rate before and after policy introduction



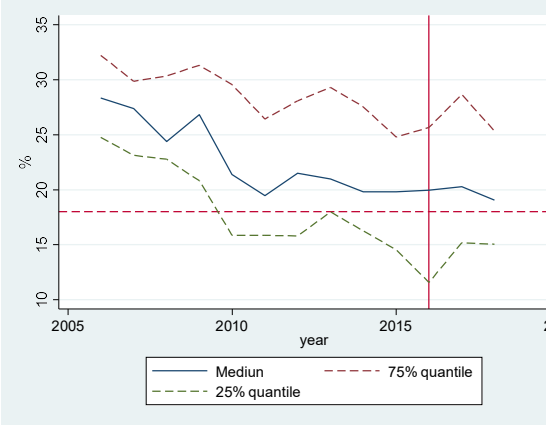
Source: Authors' calculations using the NBC supervisory annual report 2006-2018.

Figure 5 shows the time trend of the median of nominal interest rates and effective interest rates. The median of interest rates decreases after the policy change, and although the reduction is trivial, the median of effective interest rates has also decreased. Thus, even though there could be loopholes for MFIs, it is still likely that this policy change would affect MFI lending behavior.

Figure 5: Dynamics of interest rate and effective interest rate before and after the policy introduction

Panel A: Interest rate

Panel B: Effective interest rate



Source: Authors' calculations using NBC supervisory annual report 2006-2018

Operational costs (including wages) and loan sizes are significant determinants of the nominal and effective interest rates of microfinance loans.

Next, we examine what factors affect the interest rates of MFIs. Theoretically, interest rates are set to cover the cost and risks in lending, such as credit risks, operation costs and funding costs. For example, the interest rate should be high if MFIs extend more loans to rural areas or farmers due to high credit risks. By regressing interest rates on the possible cost factors, we examine which are the most significant cost factors that determine the interest rate in Cambodian MFIs. Specifically, we estimate the following regression model:

$$r_{it} = \frac{INTEREST\ INC_{it}}{LOAN_{it}}$$

$$= \Sigma\beta_k Credit\ risk\ factor_{kit} + \Sigma\gamma_j Operation\ Factors_{jit} + \alpha_t + \mu_i + \epsilon_{it}$$

where α_t is time-fixed effects, which capture the macroeconomic factor effect for all MFIs in each period (such as competition and economic growth). $Credit\ risk\ factor_{it}$ is the characteristics of the loan portfolio of MFIs, which represent the differences in lending practice of those MFIs. Some of the MFIs concentrate on lending to rural areas and women to achieve social objectives, while others focus on making profit and keep on lending in urban areas. These differences reflect the credit risks in the clientele of MFIs. $Operation\ Factors_{it}$ represent the supply side factors, such as funding costs and operational costs. Furthermore, the bigger MFIs can operate efficiently since scale economies might also exist in the microfinance business. Thus, we also capture the operational features of microfinance business model in the analysis.

Table 1: Estimation results of factors affecting interest rate and effective interest rate

Variable	Nominal interest rate	Effective interest rate
Credit Risk Factors		
Agri Loan/Total Loan	0.011	0.003
	(0.020)	(0.023)
Loans in Rural Areas/Total Loans	0.011	0.085*
	(0.039)	(0.044)
# of Female Borrowers/# of Borrowers	-0.022	-0.006
	(0.022)	(0.025)
Log (Average loan size per borrower)	-2.344***	-1.315*
	(0.627)	(0.693)
Operational Factors		
Operating Cost/Asset	0.364***	0.294***
	(0.079)	(0.089)
Funding Cost/(Borrowing+Deposits)	0.078*	0.050
	(0.043)	(0.049)
Log (Asset)	2.237***	0.711
	(0.612)	(0.691)
Growth Rate of Assets	-4.785***	-5.284***
	(0.824)	(0.932)
Year-fixed Effect	Yes	Yes
MFI-fixed effect	Yes	Yes
Constant	1.969	9.796
	(7.688)	(8.683)
R-squared	0.263	0.062
Observations	308	309
Number of MFI	63	63

Source: Authors' calculations using NBC Supervisor Annual Report and CMA-NIX (2010 - 2018).
Notes: We run fixed-effect estimation. Standard errors are reported inside brackets. Asterisks,*, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Data were collected from NBC supervisory annual reports and CMA-NIX. We present the results in Table 1. We find that the logarithm of loan amount per borrower (Log (average loan size per borrower)) were crucial determinants of interest rates. The results are statistically significant if the interest rate is the dependent variable (Column 1) and if the effective interest rate is the dependent variable (Column 2), and the estimated coefficients of both results were also large. The estimated coefficients imply that a 1% increase in average loan size per borrower leads to a 0.023% decrease in the nominal interest rate and a 0.013% decrease in the effective interest rate, which means that if loan size increases from 1,000USD to 2,000USD (loan size increases by 100%), the nominal interest rate decreases by 2.344% and the effective interest rate decreases by 1.315%. We also find that operating costs (Operating Cost/Asset) also affect the interest rate and effective interest rates at 1% statistical significance. The estimated coefficients suggest that a one-percent reduction in operating costs could be associated with 0.34% reduction in interest rates and 0.29% reduction in effective interest rates. Importantly, the ratio of the number of female borrowers (# of Female

Borrowers/# of Borrowers) is not statistically significant, suggesting that MFIs do not impose a premium for female borrowers (Column 2).

The results highlight the important aspects of MFI lending practices. Especially, the result suggests that operating costs and size of loan per borrower are crucial in determining the level of interest rates. This is in large part because lending to the poor is labor-intensive, and there is a large fixed cost to process loan provision. In MFI lending, the soft information (borrower's literacy, reputation, and other social capital) is more important due to the lack of hard information (legal documents, credit history, and decent bookkeeping). However, this lending practice is difficult to be digitized using IT methodologies, such as credit scoring. Thus, keeping lending to the poor still requires a higher interest rate for MFIs.

The coefficient of rural loan ratio is estimated at 10% statistical significance as the determinants of the effective interest rate, while it is not statistically significant as the determinants of the nominal interest rate. The results suggest that borrowers in rural areas face higher fee charges, possibly because of the physical cost to extend loans to rural areas. Furthermore, the ratio of funding costs is statistically significant as the determinant of the nominal interest rate, although the estimated coefficient is smaller than the ratio of operating costs. Increases in funding costs also push up the interest rate, although the impact is smaller than increases in operating costs.

Table 2: Summary statistics for key variables

	Mean	Std. dev.	Obs.
Outcome variables			
Interest rate	21.51	16.57	508
Effective interest rate	23.89	20.23	508
Credit risk factors			
Ratio of agricultural loans to total loans	23.21	27.63	506
Ratio of number of female borrowers to total borrowers	61.90	22.06	415
Log of average loan size per borrower	2.108	1.658	414
Ratio of loans in rural areas to total loans	85.75	17.94	416
Operational factors			
Log of assets	10.26	1.830	512
Ratio of operating cost to asset	13.35	15.58	512
Ratio of funding cost to borrowings and deposits	8.307	31.28	509

Source: Authors' calculations using the NBC Supervisor Annual Report and CMA-NIX (2010 - 2018).

3.2. Analysis of Changes in MFI Lending Behavior on the introduction of an Interest Rate Cap Policy

We investigate changes in MFIs' lending behavior after the interest rate cap policy was introduced. We use the account-level data of loan disbursements for empirical investigation into changes in the number of loan disbursements and the size of loan disbursement per account. The data were extracted from the credit registry database of Credit Bureau Cambodia (CBC), and cover a total of 6,897,168 loan disbursements from 2016M1 to 2019M3. The data cover all the disbursements of individual loans from commercial banks, specialized banks, MDIs, and non-MDIs. Since some borrowers have multiple loans, or borrow repeatedly for different purposes, or refinanced loans during the period from 2016M1 to 2019M3, the number of unique borrowers is 4,189,369 in our data.

There is a caveat in the analysis of these data. Although individual loans for the purpose of business are included, our data does not cover corporate loans. Thus, there is a concern that our analysis might overlook the important aspects of MFI lending that MDIs and non-MDIs increased their role in the financial inclusion of SMEs, and that they have increased the portion of their loan portfolio for corporate loans in recent years. However, in reality, corporate loans by MDIs and non-MDIs are still trivial in Cambodia. Table 3 shows the ratio of corporate loans to total aggregated loans for MFIs and commercial/specialized banks as of December 2019. Even though MDIs and non-MDIs have increased corporate loans recently, the share of corporate loans is still small both in terms of the balance of loans and the number of loan accounts. Therefore, our data captures almost the entire lending behavior by non-MDIs and MDIs.

Table 3: The share of commercial loans to total outstanding loans in CBC data as of December 2019

	Balance	Number of Accounts
% of corporate loans as a share of total loans (MDI + non-MDI)	0.19%	0.0048%
% of corporate loans as a share of total loans (Commercial Banks and Specialized Banks)	19.99%	0.49%

Source: Authors' calculations using CBC database.

For describing the important characteristics of the Cambodian microfinance sector, we present the composition of newly disbursed loans across non-MDIs and MDIs by urban and rural areas, by product types, and by loan sizes as of 2016 in Figure 7. Demand for loans and risk profiles of customers can vary across locations. For example, occupations and living standards of households are similar within regions. Taking into account that technologies of screening customers are limited for MDIs and non-MDIs, the locations where customers live is crucial information for lending by MDIs and non-MDIs. In Figure 6, the color of the bars shows the head accounts of disbursed loans in each category as percentages of the total number of newly disbursed loans in 2016. This shows that the operations of non-MDIs and MDIs wary widely in terms of geographical locations, product types, and loan sizes. Specifically, some of the non-MDIs and MDIs only focused on urban or urban areas. There is also a wide variation in the portfolio of loan products across MFIs. Some of the non-MDIs have large shares of mortgage loans in their loan portfolios,

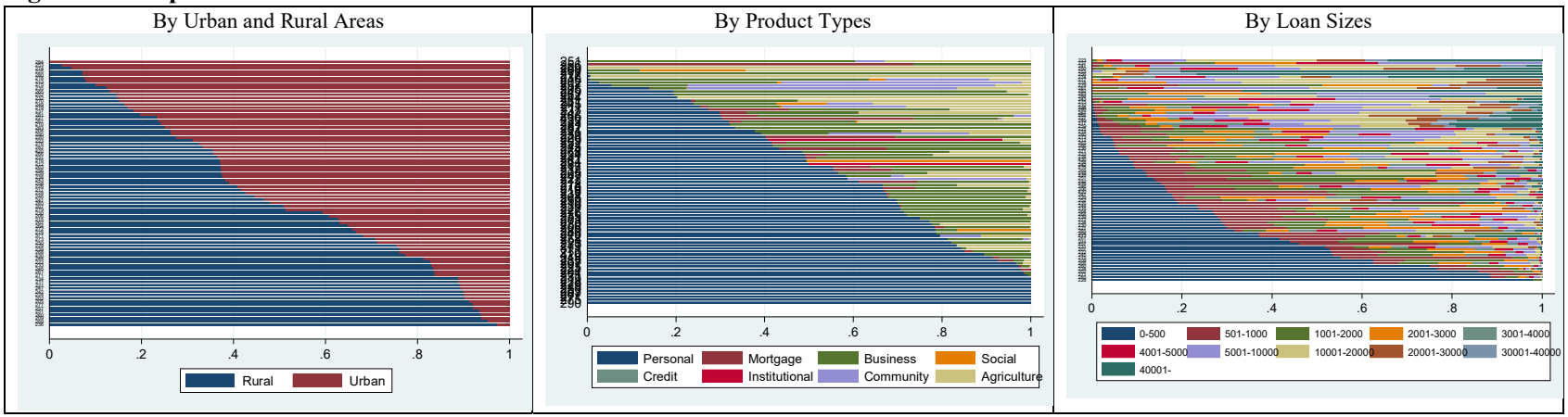
while others concentrate on agricultural and community loans. For loan sizes, there are also wide differences among non-MDIs and MDIs. Some non-MDIs and MDIs have a large share of loans of less than USD500 in their loan disbursements, while others have a large share of loans of more than USD10,000.

These results suggest that lending behavior and customer bases could differ from institution to institution. In other words, MDIs and non-MDIs differentiate loan products in terms of loan and borrower characteristics, such as locations, product types, and loan sizes. In general, the proportion of fixed costs to loan size is smaller for larger sized loans. Thus, the interest rates on loans increase in line with the sizes of loans. In addition, since the sensitivity of consumer demand to interest rates is different among product types or the purpose of loans, the impact of interest rates could vary across non-MDIs and MDIs with different business models.

In Table 4 we present the descriptive statistics of several loan characteristics by MDIs and non-MDIs. These loan characteristics are different across product types rather than types of financial institutions. The average amounts of loan disbursements are higher for MDIs than for non-MDIs within each loan product. In the meantime, there are huge variations across loan products for both MDIs and non-MDIs. The average loan sizes are lowest for community loans, which are the products relating to group lending or village banking. The loan sizes are highest for mortgage loans, which are generally extended for the purchase of houses and land. The average number of loan disbursements are generally larger in MDI loans.

Interestingly, the ratio of non-collateral loans is higher for non-MDIs than for MDIs. 70% of business loans by non-MDIs are non-collateral, while this is only 7% for MDIs. However, the ratio of loans with guarantors and the ratio of loans with land titles as collateral are higher for MDIs. This suggests that MDIs are more likely to extend loans in a group-lending scheme, or take land as collateral.

Figure 6: Comparison of Loan Portfolio across Non-MDIs and MDIs



Source: Authors' calculations using CBC data. The figures show the compositions of loans by areas, product types, and by loan sizes for each MFI, respectively.

Table 4: Descriptive Statistics of Loan Disbursement by Product Types and Types of Financial Institutions in 2016

Product Types		Amount of loans		Maturity (Month)		KHR Currency (Dummy)		Collateral (Land) (Dummy)		No Collateral (Dummy)		Collateral (Gurantor) (Dummy)	
		Non-MDI	MDI	Non-MDI	MDI	Non-MDI	MDI	Non-MDI	MDI	Non-MDI	MDI	Non-MDI	MDI
Personal	Means	1,429	3,031	14	26	0.64	0.17	0.12	0.94	0.11	0.02	0.02	0.00
	N	162,016	178,530	161,985	178,521	162,016	178,530	162,016	178,530	162,016	178,530	162,016	178,530
Morgage	Means	6,620	6,751	37	39	0.05	0.06	0.63	0.98	0.32	0.00	0.00	0.00
	N	2,452	18,976	2,451	18,976	2,452	18,976	2,452	18,976	2,452	18,976	2,452	18,976
Business	Means	2,230	3,018	18	24	0.61	0.47	0.22	0.59	0.70	0.07	0.01	0.26
	N	50,156	310,265	49,666	309,730	50,156	310,265	50,156	310,265	50,156	310,265	50,156	310,265
Social	Means	636	609	5	15	0.05	0.79	0.01	0.09	0.25	0.05	0	0.70
	N	5,587	58,821	5,586	58,762	5,587	58,821	5,587	58,821	5,587	58,821	5,587	58,821
Institutional	Means	483		12		0.14		1.00		0		0	
	N	434	0	434	0	434	0	434	0	434	0	434	0
Community	Means	279	435	12	12	0.78	0.95	0.05	0.02	0.53	0.00	0.09	0.70
	N	11,565	516,308	11,416	514,348	11,565	516,308	11,565	516,308	11,565	516,308	11,565	516,308
Agriculture	Means	1,551	1,872	18	19	0.54	0.59	0.55	0.60	0.12	0.00	0.00	0.32
	N	28,400	364,910	28,399	364,826	28,400	364,910	28,400	364,910	28,400	364,910	28,400	364,910
Total	Means	1,576	1,761	15	19	0.61	0.64	0.19	0.42	0.24	0.02	0.02	0.42
	N	260,610	1,447,810	259,937	1,445,163	260,610	1,447,810	260,610	1,447,810	260,610	1,447,810	260,610	1,447,810

The number of loan disbursements decreased from 2016M1 to 2019M3, while the amounts of these loan disbursements increased.

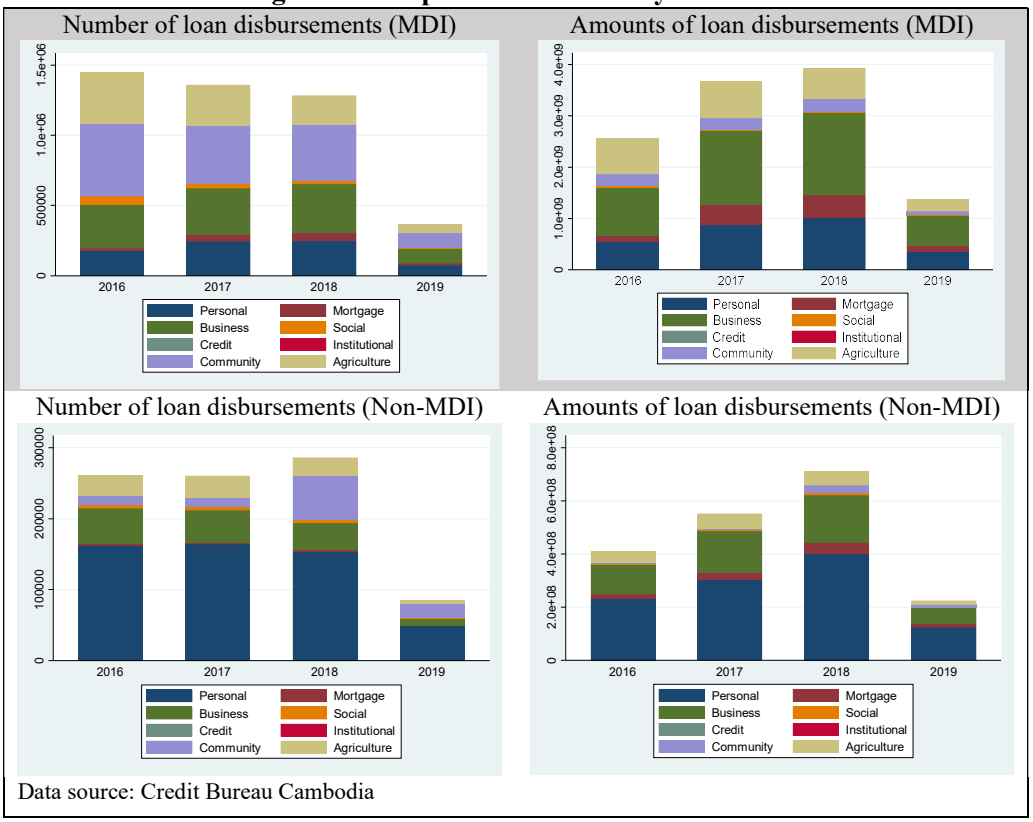
Figure 7 shows the changes in composition of MFI's loan portfolio by product types between 2016M1 and 2019M3. We aggregated the number and amounts of loan disbursements for each year by 8 types of loan products.[8] The definition of loan products is described in Table 5. Regarding the MDIs, we find that the total number of loan accounts declined from 2016 to 2018, while the total amounts lent increased. In particular, the increases in the amounts of loans were relatively large between 2016 and 2017. Regarding non-MDIs, we find that the total number of disbursed loan accounts remained stable over time, while the total amounts of disbursed loans increased over the period. It is noted that several borrowers are often included in one loan account in the case where loans are disbursed as a group-lending loan or a joint-lending loan. Figure 8 shows the total number of borrowers over the period. Despite the decrease in the number of new loan accounts, the total number of borrowers constantly increased. The findings here indicate that MDIs and non-MDIs adjusted to the interest rate cap policy by increasing average loan sizes and decreasing the number of newly disbursed loans, while they kept increasing the number of borrowers by increasing the number of borrowers per loan account.

Table 5: Definition of Loan Products

Type	Definition
Personal Loan	Loans for motorbike, durable goods, health care etc.
Mortgage Loan	Loans for housing, land purchase, etc.
Business Loan	Loans for working capital, business investment, etc.
Social Loan	Loans for emergency purpose, green energy, etc.
Credit Card Loan	Credit card loans
Institutional Loans	Loans to rural credit operators
Community Loans	Loans for group lending, village banking, etc.
Agriculture Loans	Loans for agricultural purposes

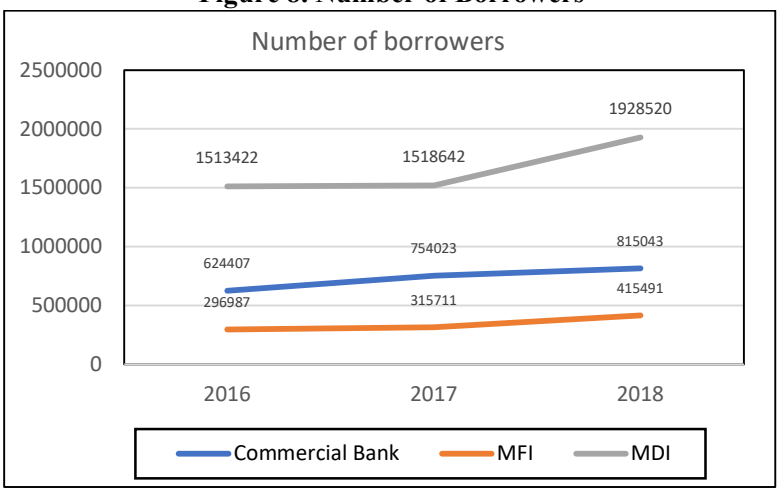
[8] In the CBC database, loans are categorized into major classifications (items of the first hierarchical level), and minor classifications (items of the second hierarchical level). Definition of loan products in our paper basically follows the major classifications, except for community loans and agricultural loans. Agricultural Loans are one of the minor classifications in Business Loans, and Community Loans are one of the minor classifications of Social Loans. However, because the number of disbursements of these loans are large they are by nature different from other Business loans and Social loans. Thus, in this paper, we make independent categories for these two loans, and we categorized loan disbursements in the CBC data into personal finance, mortgage loans, business loans, social loans, credit card, institutional loans, community loans, and agricultural loans.

Figure 7. Composition of Loans by Products



Source: Authors' calculations using the CBC database.

Figure 8. Number of Borrowers

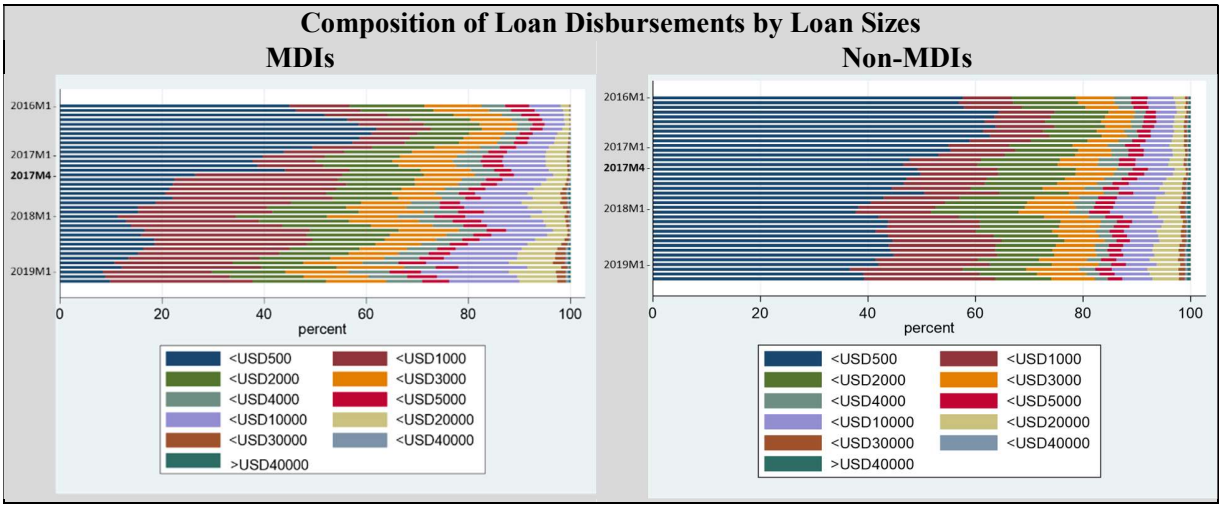


Source: Authors' calculations using the CBC database.

The policy particularly affected small-sized loans, and the MDIs reacted more significantly than non-MDIs.

Figure 9 shows the composition and trend of total loan disbursements by sizes between 2016M1 and 2019M3. The composition of loan disbursements shows that loan disbursements of smaller than USD500 dominate the substantial shares of total loan disbursements by MFIs. Specifically, loans of less than USD 500 dominate at around 50% in both MDI and non-MDI loan portfolios in 2016. However, the share of loans of less than USD500 decreased significantly in MDI loan disbursements shortly after 2017M4.

Figure 9: Composition and number of Newly Disbursed Loans by Loan Sizes

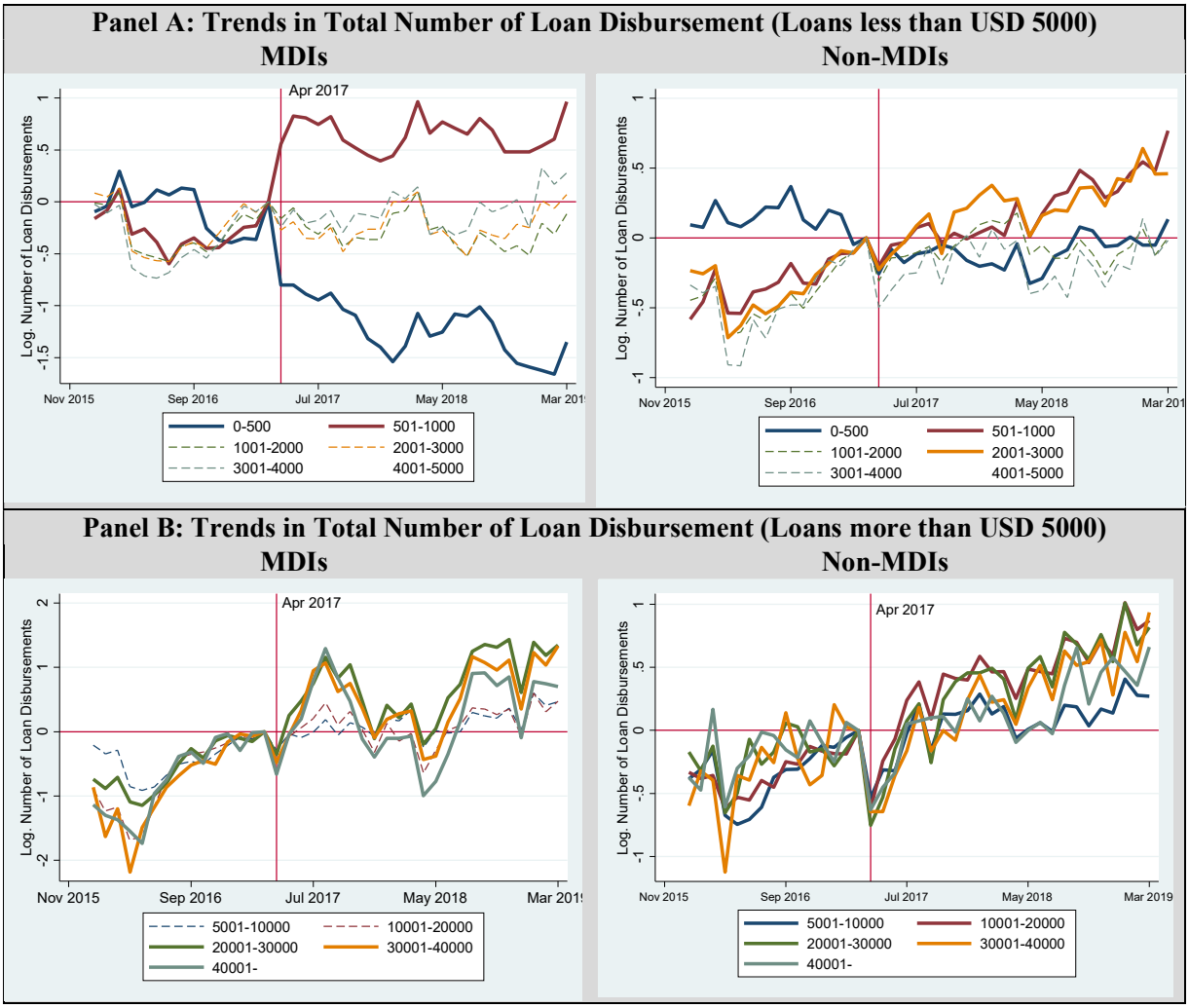


Source: Authors' calculations using the CBC database.

To understand which size of loans decreased after the interest rate cap policy was implemented, we present the trends in the total number of loan disbursements in Figure 10. To compare the trend across loan sizes, we took a logarithm for the number of loan disbursements and adjusted the numbers at zero for all the loan sizes in March 2017. Figure 10 also shows that the total number of loan disbursements of less than USD 500 significantly declined for both MDIs and non-MDIs in 2017M4 (Panel A). In addition, the decline was larger for MDIs than non-MDIs. In the meantime, larger size loans increased after the implementation of the interest rate cap policy, particularly for loans of USD500-1,000 for MDIs, and loans for USD500-1,000 and USD2,000-3,000.

In Panel B of Figure 10, we present the trend in the total number of loans of more than USD5,000. The total number of loan disbursements have constantly increased for in all loan sizes. Even though there is a steep decline shortly after the interest rate cap policy in all the loan sizes for both non-MDIs and MDIs, the number of loan disbursements was back to the same trend in half a year. This suggests that there has been no significant persistent negative impact on loan disbursements of large sizes, while there have been persistent declines in small-size loans for both MDIs and non-MDIs.

Figure 10 Trends in the Total Number of Loan Disbursements before and after the introduction of the interest rate cap policy



Source: Authors' calculations using the CBC database. To compare the trend across loan sizes, we take a logarithm for the number of loan disbursements and we adjusted the numbers of all the loan sizes to zero in March 2017.

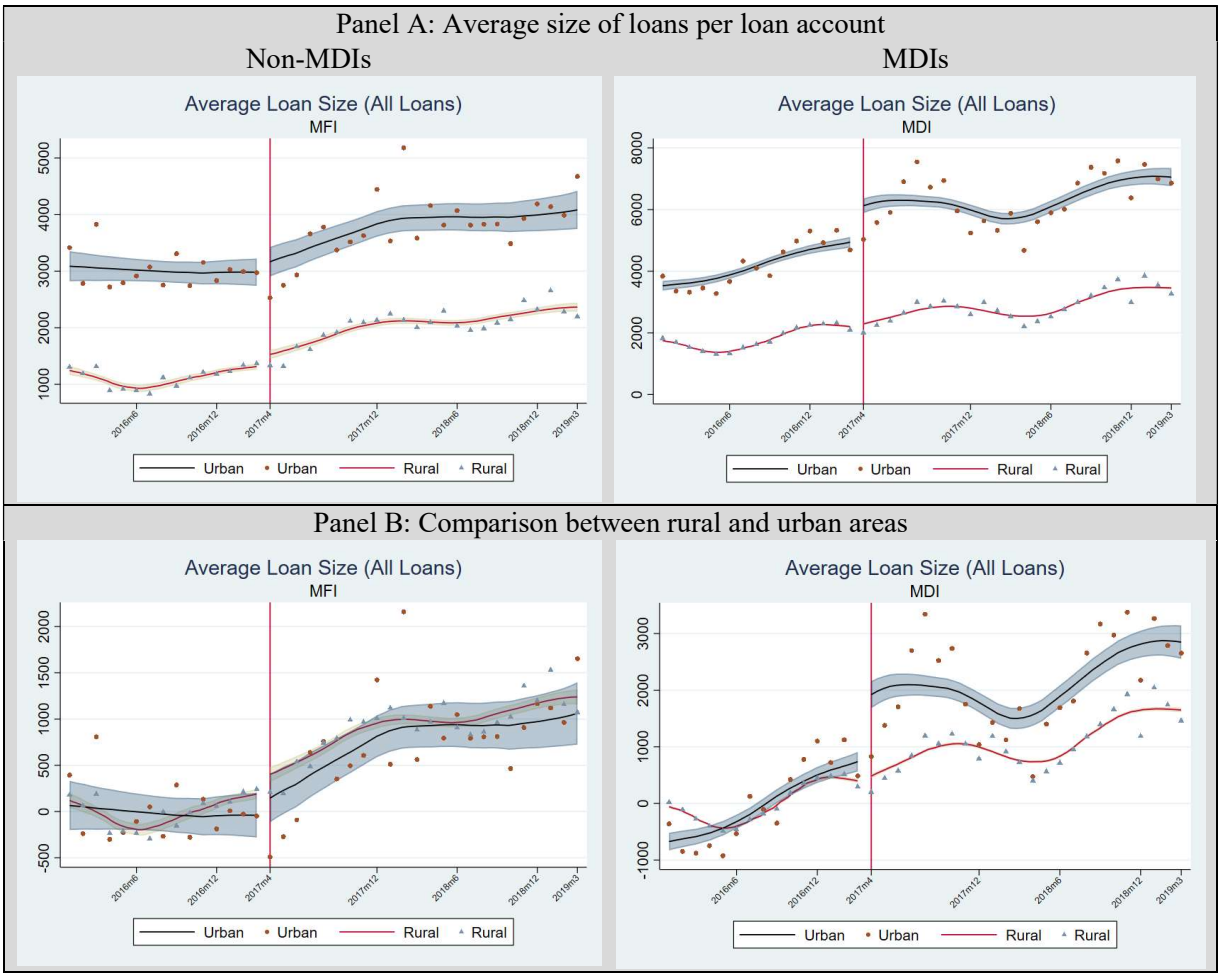
Loan sizes significantly increased from 2016M1 to 2019M3, and the number of borrowers started concentrating in urban areas just after the policy was introduced.

Next, we investigate the changes in lending behavior by non-MDIs and MDIs. Figure 11 shows the average loan sizes per loan account from 2016M to 2019M3. Previously, Figure 10 showed the average number of loan disbursement per commune by a financial institution. The average loan size is in general larger for MDIs than non-MDIs, and it is larger in urban areas than in rural areas.[9] Although there was an increasing trend in average loan size from 2016M1 to 2019M3, the average loan size became larger in rural areas for non-MDIs after the introduction of the interest rate cap policy (increasing from about 1,000USD in 2016M1 to 2,000USD in 2018M12). We observe a jump in average sizes of MDI loans in urban areas at this time,

[9] We define communes in Phnom Penh and communes in the capital district of each province as urban areas, otherwise we define communes as rural areas.

suggesting that MDIs adjusted to the interest rate cap policy by increasing loan sizes in urban areas. In addition, the average loan size constantly increased from 2016M1 to 2019M3 in both rural and urban areas (from about 3,000USD to about 6,000USD in urban areas and from about 1,500USD to about 3,000USD in rural areas).

Figure 11: Average size of loans per loan account

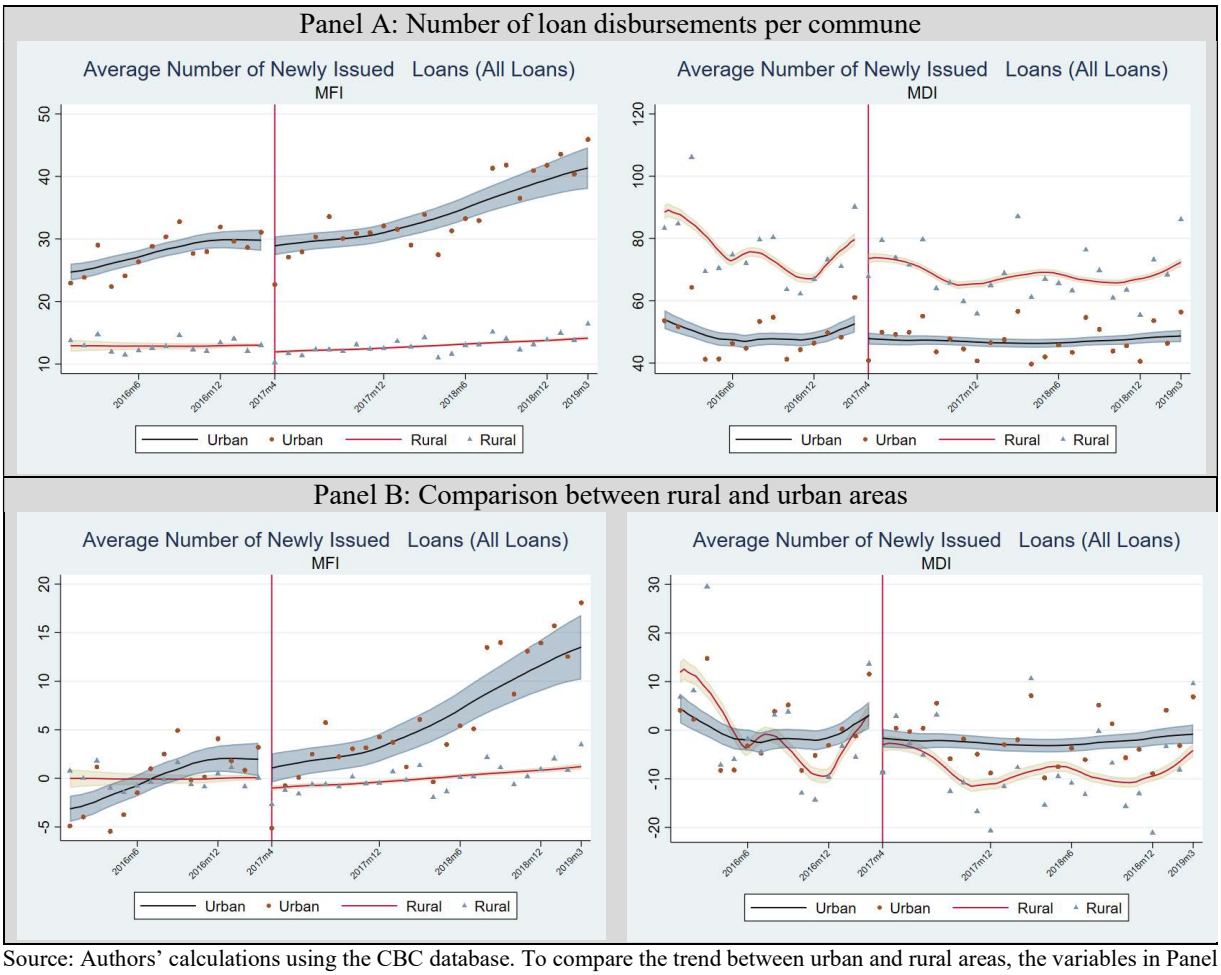


Source: Authors' calculations using the CBC database. To compare the trend between urban and rural areas, the variables in Panel B are adjusted with the average value before the policy was implemented.

Figure 12 shows the average number of loan disbursements in urban and rural areas before and after the interest rate cap was introduced. We calculated the average number of loan disbursements per commune-MFI pair, and we also plotted the 95% confidential intervals. We find that the average number of loan disbursements in rural and urban areas followed the same trend and decreased before the interest rate cap policy, while the trends were different between urban and rural areas after the interest rate cap policy was introduced. The average number of loan disbursements increased in urban areas, while they remained stable in rural areas after the interest rate cap policy came into being. The results suggest that both non-MDIs and

MDIs started concentrating on urban areas, possibly because it became difficult to make a profit from rural households under the low interest rate circumstances.

Figure 12: Number of loan disbursements per commune



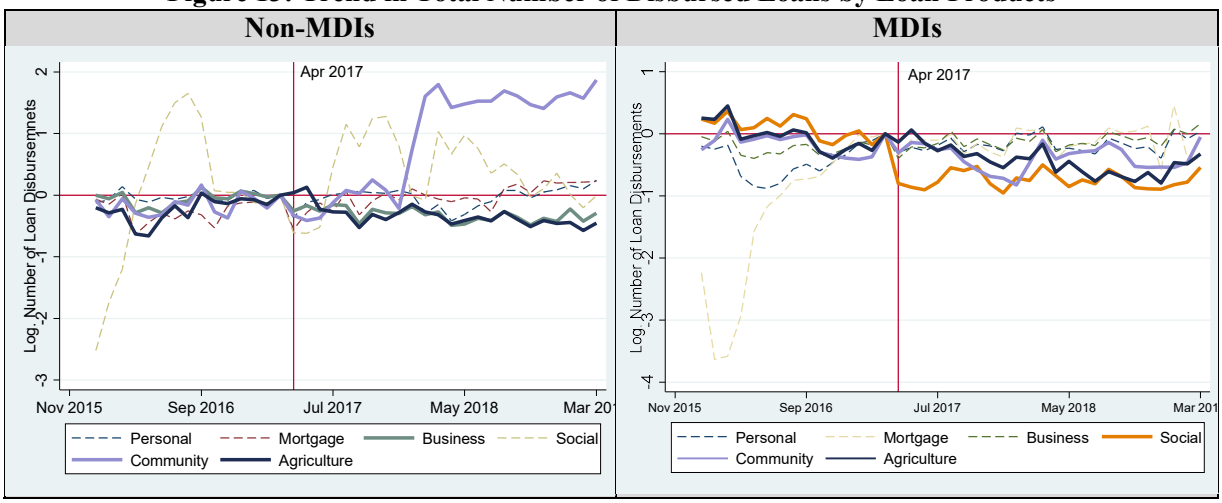
Source: Authors' calculations using the CBC database. To compare the trend between urban and rural areas, the variables in Panel B are adjusted with the average value before the policy was implemented.

Generally, MDI decreased loan disbursements of all the products both in urban and rural areas, while non-MDIs increased loan disbursements of personal and mortgage loans in urban areas.

The reactions to interest rate cap policy in lending are different between MDIs and non-MDIs. In addition, it also seems that the reactions of MDIs and non-MDIs are different across loan products. Figure 13 shows the trend in total number of loan disbursements by product. For each product type, we aggregated the number of loan disbursements by types of financial institutions: MDIs and non-MDIs. To compare the trend across loan types, we take a logarithm for the number of loan disbursements and the numbers were adjusted at zero at March 2017. For non-MDIs, changes in the number of loan disbursements were large for business loans, community loans and agricultural loans. Specifically, the numbers of loan disbursements were lower than zero for business loans and agricultural loans after April 2017, meaning that the numbers of loan disbursements decreased in those loans after the interest rate cap policy was introduced. In the meantime,

the number of loan disbursements had jumped for community loans by January 2018. For MDIs, the number of loan disbursements for social loans, community loans, and agricultural loans were constantly lower than zero after April 2017 as seen in Figure 13, suggesting that there were declines in the number of loan disbursements for these types of loans.

Figure 13: Trend in Total Number of Disbursed Loans by Loan Products



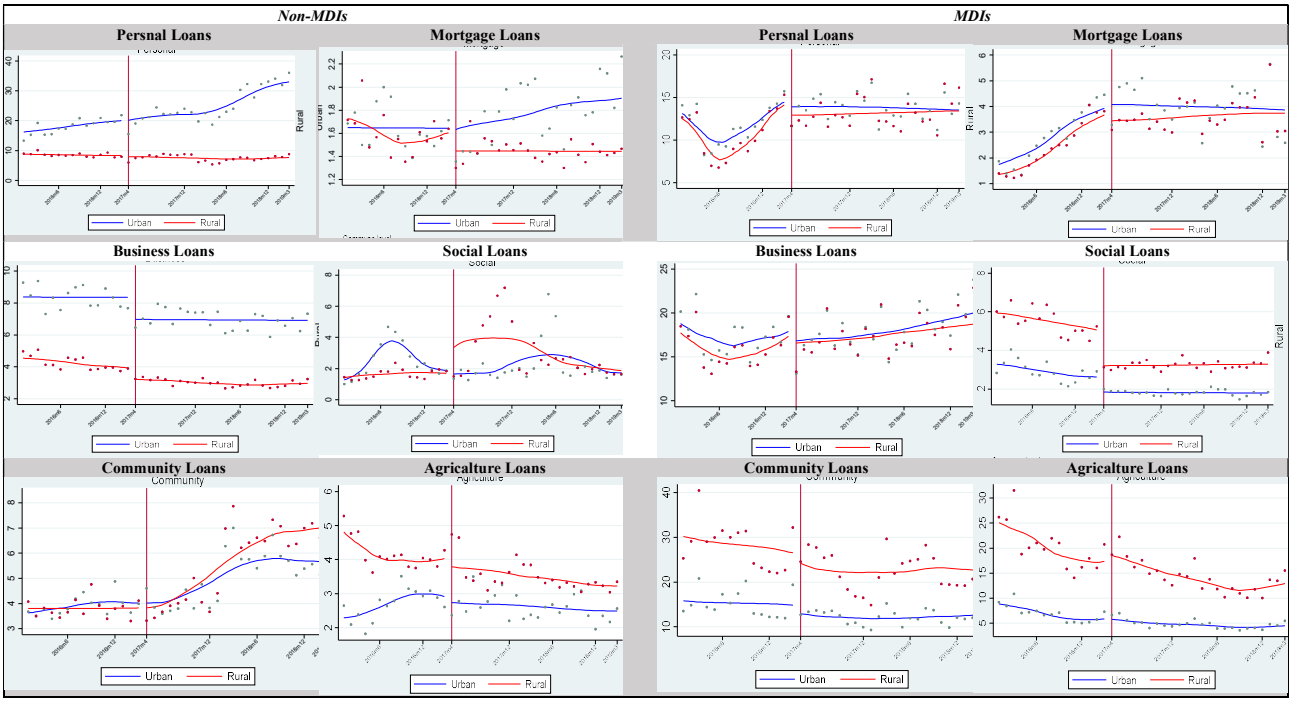
Source: Authors' calculations using the CBC database. To compare the trend across loan types, we took a logarithm for the number of loan disbursements and we adjusted the numbers of all the loan types at zero in March 2017.

Figure 14 shows the average number of loan disbursements for each loan product by urban and rural areas per commune-MFI pair, and Figure 15 shows the average size of loans for each product. There is also a difference across product types in trends of average loan size and the average number of loan disbursements after the interest rate cap policy. For non-MDIs, the average number of loan disbursement per commune increased in urban areas for personal loans and mortgage loans compared to rural areas after the interest rate cap policy implementation. The average number of loan disbursements increased in both urban and rural areas for community loans. In the meantime, the reaction of non-MDI organizations in lending business loans was in the opposite direction. The average size significantly jumped shortly after the interest rate cap policy, and the average number of business loans decreased in urban areas. These findings suggests that the interest rate cap had an impact on loan allocations in terms of product types, and in responses to the interest rate cap policy, non-MDIs increased the number of their personal loans and mortgage loans (especially in urban areas), while they decreased the number of their business loans. This indicates that non-MDIs concentrated disbursements of mortgage loans in urban areas after the introduction of the interest rate cap policy.

In contrast to the non-MDIs, for MDIs the average number of loan disbursement decreased or at least did not increase for all types of loans after the interest rate cap policy was implemented.[10] This indicates that the interest rate cap policy negatively affected the number of loan disbursements for MDIs. Furthermore, community loans seem to have been most affected by the interest rate cap policy for MDIs, since there is a clear jump in the average size of community loans just after the implementation of the interest rate cap policy, and the average number of loan disbursements also decreased, especially in rural areas.

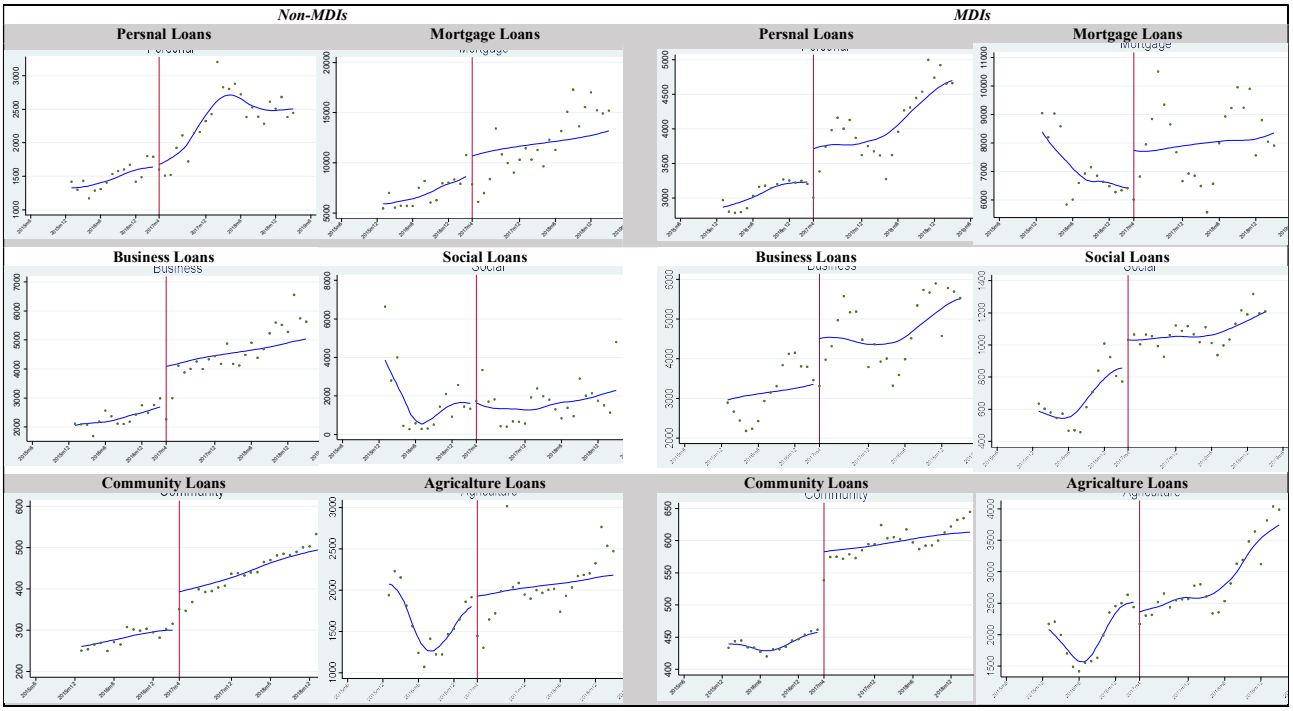
[10] However, as shown in the regression analysis, the impact on community loans is different across the MDIs, and MDIs with higher pre-regulated interest rates were trying to keep providing community loans under the low interest rate environment.

Figure 14: The Average Number of Disbursed Loans



Source: Authors' calculations using the CBC database. This figure shows the average loan size per loan account, and average number of loan disbursements per commune-MFI pair.

Figure 15: The Average Size of Loans by Product



Source: Authors' calculations using the CBC database. This figure shows the average loan size per loan account.

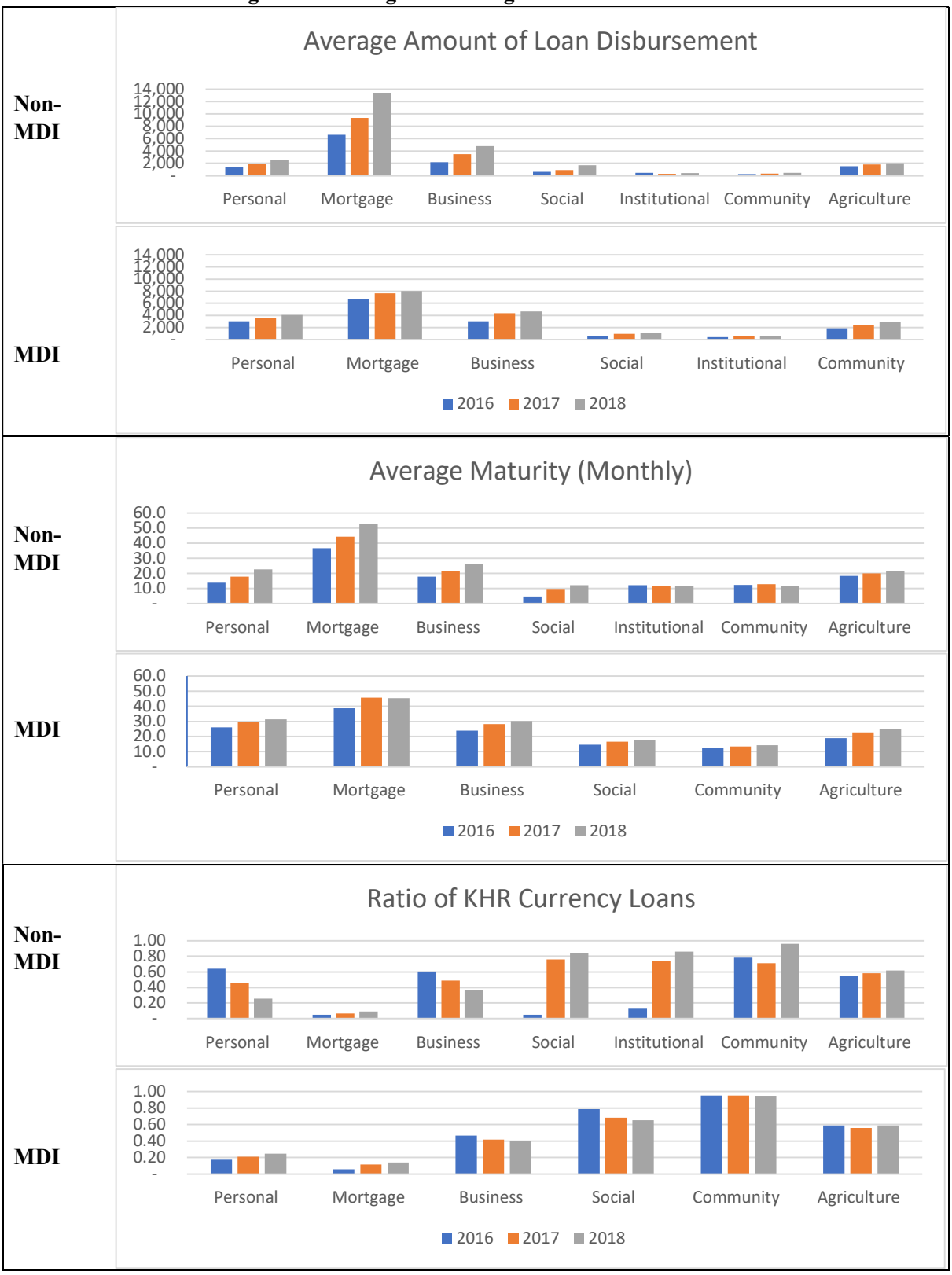
After the interest rate cap policy, the loan provision shifted toward less costly lending schemes, such as secured loans with land titles, USD currency loans, and longer-term loans.

Regarding other loan characteristics, we present the average loan characteristics by product type for MDIs and non-MDIs in Figure 16. Apart from the average size of loan disbursements, the average time of maturity also increased from 2016 to 2018. The increase in average maturity time is larger from 2016 to 2017 (from 18 months to 23 months) than from 2017 to 2018 (from 23 to 25 months). Even though the development of the financial sector also contributed to the increase in maturity by financial institutions, the significant increase between 2016 and 2017 indicates that the interest rate cap policy encouraged financial institutions to increase maturity per loan, to increase their profit per loan.

In total, the ratio of KHR currency loans to total loans in terms of headcount has decreased constantly from 2016 to 2018. In particular, the decline between 2016 and 2017 was significant, suggesting that the interest rate cap policy led non-MDIs and MDIs to decrease the KHR currency loan provisions, possibly because of the decline in loan provision to high-risk profile borrowers. However, the changes in the ratios of KHR currency loans were different from product to product, and between MDIs and non-MDIs. For example, the ratio of KHR currency increased in personal loans and mortgage loans for MDIs, and it particularly increased in the community loans for non-MDIs.

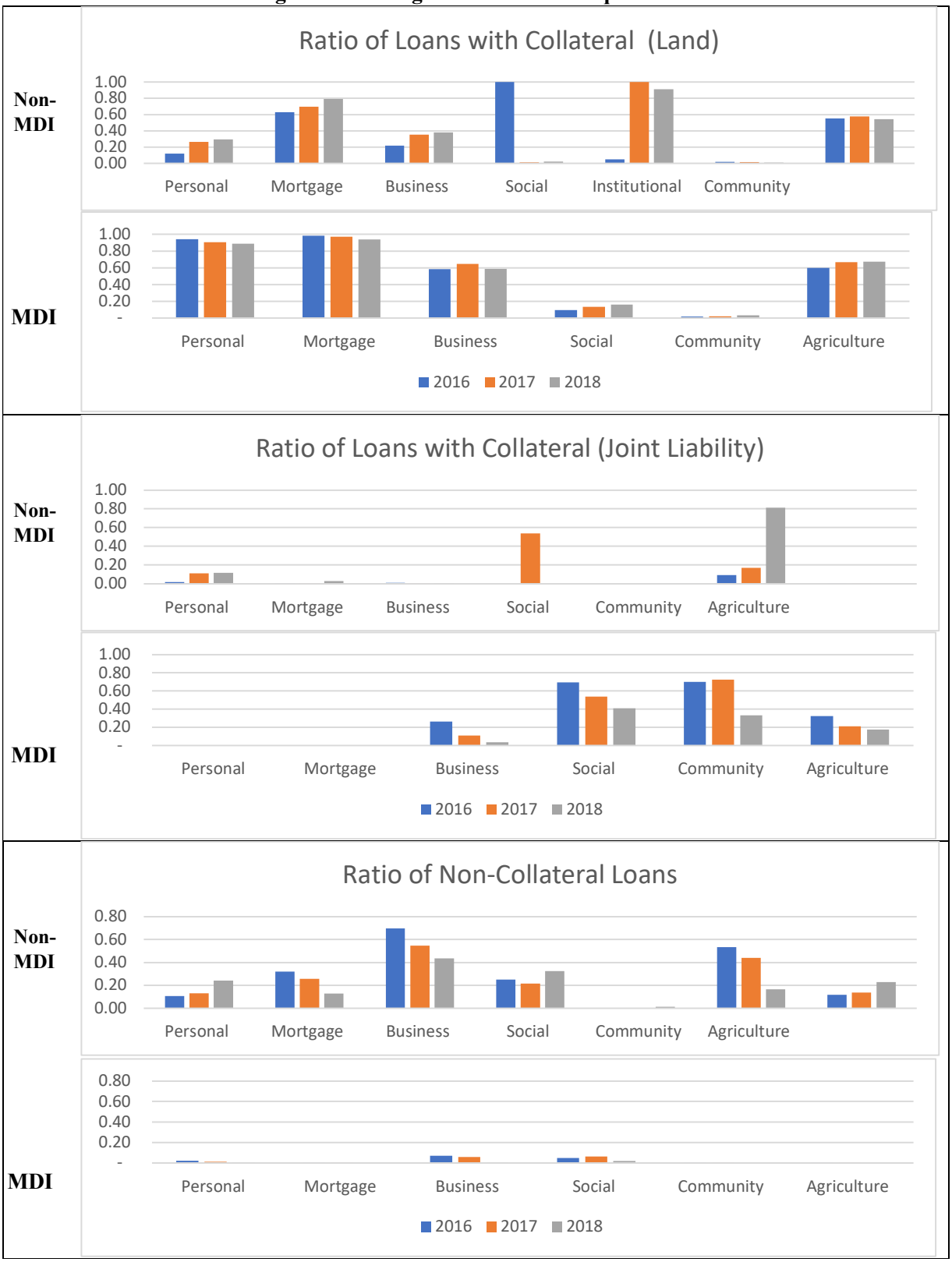
Next, we further investigated the collateral requirements of non-MDIs and MDIs. In Figure 17, we calculate the ratio of loans made with land titles as collateral, the ratio of loans with any guarantor, and the ratio of loans without any type of collateral. According to the data, the use of land titles as collateral increased from 2016 to 2017 in all the loan products, while it decreased from 2018 to 2019. However, we found that this trend in using land titles as collateral differed across product types. For personal loans and mortgage loans, the ratio of the use of land titles as collateral decreased from 2016 to 2018. In the meantime, it increased from 2016 to 2017 for business loans, social loans, and agricultural loans, while it decreased or did not change significantly from 2017 to 2018 for those loan types. The overall trend in using land titles as collateral was similar for non-MDIs. The ratio increased from 2016 to 2017, while it decreased from 2018 to 2019. It is noteworthy that the ratio of the use of land titles as collateral in the business loans and personal loans that make up a large share of the MFI loan portfolio significantly increased from 2016 to 2018. Although the trends were also different across product types, the ratio of the use of land titles as collateral has increased in most of their loan products.

Figure 16: Changes in Average Loan Characteristics



Source: Authors' calculations using the CBC database.

Figure 17: Changes in Collateral Requirement



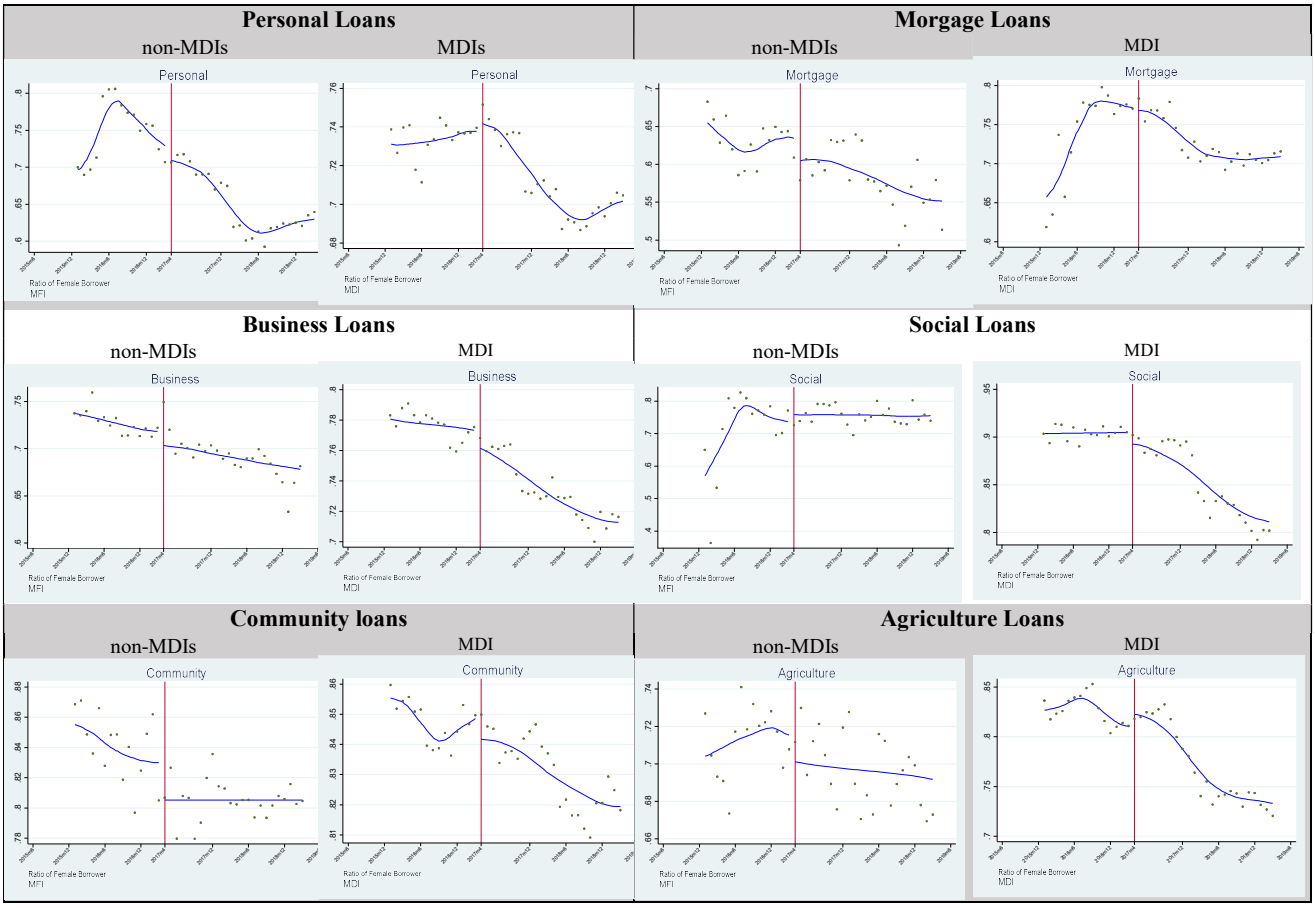
Source: Authors' calculations using the CBC database.

MFI's lending to female borrowers declined after the interest rate cap policy was implemented.

Next, we investigated Non-MDI and MDI lending to female borrowers. Figure 18 shows the ratio of female-related loans to the total number of loan disbursements. We defined loan disbursements which included at least one female borrower as a female-related loan. The figure shows that the ratio of female-related loans declined in all the products from 2016M1 to 2019M3. Although some loans, such as the personal loans of non-MDIs and business loans of both non-MDIs and MDIs decreased even before the interest rate cap policy, there was a clear shift in trends of the ratio of female-related loans after the policy came into being, particularly for the personal loans and agriculture loans of MDIs. The results reveal that the introduction of the interest rate cap policy had negative relationship with female financial inclusion.

However, it is also noted that the Figure 18 does not necessarily mean that there is a causal relationship between reduction in female-related loans and the interest rate cap. In other words, female-borrowers are not necessarily rejected/discouraged from borrowing because they are a cost factor for MFIs. In fact, there is a correlation between female-related loans and some loan characteristics, such as rural areas, non-collateral loans, and small-size loans. Thus, the interest rate cap might affect the provision of costly loans, such as small-sized loans and non-collateral loans, and then as a consequence, it became difficult for female borrowers to borrow from formal financial institutions. We discuss this causal relation in more detail using regression models in Section 3.4.

Figure 18: The ratio of female-related loans to total number of loan disbursements

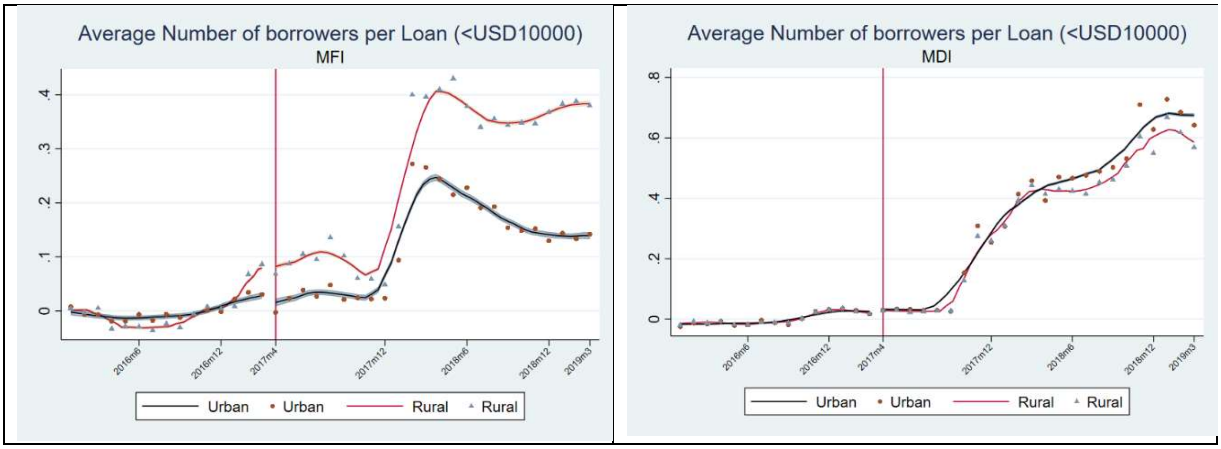


Source: Authors' calculations using the CBC database.

The Number of Borrowers per loan account increased after the interest rate cap policy was implemented.

The substantial share of microfinance loans are group-lending loans and joint-account loans. Thus, several borrowers may be involved in one loan account. Figure 19 shows the average number of borrowers per loan account in all the loans made by Non-MDIs and MDIs. For both Non-MDIs and MDIs the average number of borrowers per loan account increased after the interest rate cap policy was implemented. This can be explained by the large fixed cost per loan in microfinance loans. Loan provisions require a proportionally large fixed cost per loan, although financial institutions need to reduce their fixed costs in loans under the circumstance of the low interest rate cap. In response to the 18% interest rate cap, non-MDIs and MDI might increase the number of borrowers in one loan provision to lower the costs of loan provision, so that they can keep the number of borrowers in group-lending or joint-account loans by increasing the number of borrowers per loan account.

Figure 19: Number of Borrowers per Loan Account



Source: Authors' calculations using the CBC database.

3.3 Regression analysis on impacts of interest rate cap policy on MFI Lending

In this section, we examine the causal impacts of the interest rate cap policy on loan disbursements of MDIs and non-MDIs. However, there is a challenge to empirically identify the causal impact of interest rate policy. For the estimation of the causal impact of a policy change, researchers are in general required to compare the sample which is affected by a policy (a treatment group) with a sample that is not affected (a control group), and then the average difference between these two samples is the causal impact.[11] Since all MFIs

[11] The estimated effect is called an average treatment effect (ATE). The way to estimate the ATE is by comparing the difference in outcome between before and after policy implementation and between treatment group and control group. This is the so-called difference-in-difference (DD) estimation.

are affected by the interest rate cap policy, the impact of this policy and other changes in macroeconomic or regulatory conditions are likely to be mixed together in the estimation.[12]

To circumvent this problem, we use difference-in-difference-in-difference (DDD) estimation exploiting heterogeneity in assessing the effect of interest rate cap policies, and we also control for other possible effects. Even though the interest rate cap policy affected all of the MFIs in Cambodia, MFIs which imposed higher interest rates before the policy implementation are more likely to be affected, since they had to adjust their loan portfolio to meet the policy with a bigger effort. By examining the heterogeneity in the impact of interest rate cap policy across the different levels of pre-regulated interest rates of MFIs, we examine whether interest rate cap policy had a causal impact on MFIs' lending behavior. Furthermore, the interest rate cap policy would negatively affect the outreach of MFIs, and could affect loan provision to rural and urban areas. Thus, there could also be heterogeneity in the effect of interest rate cap policy between urban and rural areas.

Regression Analysis of Impacts on the Number of Loan Disbursements

We take into account the challenges in estimation, and we estimate the heterogeneous impact of interest rate cap policy on outreach, loan sizes and other loan characteristics for Non-MDIs and MDIs. First, we estimate the following equation to examine whether there is any change in the outreach of loan provision before and after the interest rate cap policy:

$$\begin{aligned} &Number\ of\ Loan\ Disbursement_{b,k,m,t} \\ &\quad = \alpha + \beta_1 X_{b,k,m,t} + \beta_2 Urban_k \cdot Policy_t + \beta_3 InterestRate_{b,2016} \cdot Policy_t \\ &\quad + \beta_4 X_{b,k,m,t} \cdot Policy_t + \tau_t + \varphi_m + \mu_b + \psi_k + u_{b,k,m,t} \end{aligned}$$

where $Number\ of\ Loan\ Disbursement_{b,k,m,t}$ is the number of loan disbursements related to product m by financial institution b in commune k at period t. This variable is the aggregated number of loan disbursements by products at financial institution-commune level in each month. If this variable shows higher values, the financial institutions increased loan provided to communes. $InterestRate_{b,2016}$ is the pre-regulated interest rate of MFIs in 2016 and is calculated as the total interest expense in 2016 divided by the outstanding loans at the end of 2016. $Policy_t$ is a dummy variable for policy implementation and takes the value one after 2017M4. $Urban_c$ is a dummy variable that takes the value one if the commune k is the capital of a province or located in Phnom Penh Province. We also control fixed effects in four ways, $\tau_t, \varphi_p, \mu_b, \psi_c$ or Time-fixed effect, product-fixed effect, financial-institution-fixed effect, and commune-fixed effect. Lastly, $u_{b,c,p,t}$ is a white noise variable.

If the policy has a larger impact on MFIs with higher pre-regulated interest rates, coefficients of $InterestRate_{b,2016Q4}$ would be estimated as negative ($\beta_3 < 0$). If MFIs decrease the loan provision to rural areas relative to urban areas after the interest rate cap policy, the coefficient of $Urban_k$ would be estimated as positive ($\beta_4 > 0$). Similarly, we test the heterogeneous effects of interest rate cap policy on loan provisions across different loan characteristics. The variables used for regression are presented in Table 6.

[12] This estimated effect is generally dubbed as the average treatment effect of the treated sample (ATT). For the friendly introduction of causal inference, see Agrist and Pischke (2014).

Table 6: Variables used in regression analysis

Characters (X)	Definition
Bank Characteristics	
$InterestRate_{j,2016}$	Pre-regulated interest rate of MFIs in 2016 (%). The variable is calculated as total interest expense in 2016 divided by outstanding loans at the end of 2016.
Region Characteristics	
$Urban\ Dummy$	A dummy variable to take the value one if the commune k is a capital of a province or located in Phnom Penh Province.
Loan Characteristics	
KHR Currency Dummy	A dummy variable to take the value one if a loan is denominated in KHR.
Non-Collateral Loan Dummy	A dummy variable to take the value one if a loan is unsecured.
Female-Related Loan Dummy	A dummy variable to take the value one if a female borrower is involved in a loan account.
Group-Lending Dummy	A dummy variable to take the value one if a loan is a group-lending loan.
Joint-Account Dummy	A dummy variable to take the value one if a loan is a joint account loan.
Long-Term Loan Dummy	A dummy variable to take the value one if a loan has a maturity of more than one year.

We present the results of the estimation in Table 7. We estimated the model using the OLS method with cluster-robust standard errors at financial institutions. We run a regression with a full sample of both MDIs and Non-MDIs in column 1-3, a subsample of non-MDIs in column 4-6, and a subsample with MDIs in column 7-9, respectively. We also run a regression with a subsample of small loans of two different definitions as (1) loans of less than USD10,000 and loans of less than USD20,000.

We found that the interaction terms of pre-regulated interest rate and policy dummies (Interest Rate X Policy 1 & 2) are negatively correlated to loan disbursement for non-MDIs at 1% statistical significance in column 4-6. This suggests that non-MDIs with higher interest rates decreased loan disbursements after the interest rate cap policy. This is consistent with the hypothesis that microfinance institutions reduce costly loans in response to the interest rate cap. In the meantime, MDIs differentially responded to the interest rate cap. The interaction terms of pre-regulated interest rate and policy dummies are positively associated with the number of loan disbursements of MDIs.

In Hypothesis 1, non-MDIs and MDIs would decrease costly loans in response to the interest rate cap policy. The cost factors of non-MDIs and MDIs could be loan provision to rural areas, loans without collateral, female-related loans, group-lending loans, and loans in KHR currency. These loans are supposed to be high risk-profile. As regression results, we found that the interaction terms of group-lending and policy dummies (Group Account X Policy 1 & 2) are negatively associated with the number of loan disbursements in column 1-3 and 6-9. This suggests that MDIs decreased group-lending loans after the interest rate cap policy was implemented.

In terms of loan provision to rural areas, there were no statistically significant results (Urban X Policy). The interaction terms of non-collateral dummy and policy dummies (Non-Collateral X Policy) are also negative at statistical significance in column 4-9, suggesting that both non-MDIs and MDIs decreased the number of non-collateral loans. Regarding female-related loans, the interaction terms of policy dummies

were significantly negative within one year after the policy implementation (Female-Related X Policy 1). This suggests that the interest rate cap policy negatively affected the provision of female-related loans from MDIs and non-MDIs after implementation, but the negative effects disappeared and the loan provision to female borrower was back to normal before the interest rate cap policy was terminated.

Regarding product types, we found that loans for agricultural purposes (Agricultural X Policy) and social loans (Agricultural X Policy) declined after the interest rate cap policy came in. Since agricultural business is prone to disaster risks and climate change, loans for this sector are supposed to be risky, and high interest rate are required to be set to cover the costs of delinquency. Thus, in line with Hypothesis 1, the results suggest that the interest rate cap policy leads to reduction in high-risk profile loans. Furthermore, most social loans are for emergency purposes. Since the demand for short-term loans is insensitive to interest rate and the costs of keeping high liquidity for temporal fund needs is high for financial institutions, the interest rate for those loans are generally set at a high level. Given the nature of social loans in Cambodia, the results suggest that MDIs reduce costly loans because they cannot afford to provide these loans.

Furthermore, the results suggest that disbursements of long-term loans increased relative to short-term loans after the interest rate cap policy (Long-term X Policy). Making maturity longer is one of the possible strategies to reduce interest rates on loans (Hypothesis 4), and regression results also support this MFI behavior. Shifting from the short-term loans to long-term loans is beneficial in the sense that borrowers can invest in longer term projects and reduce the risks of default. However, since maturity is also determined by the purpose of loans, there is a limitation on reducing interest rates by making maturity periods longer, and the results might indicate that some borrowers for short-term loans could be excluded from formal finance. Thus, the results might also reflect the possibility that the borrowers demanding short-term loans increased their access to informal finance instead of to formal financial institutions.

Table 7: Regression Analysis of the Impact on the Number of Loan Disbursements

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	MDI & non-MDI			non-MDI			MDI		
	Alll	<10000	<5000	Alll	<10000	<5000	Alll	<10000	<5000
Urban X Policy 1	-0.019	-0.010	-0.049	-0.107	-0.091	-0.107	0.118	0.111	0.070
	(0.071)	(0.075)	(0.070)	(0.097)	(0.098)	(0.098)	(0.092)	(0.098)	(0.091)
Urban X Policy 2	0.079	0.095	0.053	0.060	0.096	0.066	0.181	0.162	0.124
	(0.117)	(0.119)	(0.119)	(0.209)	(0.208)	(0.209)	(0.103)	(0.112)	(0.108)
Interest Rate X Policy 1	-0.007	-0.006	-0.006	-0.016***	-0.015***	-0.015***	0.064***	0.0636***	0.0704***
	(0.010)	(0.010)	(0.011)	(0.003)	(0.003)	(0.003)	(0.009)	(0.011)	(0.009)
Interest Rate X Policy 2	0.349	0.004	0.005	-0.020***	-0.020***	-0.020***	0.107**	0.110**	0.117**
	(0.018)	(0.018)	(0.019)	(0.005)	(0.004)	(0.005)	(0.038)	(0.037)	(0.036)
NonCollateral X Policy 1	-0.073	-0.073	-0.083	-0.285**	-0.238*	-0.261*	-0.653**	-0.590**	-0.629**
	(0.185)	(0.193)	(0.196)	(0.136)	(0.140)	(0.138)	(0.200)	(0.173)	(0.191)
NonCollateral X Policy 2	0.238	0.227	0.229	0.080	0.169	0.120	-1.196**	-1.071**	-1.145***
	(0.543)	(0.500)	(0.530)	(0.182)	(0.179)	(0.181)	(0.323)	(0.301)	(0.309)
Group Account X Policy 1	-0.568***	-0.497**	-0.551**	-0.113	-0.034	-0.031	-0.916*	-0.835	-0.922*
	(0.195)	(0.214)	(0.214)	(0.267)	(0.274)	(0.273)	(0.441)	(0.479)	(0.472)
Group Account X Policy 2	-0.990***	-0.830***	-0.908***	0.001	0.117	0.131	-1.529**	-1.337**	-1.463**
	(0.307)	(0.294)	(0.308)	(0.311)	(0.319)	(0.319)	(0.513)	(0.500)	(0.508)
Joint Account X Policy 1	-1.426**	-1.395**	-1.429**	1.168**	1.204**	1.230**	-2.315**	-2.275**	-2.364**
	(0.661)	(0.627)	(0.652)	(0.512)	(0.470)	(0.499)	(0.715)	(0.683)	(0.709)
Joint Account X Policy 2	-1.813**	-1.749**	-1.789**	0.589*	0.715**	0.708**	-2.734**	-2.699**	-2.784**
	(0.824)	(0.818)	(0.835)	(0.342)	(0.334)	(0.338)	(0.787)	(0.783)	(0.794)
Female-Related Loan X Policy 1	-0.412**	-0.422**	-0.420**	-0.511	-0.532	-0.522	-0.372	-0.383	-0.379
	(0.200)	(0.208)	(0.201)	(0.449)	(0.450)	(0.449)	(0.290)	(0.297)	(0.292)
Female-Related Loan X Policy 2	-0.374	-0.355	-0.371	-0.549	-0.578	-0.565	-0.204	-0.183	-0.198
	(0.340)	(0.352)	(0.345)	(0.513)	(0.512)	(0.512)	(0.533)	(0.545)	(0.540)
Loang-Term Loan X Policy 1	0.035**	0.034**	0.034**	0.017	0.017	0.017	0.034*	0.033*	0.032
	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)
Loang-Term Loan X Policy 2	0.088**	0.089**	0.091**	0.030	0.030	0.031	0.089	0.089	0.090
	(0.037)	(0.038)	(0.040)	(0.021)	(0.021)	(0.022)	(0.057)	(0.060)	(0.063)
KHR Currency X Policy 1	0.015	0.013	0.012	0.013	0.013	0.010	0.009	0.007	0.006
	(0.009)	(0.009)	(0.009)	(0.011)	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)
KHR Currency X Policy 2	0.087**	0.084*	0.085*	0.020	0.019	0.017	0.095	0.093	0.097
	(0.041)	(0.043)	(0.047)	(0.016)	(0.015)	(0.013)	(0.055)	(0.058)	(0.062)
Morgage X Policy 1	-0.036	-0.064	-0.077	0.063	0.012	-0.000	0.043	0.035	0.016
	(0.073)	(0.050)	(0.065)	(0.082)	(0.080)	(0.094)	(0.070)	(0.046)	(0.054)
Morgage X Policy 2	0.087	-0.087	-0.061	-0.230	-0.359**	-0.410**	0.243	0.076	0.107
	(0.135)	(0.104)	(0.116)	(0.146)	(0.179)	(0.159)	(0.153)	(0.109)	(0.109)
Business X Policy 1	0.111	0.135	0.088	0.171	0.179	0.171	-0.055	-0.021	-0.100
	(0.134)	(0.124)	(0.141)	(0.116)	(0.114)	(0.118)	(0.133)	(0.134)	(0.142)
Business X Policy 2	0.177	0.191	0.143	-0.102	-0.074	-0.083	0.006	-0.008	-0.077
	(0.169)	(0.157)	(0.173)	(0.122)	(0.123)	(0.126)	(0.248)	(0.238)	(0.249)
Social X Policy 1	-0.285	-0.180	-0.255	1.065	1.249	1.140	-0.627***	-0.512**	-0.612**
	(0.248)	(0.245)	(0.248)	(0.865)	(0.888)	(0.879)	(0.152)	(0.173)	(0.167)
Social X Policy 2	-0.262	-0.136	-0.232	0.338	0.540	0.424	-0.608***	-0.490*	-0.613**
	(0.241)	(0.262)	(0.254)	(0.368)	(0.360)	(0.369)	(0.114)	(0.221)	(0.182)
Credit X Policy 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Credit X Policy 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Institutional X Policy 1	0.498**	0.537**	0.773***	0.617***	0.512**	0.784***	0.000	0.000	0.000
	(0.243)	(0.255)	(0.257)	(0.184)	(0.195)	(0.199)	(.)	(.)	(.)
Institutional X Policy 2	0.432	0.934	0.684	0.120	0.445	0.264	0.000	0.000	0.000
	(0.520)	(0.629)	(0.566)	(0.460)	(0.539)	(0.495)	(.)	(.)	(.)

Table 7: Regression Analysis of the Impact on the Number of Loan Disbursements (Cont.)

	MDI & non-MDI			non-MDI			MDI		
	Alll	<10000	<5000	Alll	<10000	<5000	Alll	<10000	<5000
Community X Policy 1	0.357	0.391	0.349	0.387	0.408*	0.396	0.426	0.462	0.398
	(0.606)	(0.578)	(0.597)	(0.242)	(0.233)	(0.242)	(0.606)	(0.575)	(0.587)
Community X Policy 2	0.282	0.300	0.252	1.702***	1.597***	1.663***	0.209	0.212	0.144
	(0.787)	(0.775)	(0.793)	(0.540)	(0.492)	(0.523)	(0.763)	(0.753)	(0.757)
Agricultural X Policy 1	-0.245*	-0.169	-0.225*	0.096	0.143	0.120	-0.299*	-0.214	-0.281*
	(0.137)	(0.128)	(0.132)	(0.136)	(0.127)	(0.132)	(0.134)	(0.125)	(0.131)
Agricultural X Policy 2	-0.497**	-0.385*	-0.463**	-0.117	-0.089	-0.101	-0.535**	-0.420*	-0.507*
	(0.197)	(0.193)	(0.193)	(0.185)	(0.181)	(0.186)	(0.214)	(0.209)	(0.210)
KHR Currency	-0.067	0.207	0.025	0.438**	0.510***	0.457**	-0.213	0.080	-0.115
	(0.151)	(0.169)	(0.160)	(0.182)	(0.166)	(0.176)	(0.136)	(0.167)	(0.151)
Group Account	0.901***	1.004***	0.947***	0.527	0.556*	0.497	1.182***	1.305***	1.258***
	(0.218)	(0.249)	(0.238)	(0.332)	(0.326)	(0.332)	(0.270)	(0.293)	(0.279)
Joint Account	3.715***	3.738***	3.710***	0.568**	0.568***	0.503**	4.459***	4.506***	4.507***
	(0.592)	(0.569)	(0.588)	(0.215)	(0.197)	(0.205)	(0.578)	(0.517)	(0.549)
Female-Related Loan	1.636***	1.559***	1.612***	1.195**	1.199**	1.202**	1.771***	1.678***	1.741***
	(0.308)	(0.341)	(0.320)	(0.573)	(0.572)	(0.571)	(0.375)	(0.421)	(0.391)
Non-Collateral	0.040	-0.244*	-0.048	-0.211	-0.471***	-0.298**	0.067	-0.220	-0.021
	(0.216)	(0.136)	(0.180)	(0.131)	(0.132)	(0.130)	(0.259)	(0.168)	(0.218)
Long-Term Loan	0.075	0.094	0.084	0.250*	0.266*	0.267**	0.408	0.489	0.462
	(0.209)	(0.227)	(0.220)	(0.125)	(0.136)	(0.131)	(0.399)	(0.414)	(0.406)
Morgage	-0.376***	-0.657***	-0.532***	-0.180*	-0.292***	-0.244**	-0.474***	-0.772***	-0.643***
	(0.083)	(0.102)	(0.092)	(0.098)	(0.092)	(0.096)	(0.058)	(0.073)	(0.054)
Business	-0.113	-0.361**	-0.284*	0.055	-0.039	-0.020	-0.030	-0.298	-0.202
	(0.156)	(0.156)	(0.154)	(0.133)	(0.134)	(0.135)	(0.210)	(0.222)	(0.213)
Social	-0.165*	-0.308***	-0.272***	-0.280	-0.590	-0.461	-0.098	-0.232***	-0.190***
	(0.083)	(0.081)	(0.083)	(0.469)	(0.435)	(0.454)	(0.052)	(0.041)	(0.047)
Credit	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Institutional	-0.736***	-0.907***	-0.811***	-0.484***	-0.570***	-0.513***	0.000	0.000	0.000
	(0.223)	(0.232)	(0.231)	(0.167)	(0.164)	(0.172)	(.)	(.)	(.)
Community	1.984**	1.827*	1.866*	0.259	0.188	0.212	2.143*	1.959	2.013
	(0.966)	(0.950)	(0.958)	(0.198)	(0.201)	(0.198)	(1.059)	(1.038)	(1.044)
Agricultural	0.266*	0.143	0.212	0.092	0.028	0.045	0.308	0.170	0.251
	(0.152)	(0.151)	(0.149)	(0.137)	(0.133)	(0.138)	(0.169)	(0.167)	(0.164)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FI Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commune Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.940***	0.945***	0.948***	1.015***	1.020***	1.022***	0.994***	0.998***	1.001***
	(0.051)	(0.050)	(0.051)	(0.017)	(0.018)	(0.019)	(0.045)	(0.046)	(0.048)
R-Squared	0.834	0.841	0.832	0.820	0.829	0.830	0.847	0.854	0.845
Observations	5293795	5045820	4655310	845052	813570	777224	4448743	4232250	3878086

Note: ***, **, and * represent the statistical significance at 1%, 5%, and 10%, respectively. The unit of observation in this analysis is the institution-commune pair. Policy Dummy 1 is a dummy for policy implementation and takes the value one if the time is from 2017M4 to 2018M3. Policy Dummy 2 is a dummy for policy implementation and takes the value one if the time is from 2018M4 to 2019M3. The Urban Dummy is a dummy that takes the value one if the commune k is capital of a province or located in Phnom Penh Province. The pre-regulated interest rate represents the level of interest rates before the interest rate cap policy and is defined as interest rate expenses divided by loan amounts.

Regression Analysis of Impacts on Average Loan Size

The ratio of fixed cost to the loan amounts in MFI lending is high since lending to distant areas and the amount of loans poor households require are generally small. Thus, to cover fixed costs under the restriction on maximum interest rates when lending, it is likely that the MFIs will increase loan sizes (Hypothesis 3). We estimate the impact of interest rate cap policy on loan size per loan account, using the following equation:

$$\begin{aligned} Loan\ Amount_{i,b,c,p,t} &= \alpha + \beta_1 X_{i,b,c,p,t} + \beta_2 X_{i,b,c,p,t} \cdot Policy_t + \beta_3 InterestRate_{b,2016} \cdot Policy_t \\ &+ \beta_4 Urban_c \cdot Policy_t + \tau_t + \varphi_p + \mu_b + \psi_c + u_{i,b,c,p,t} \end{aligned}$$

where $Loan\ Amount_{i,b,c,m,t}$ represents amounts of loan in a disbursed loan account *i* of product p of MFI b in commune *c* at the period *t.* $InterestRate_{b,2016Q4}$ is the pre-regulated interest rate of MFIs in 2016 and is calculated as total interest rate expense in 2016 divided by outstanding loans at the end of 2016. $Policy_t$ is dummy for policy implementation and takes one after 2017M4. $Urban_c$ is the dummy that takes the value one if the commune *k* is capital of a province or located in Phnom Penh Province. X is the vector of other characteristics of loan disbursement, such as collateral requirements and the gender of the borrowers. We also control fixed effects in four ways, $\tau_t, \varphi_p, \mu_b, \psi_c$: Time-fixed effect, product-fixed effect, financial-institution-fixed effect, commune-fixed effect. Lastly, $u_{i,b,c,p,t}$ is a white noise.

Similarly to regression analysis on the number of loan disbursements, if the policy has a large impact on the size of each loan disbursement, particularly from MFIs with higher pre-regulated interest rates, coefficients of $InterestRate_{b,2016}$ would be estimated as positive ($\beta_3 > 0$). If MFIs covered the cost in lending to keep lending to rural areas relatively to urban areas after the interest rate cap policy, coefficient of $Urban_k$ would be estimated as positive ($\beta_4 < 0$). In addition, the number of loans that include female borrowers and non-collateral loans would become higher after the introduction of the interest rate cap policy, since the cost for those loans are relatively high and MFIs need to cover these costs by increasing the loan size under the low interest rates.

We present the results of this estimation in Table 8. We estimated the model using the OLS estimation method with cluster-robust standard errors at MFI-level. We ran the regression with the full sample of both MDIs and non-MDIs in column 1-3, a subsample of non-MDIs in column 4-6, and a subsample with MDIs in column 7-9, respectively. We also run regression with subsample of small loans of two different definitions as (1) loans of less than USD10,000 and (2) loans of less than US5,000.

Firstly, we found that the interaction terms of policy dummies and pre-regulated interest rates (Interest Rate X Policy 1 & 2) are significantly positive in column 1-3, suggesting that both MDIs and non-MDIs with higher pre-regulated interest rates increased loan sizes on average after the introduction of the interest rate cap policy. In other words, the higher MFIs have set pre-regulated interest rates, the larger the decline of the average number of loan disbursements. This finding is consistent with Hypothesis 3.

Table 8: Regression Analysis of Impacts on Loan Size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Amounts of Loans (log)	MDI & Non-MDI			Non-MDI			MDI		
	Alll	<10000	<5000	Alll	<10000	<5000	Alll	<10000	<5000
Urban X Policy 1	0.025	-0.017	-0.006	0.012	-0.002	0.009	0.024	-0.028	-0.024
	(0.023)	(0.018)	(0.019)	(0.029)	(0.026)	(0.027)	(0.024)	(0.018)	(0.017)
Urban X Policy 2	0.008	-0.029	-0.013	-0.016	-0.025	-0.004	-0.010	-0.055*	-0.048
	(0.029)	(0.024)	(0.027)	(0.037)	(0.039)	(0.041)	(0.040)	(0.026)	(0.026)
Interest Rate X Policy 1	0.003	0.004	0.004*	0.002	0.002	0.003	0.009**	0.016***	0.016***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Interest Rate X Policy 2	0.005	0.007**	0.007**	0.006**	0.006**	0.005**	0.001	0.009	0.010
	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.009)	(0.007)	(0.006)
Non-Collateral X Policy 1	0.075	0.115**	0.130***	0.114*	0.115*	0.125**	0.024	0.078	0.116**
	(0.045)	(0.047)	(0.044)	(0.061)	(0.059)	(0.057)	(0.052)	(0.047)	(0.032)
Non-Collateral X Policy 2	0.231*	0.236**	0.248***	-0.075	-0.056	-0.006	0.701**	0.660**	0.599**
	(0.118)	(0.103)	(0.091)	(0.098)	(0.084)	(0.075)	(0.251)	(0.238)	(0.239)
Group Account X Policy 1	0.175*	0.180**	0.190**	-0.014	-0.024	-0.047	0.166*	0.156*	0.168**
	(0.090)	(0.082)	(0.072)	(0.130)	(0.119)	(0.111)	(0.075)	(0.072)	(0.062)
Group Account X Policy 2	0.301***	0.309***	0.302***	0.133	0.118	0.097	0.410***	0.393***	0.372***
	(0.105)	(0.087)	(0.074)	(0.193)	(0.170)	(0.157)	(0.100)	(0.088)	(0.075)
Joint Account X Policy 1	-0.019	0.004	-0.011	0.146	0.050	0.030	-0.114	-0.041	-0.065
	(0.090)	(0.067)	(0.049)	(0.099)	(0.079)	(0.076)	(0.177)	(0.128)	(0.091)
Joint Account X Policy 2	0.083	0.085	0.049	0.224	0.059	0.019	0.014	0.083	0.039
	(0.113)	(0.083)	(0.077)	(0.144)	(0.110)	(0.100)	(0.185)	(0.147)	(0.129)
Female-Related Loan X Policy 1	-0.001	-0.000	-0.007	0.031	0.027	0.022	-0.003	0.005	0.001
	(0.014)	(0.010)	(0.008)	(0.025)	(0.025)	(0.024)	(0.020)	(0.013)	(0.011)
Female-Related Loan X Policy 2	-0.014	-0.011	-0.018	0.061*	0.058	0.054	-0.011	-0.005	-0.011
	(0.022)	(0.018)	(0.016)	(0.035)	(0.036)	(0.034)	(0.035)	(0.023)	(0.019)
Loang-Term Loan X Policy 1	-0.003	-0.025	-0.037	0.079	0.073	0.075	-0.036	-0.058	-0.076
	(0.065)	(0.061)	(0.059)	(0.077)	(0.070)	(0.062)	(0.066)	(0.060)	(0.055)
Loang-Term Loan X Policy 2	0.056	0.003	-0.028	0.076	0.040	0.032	0.020	-0.030	-0.067
	(0.091)	(0.082)	(0.077)	(0.104)	(0.103)	(0.102)	(0.095)	(0.081)	(0.072)
KHR Currency X Policy 1	0.008	0.060	0.091**	0.094	0.107	0.105	-0.007	0.059	0.101***
	(0.043)	(0.040)	(0.035)	(0.105)	(0.101)	(0.094)	(0.036)	(0.036)	(0.025)
KHR Currency X Policy 2	0.052	0.132***	0.164***	0.004	0.070	0.119	0.045	0.135**	0.173***
	(0.060)	(0.045)	(0.036)	(0.103)	(0.101)	(0.103)	(0.063)	(0.046)	(0.034)
Morgage X Policy 1	0.027	0.022	0.024	0.059	0.036	-0.011	0.010	0.017	0.033
	(0.034)	(0.030)	(0.036)	(0.069)	(0.065)	(0.078)	(0.046)	(0.037)	(0.040)
Morgage X Policy 2	0.017	0.014	-0.016	0.360**	0.171	0.078	-0.006	0.012	0.001
	(0.051)	(0.046)	(0.049)	(0.148)	(0.125)	(0.118)	(0.083)	(0.062)	(0.059)
Business X Policy 1	0.106**	0.080	0.089	0.060	0.067	0.072	0.038	-0.026	-0.022
	(0.041)	(0.050)	(0.055)	(0.051)	(0.056)	(0.057)	(0.033)	(0.021)	(0.025)
Business X Policy 2	0.031	0.008	0.033	0.125	0.140	0.132	0.020	-0.037	-0.010
	(0.068)	(0.051)	(0.050)	(0.100)	(0.086)	(0.080)	(0.089)	(0.055)	(0.047)
Social X Policy 1	0.239	0.250	0.301	0.442	0.544	0.637	0.260**	0.251**	0.303**
	(0.209)	(0.213)	(0.216)	(0.730)	(0.686)	(0.682)	(0.084)	(0.091)	(0.098)
Social X Policy 2	0.130	0.142	0.222	1.056*	1.134*	1.199**	0.021	0.018	0.112
	(0.191)	(0.198)	(0.205)	(0.631)	(0.594)	(0.594)	(0.258)	(0.266)	(0.278)
Credit X Policy 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Credit X Policy 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Institutional X Policy 1	-0.025	0.219	0.207	0.039	0.322	0.410	0.000	0.000	0.000
	(0.222)	(0.259)	(0.346)	(0.219)	(0.212)	(0.267)	(.)	(.)	(.)
Institutional X Policy 2	-0.051	-0.057	0.487	-0.053	-0.022	0.450*	0.000	0.000	0.000
	(0.249)	(0.251)	(0.319)	(0.288)	(0.242)	(0.267)	(.)	(.)	(.)

Table 8: Regression Analysis of Impacts on Loan Size (Cont.)

Amounts of Loans (log.)	MDI & Non-MDI			Non-MDI			MDI		
	Alll	<10000	<5000	Alll	<10000	<5000	Alll	<10000	<5000
Community X Policy 1	0.045	0.031	0.032	0.332***	0.365***	0.391***	-0.034	-0.076	-0.080
	(0.102)	(0.093)	(0.093)	(0.072)	(0.068)	(0.065)	(0.097)	(0.071)	(0.060)
Community X Policy 2	-0.029	-0.069	-0.063	0.483***	0.484***	0.464***	-0.110	-0.169	-0.157
	(0.201)	(0.175)	(0.155)	(0.159)	(0.135)	(0.116)	(0.230)	(0.190)	(0.161)
Agricultural X Policy 1	-0.024	-0.018	-0.004	-0.009	0.012	0.026	-0.066	-0.077	-0.066
	(0.044)	(0.043)	(0.045)	(0.072)	(0.064)	(0.062)	(0.051)	(0.050)	(0.049)
Agricultural X Policy 2	-0.037	-0.031	-0.018	0.154	0.160*	0.149*	-0.073	-0.083	-0.068
	(0.073)	(0.062)	(0.057)	(0.097)	(0.087)	(0.089)	(0.099)	(0.082)	(0.069)
KHR Currency	-0.817***	-0.748***	-0.651***	-0.557***	-0.533***	-0.493***	-0.839***	-0.771***	-0.673***
	(0.053)	(0.042)	(0.040)	(0.116)	(0.110)	(0.103)	(0.052)	(0.041)	(0.038)
Group Account	-0.769***	-0.798***	-0.784***	-0.353***	-0.399***	-0.400***	-0.825***	-0.835***	-0.815***
	(0.084)	(0.089)	(0.099)	(0.110)	(0.101)	(0.092)	(0.077)	(0.091)	(0.107)
Joint Account	0.295***	0.248***	0.194***	0.115	0.184**	0.170**	0.398**	0.301**	0.248***
	(0.094)	(0.065)	(0.052)	(0.102)	(0.075)	(0.077)	(0.108)	(0.088)	(0.066)
Female-Related Loan	-0.016	-0.009	-0.005	-0.077***	-0.067***	-0.065***	-0.011	-0.006	-0.003
	(0.010)	(0.009)	(0.010)	(0.023)	(0.019)	(0.019)	(0.013)	(0.012)	(0.013)
Non-Collateral	-0.878***	-0.829***	-0.786***	-0.381***	-0.343***	-0.347***	-1.155***	-1.070***	-0.987***
	(0.142)	(0.134)	(0.123)	(0.107)	(0.098)	(0.100)	(0.074)	(0.056)	(0.057)
Long-Term Loan	0.482***	0.340***	0.244***	0.471***	0.384**	0.362*	0.504***	0.356***	0.251***
	(0.039)	(0.034)	(0.038)	(0.147)	(0.161)	(0.183)	(0.044)	(0.031)	(0.031)
Morgage	0.194**	0.047	-0.022	0.034	-0.103	-0.168*	0.268**	0.137*	0.075
	(0.092)	(0.080)	(0.075)	(0.116)	(0.100)	(0.089)	(0.075)	(0.062)	(0.059)
Business	-0.514***	-0.597***	-0.626***	-1.477***	-1.711***	-1.837***	-0.384***	-0.447***	-0.469***
	(0.132)	(0.142)	(0.158)	(0.516)	(0.491)	(0.503)	(0.067)	(0.079)	(0.093)
Social	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Credit	0.365*	0.246	-0.171	0.402**	0.192	-0.188	0.000	0.000	0.000
	(0.202)	(0.251)	(0.336)	(0.184)	(0.194)	(0.246)	(.)	(.)	(.)
Institutional	0.285***	0.191**	0.166*	-0.308**	-0.378***	-0.422***	0.379***	0.282**	0.260**
	(0.102)	(0.093)	(0.098)	(0.117)	(0.102)	(0.087)	(0.101)	(0.102)	(0.106)
Community	0.105**	0.052	0.019	-0.014	-0.085	-0.115	0.153***	0.111**	0.081*
	(0.044)	(0.044)	(0.044)	(0.108)	(0.099)	(0.094)	(0.037)	(0.037)	(0.040)
Agricultural	0.705***	0.685***	0.638***	1.133***	1.077***	0.985***	0.653***	0.636***	0.595***
	(0.101)	(0.080)	(0.061)	(0.098)	(0.075)	(0.063)	(0.116)	(0.089)	(0.066)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FI Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commune Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	6.888***	7.028***	7.020***	5.711***	5.784***	5.877***	6.847***	6.957***	6.941***
	(0.138)	(0.112)	(0.092)	(0.141)	(0.130)	(0.128)	(0.154)	(0.131)	(0.104)
R-Squared	0.717	0.712	0.684	0.759	0.750	0.722	0.711	0.707	0.678
Observations	5293565	5045590	4655080	845044	813562	777216	4448521	4232028	3877864

Note: ***, **, and * represent the statistical significance at 1%, 5%, and 10%, respectively. The unit of observations in this analysis is a loan account. Policy Dummy1 is a dummy for policy implementation and takes the value one if the time is from 2017M4 to 2018M3. Policy Dummy 2 is a dummy for policy implementation and takes the value one if the time is from 2018M4 to 2019M3. Urban Dummy is a dummy that takes the value one if the commune k is capital of a province or located in Phnom Penh Province. Female Dummy takes the value one if at least one of the borrowers in the loan account is female. The Non-Collateral Dummy takes the value one if the loan account required no collateral. Pre-regulated interest rate represents the level of interest rates before the interest rate cap policy and is defined as interest rate expenses divided by loan amounts.

Second, the interaction terms of policy dummies with non-collateral loan dummies (Non-Collateral X Policy), group-lending loans (Group Account X Policy), and KHR loans (KHR Currency X Policy) are estimated as positive at statistical significance, respectively. This suggests that MFIs have increased loan sizes particularly for the loans without non-collateral, group-lending loans, and KHR loans, respectively. Those loans were set higher interest rate before the interest rate cap policy. Thus, the results suggest that MFIs increased the loan size for those loans to cover the decline in the interest rate.

Interestingly, the interaction terms of policy dummies with the business loan dummy dummies (Business X Policy) is also estimated as positive at statistical significance in column 1, suggesting that the size of business loans increased after the introduction of the interest rate cap policy. However, the results are not significant in other columns, suggesting that other factors might have driven the increase in loan sizes, rather than business-type loans per se. In fact, 70% of business loans are non-collateral for non-MDIs, and 26% of business loans are with guarantors for MDIs (Table 1). Thus, the decline in business loans after the interest rate cap policy could be driven by the problem that security of business loans is not strong in the MFI sector. Last, we found that the coefficients in the model are more significant if we reduce the sample to a sub-sample of smaller loans. This suggests that smaller loans are more affected by the policy.

Regression Analysis of Impacts on Number of Borrowers per Loan Account

Under the low interest rate environments, increasing the number of borrowers is also the possible strategy for MFIs to keep the number of borrowers. As we saw in previous analyses, the number of loan disbursements has decreased in small-sized loans and in group lending schemes. However, MFIs need to keep the number of borrowers at sufficiently high level as the indicator of outreach. Thus, MFIs increased the number of borrowers per loan account after the interest rate cap policy as we saw in Figure 19.

Here, we further investigate which loan characteristics particularly drove the increase or decrease in number of borrowers after the interest rate cap policy. To do so, we estimate the following empirical model:

$$
\begin{aligned}
&Number\ of\ Borrowers_{i,b,c,p,t} \\
&\quad = \alpha + \beta_1 X_{i,b,c,p,t} + \beta_2 X_{i,b,c,p,t} \cdot Policy_t + \beta_3 InterestRate_{b,2016} \cdot Policy_t \\
&\quad + \beta_4 Urban_c \cdot Policy_t + \tau_t + \varphi_p + \mu_b + \psi_c + u_{i,b,c,p,t}
\end{aligned}
$$

where $Number\ of\ Borrowers_{i,b,c,m,t}$ represents number of borrowers in a disbursed loan account i of product p of financial institution b in commune c at the period t. $InterestRate_{b,2016}$ is the pre-regulated interest rate of MFIs in 2016 and is calculated as total interest rate expense in 2016 divided by outstanding loans at the end of 2016. $Policy_t$ is dummy for policy implementation and takes the value one after 2017M4. $Urban_c$ is a dummy that takes the value one if the commune k is capital of a province or located in Phnom Penh Province. X is the vector of other characteristics of loan disbursement, such as collateral requirement and gender of the borrowers. We also control fixed effects in four ways, $\tau_t, \varphi_p, \mu_b, \psi_c$: Time-fixed effect, product-fixed effect, financial-institution-fixed effect, commune-fixed effect. Lastly, $u_{i,b,c,p,t}$ is white noise.

We present the results of estimation in Table 9. We estimated the model using OLS method with cluster-robust standard errors at financial institutions. We run regression with full sample of both MDIs and non-MDIs in column 1-3, subsample of non-MDIs in column 4-6, and subsample with MDIs in column 7-9,

respectively. We also ran a regression with subsample of small loans of two different definitions as (1) loans of less than USD10,000 and (2) loans of less than US5,000.

We find that the coefficients of interaction terms of group-lending account and policy dummies (Group Account X Policy), are estimated as positive, and the coefficients of joint-account dummy and policy dummies (Joint Account X Policy) are estimated as negative. These results suggest that the number of borrowers per loan account increased in a group lending scheme, but decreased in joint-account lending after the introduction of the interest rate cap policy. The results suggest that the number of borrowers especially increased for the group-lending accounts after the interest rate decreased.

Interestingly, the interaction terms of coefficients of female-related loan dummy and policy dummy (Female-Related X Policy) was positive at statistical significance in column 1-3, and column 7-8, meaning that number of borrowers per loan account increased for female-related loans. The results suggest that MFIs struggled to keep the number of female borrowers by increasing the number of borrowers per loan account after the interest rate cap policy.

We found that the interaction terms of urban dummy and policy dummies (Urban X Policy) were estimated as positive, meaning that the number of borrowers per account also increased in urban areas compared to rural areas. The results are counter-intuitive and different from Figure 19. However, the loans in rural areas are likely to be loans for female borrowers and group-lending accounts, and the results in Figure 19 could be driven by such factors.

Table 9: Regression analysis of the impact of the interest rate cap on the number of borrowers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Number of Borrowers	MDI & Non-MDI			Non-MDIs			MDI		
	Alll	<10000	<5000	Alll	<10000	<5000	Alll	<10000	<5000
Urban X Policy 1	0.000	-0.000	-0.000	0.007	0.006	0.007	-0.002	-0.002	-0.002
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.003)	(0.003)	(0.004)
Urban X Policy 2	0.019**	0.017*	0.017*	0.008	0.010*	0.012**	0.023**	0.020**	0.021**
	(0.009)	(0.009)	(0.009)	(0.005)	(0.005)	(0.006)	(0.009)	(0.007)	(0.007)
Interest Rate X Policy 1	-0.000	-0.000	-0.000	0.000	0.000	0.000	-0.004	-0.004	-0.003
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.004)	(0.004)
Interest Rate X Policy 2	-0.001	-0.001	-0.001	-0.000	-0.000	-0.000	-0.010	-0.009	-0.009
	(0.003)	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)	(0.011)	(0.011)	(0.012)
NonCollateral X Policy 1	0.010	0.011	0.011	-0.027	-0.028	-0.029	0.028	0.027	0.025
	(0.017)	(0.017)	(0.018)	(0.028)	(0.029)	(0.031)	(0.027)	(0.027)	(0.028)
NonCollateral X Policy 2	0.071	0.073	0.077	-0.001	0.000	0.003	0.029	0.025	0.024
	(0.063)	(0.065)	(0.068)	(0.026)	(0.028)	(0.029)	(0.052)	(0.048)	(0.047)
Group Account X Policy 1	-0.015	-0.017	-0.020	-0.011	-0.008	-0.007	0.043*	0.039*	0.035*
	(0.042)	(0.042)	(0.042)	(0.051)	(0.052)	(0.053)	(0.019)	(0.018)	(0.018)
Group Account X Policy 2	0.209*	0.199*	0.192*	0.423**	0.420**	0.415**	0.219	0.203	0.190
	(0.119)	(0.115)	(0.114)	(0.187)	(0.185)	(0.185)	(0.131)	(0.124)	(0.119)
Joint Account X Policy 1	-0.060	-0.067	-0.080*	-0.014	-0.014	-0.020	-0.063	-0.073	-0.087
	(0.038)	(0.041)	(0.046)	(0.022)	(0.023)	(0.025)	(0.052)	(0.057)	(0.065)
Joint Account X Policy 2	-0.100*	-0.113*	-0.128**	-0.005	-0.011	-0.015	-0.126	-0.143	-0.163
	(0.058)	(0.057)	(0.058)	(0.024)	(0.026)	(0.028)	(0.104)	(0.103)	(0.108)
Female-Related Loan X Policy 1	0.035**	0.034**	0.034**	0.017	0.017	0.017	0.034*	0.033*	0.032
	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)
Female-Related Loan X Policy 2	0.088**	0.089**	0.091**	0.030	0.030	0.031	0.089	0.089	0.090
	(0.037)	(0.038)	(0.040)	(0.021)	(0.021)	(0.022)	(0.057)	(0.060)	(0.063)
Loang-Term Loan X Policy 1	0.015	0.013	0.012	0.013	0.013	0.010	0.009	0.007	0.006
	(0.009)	(0.009)	(0.009)	(0.011)	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)
Loang-Term Loan X Policy 2	0.087**	0.084*	0.085*	0.020	0.019	0.017	0.095	0.093	0.097
	(0.041)	(0.043)	(0.047)	(0.016)	(0.015)	(0.013)	(0.055)	(0.058)	(0.062)
KHR Currency X Policy 1	-0.015*	-0.014*	-0.015*	0.015	0.016	0.016	-0.015*	-0.014*	-0.015*
	(0.008)	(0.008)	(0.009)	(0.016)	(0.016)	(0.016)	(0.007)	(0.007)	(0.007)
KHR Currency X Policy 2	-0.023*	-0.018	-0.019	0.043	0.048	0.053	-0.035**	-0.032**	-0.037**
	(0.013)	(0.012)	(0.014)	(0.033)	(0.034)	(0.035)	(0.013)	(0.012)	(0.014)
Morgage X Policy 1	0.061***	0.057***	0.055**	0.021	0.026	0.012	0.041***	0.036***	0.031**
	(0.019)	(0.020)	(0.024)	(0.020)	(0.020)	(0.028)	(0.008)	(0.009)	(0.012)
Morgage X Policy 2	0.029	0.019	0.010	-0.035	-0.035	-0.064	0.017	0.005	-0.005
	(0.019)	(0.018)	(0.019)	(0.032)	(0.033)	(0.044)	(0.018)	(0.016)	(0.016)
Business X Policy 1	0.013	0.010	0.011	0.027	0.028	0.030	-0.007	-0.013	-0.017
	(0.028)	(0.031)	(0.035)	(0.024)	(0.025)	(0.027)	(0.010)	(0.011)	(0.013)
Business X Policy 2	-0.036*	-0.041***	-0.042***	-0.024*	-0.021	-0.022	-0.012	-0.018	-0.021
	(0.021)	(0.015)	(0.015)	(0.014)	(0.015)	(0.016)	(0.038)	(0.041)	(0.051)
Social X Policy 1	0.036	0.035	0.037	0.057***	0.064***	0.072***	-0.001	-0.005	-0.009
	(0.041)	(0.043)	(0.046)	(0.021)	(0.021)	(0.023)	(0.013)	(0.013)	(0.013)
Social X Policy 2	0.071	0.074*	0.080*	-0.008	-0.000	0.007	0.106	0.108	0.111
	(0.046)	(0.043)	(0.042)	(0.021)	(0.023)	(0.025)	(0.062)	(0.060)	(0.062)
Credit X Policy 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Credit X Policy 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Institutional X Policy 1	0.028	0.020	-0.012	-0.016	-0.020	-0.053	0.000	0.000	0.000
	(0.021)	(0.022)	(0.033)	(0.024)	(0.023)	(0.035)	(.)	(.)	(.)
Institutional X Policy 2	-0.025	-0.022	-0.021	-0.000	0.007	0.010	0.000	0.000	0.000
	(0.040)	(0.042)	(0.044)	(0.021)	(0.021)	(0.022)	(.)	(.)	(.)

Table 9: Regression analysis of the impact of the interest rate cap on the number of borrowers (Cont.)

Number of Borrowers	MDI & Non-MDI			Non-MDIs			MDI		
	Alll	<10000	<5000	Alll	<10000	<5000	Alll	<10000	<5000
Community X Policy 1	0.072	0.070	0.073	0.347***	0.343***	0.339***	-0.006	-0.009	-0.011
	(0.067)	(0.068)	(0.070)	(0.122)	(0.120)	(0.116)	(0.030)	(0.030)	(0.030)
Community X Policy 2	-0.007	-0.006	-0.000	0.105	0.106	0.107	-0.010	-0.009	-0.003
	(0.109)	(0.111)	(0.112)	(0.173)	(0.170)	(0.167)	(0.149)	(0.151)	(0.155)
Agricultural X Policy 1	0.031	0.032	0.037	0.034*	0.035*	0.039*	-0.002	-0.004	-0.005
	(0.031)	(0.032)	(0.036)	(0.019)	(0.019)	(0.020)	(0.006)	(0.007)	(0.007)
Agricultural X Policy 2	0.014	0.022	0.034	-0.014	-0.010	-0.008	0.014	0.021	0.033
	(0.027)	(0.026)	(0.028)	(0.017)	(0.019)	(0.021)	(0.027)	(0.025)	(0.026)
KHR Currency	0.006	0.006	0.006	-0.008	-0.009	-0.011	0.010**	0.010**	0.012**
	(0.004)	(0.004)	(0.005)	(0.008)	(0.008)	(0.009)	(0.004)	(0.004)	(0.005)
Group Account	0.037*	0.035	0.035	0.060***	0.061***	0.066***	0.014	0.014	0.015
	(0.022)	(0.021)	(0.022)	(0.020)	(0.021)	(0.022)	(0.019)	(0.020)	(0.021)
Joint Account	1.077***	1.072***	1.072***	1.015***	1.013***	1.012***	1.076***	1.071***	1.072***
	(0.021)	(0.020)	(0.020)	(0.020)	(0.022)	(0.024)	(0.028)	(0.029)	(0.032)
Female-Related Loan	-0.004	-0.004*	-0.005**	0.009**	0.008**	0.008**	-0.002**	-0.003***	-0.003**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
Non-Collateral	0.026	0.025	0.027	-0.005	-0.002	0.000	0.032	0.033	0.034
	(0.021)	(0.021)	(0.022)	(0.017)	(0.018)	(0.020)	(0.027)	(0.028)	(0.031)
Long-Term Loan	-0.013	-0.011	-0.009	-0.002	-0.004	-0.004	-0.013	-0.011	-0.010
	(0.010)	(0.010)	(0.010)	(0.005)	(0.004)	(0.004)	(0.011)	(0.010)	(0.010)
Morgage	-0.004	-0.002	-0.001	0.068	0.081	0.101	-0.008	-0.008	-0.008
	(0.008)	(0.009)	(0.011)	(0.052)	(0.059)	(0.070)	(0.006)	(0.006)	(0.007)
Business	0.028	0.028	0.031	0.033	0.037	0.044*	0.007	0.006	0.007
	(0.018)	(0.019)	(0.021)	(0.021)	(0.023)	(0.025)	(0.004)	(0.004)	(0.005)
Social	0.000	-0.001	-0.001	0.020	0.015	0.011	-0.010	-0.011	-0.011
	(0.011)	(0.011)	(0.011)	(0.014)	(0.014)	(0.015)	(0.013)	(0.013)	(0.013)
Credit	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Institutional	-0.002	-0.002	0.001	-0.012	-0.010	-0.009	0.000	0.000	0.000
	(0.016)	(0.016)	(0.018)	(0.017)	(0.017)	(0.019)	(.)	(.)	(.)
Community	0.019	0.017	0.017	0.012	0.015	0.018	0.005	0.001	-0.001
	(0.031)	(0.032)	(0.035)	(0.026)	(0.026)	(0.028)	(0.027)	(0.027)	(0.028)
Agricultural	0.000	-0.000	-0.001	0.040**	0.042**	0.046**	-0.007	-0.008	-0.009
	(0.007)	(0.007)	(0.007)	(0.019)	(0.020)	(0.021)	(0.008)	(0.008)	(0.008)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FI Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Commune Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.940***	0.945***	0.948***	1.015***	1.020***	1.022***	0.994***	0.998***	1.001***
	(0.051)	(0.050)	(0.051)	(0.017)	(0.018)	(0.019)	(0.045)	(0.046)	(0.048)
R-Squared	0.834	0.841	0.832	0.820	0.829	0.830	0.847	0.854	0.845
Observations	5293795	5045820	4655310	845052	813570	777224	4448743	4232250	3878086

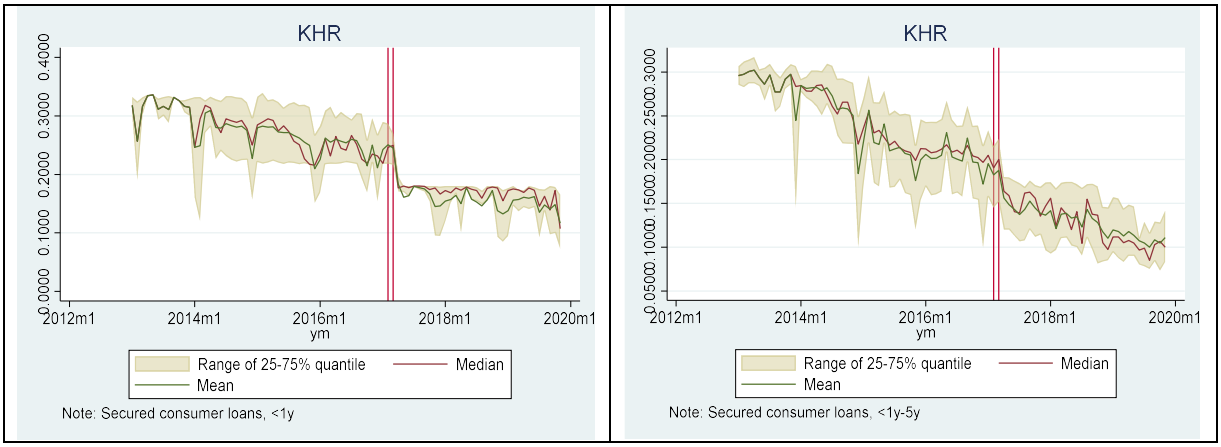
Note: ***, **, and * represent the statistical significance at 1%, 5%, and 10%, respectively. The unit of observations in this analysis is a loan account. Policy Dummy 1 is dummy for policy implementation and takes the value one if the time is from 2017M4 to 2018M3. Policy Dummy 2 is dummy for policy implementation and takes the value one if the time is from 2018M4 to 2019M3. The Urban Dummy takes the value one if the commune k is capital of a province or located in Phnom Penh Province. The Female Dummy takes the value one if at least one of the borrowers in the loan account is female. The Non-Collateral Dummy takes the value one if the loan account required no collateral. The pre-regulated interest rate represents the level of interest rates before introduction of the interest rate cap policy, and is defined as interest rate expenses divided by loan amounts.

3.3 Indirect impacts of the interest rate cap policy on commercial banks

There was an indirect impact from the interest rate cap policy on commercial banks, suggesting that competition between commercial banks and MFIs has also been intense.

Figure 21 shows the average and median of the impact of commercial bank interest rates on consumer loans. We find that the interest rates of commercial banks also dropped shortly after the introduction of the interest rate cap policy. This suggests that commercial banks were also affected by the interest rate cap policy, even though the policy does not explicitly force commercial banks to set an interest rate lower than 18%.

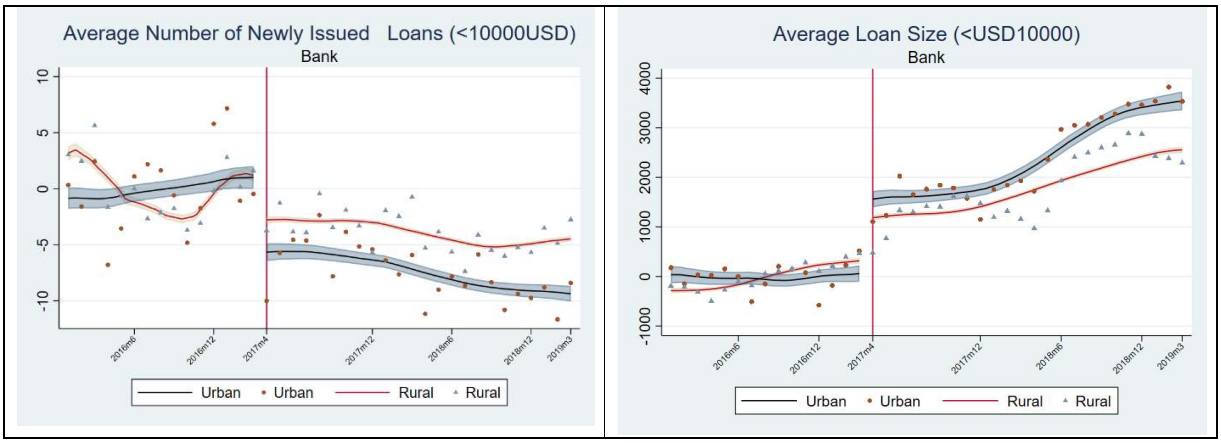
Figure 21: Interest Rates of Commercial Banks on Consumer Loans



Source: Author's calculation using the data provided by National Bank of Cambodia.

To investigate the impact of interest rate cap policy on the lending of commercial banks, we present the average number of loan disbursements and average loan sizes of loans of less than 10,000USD for commercial banks in Figure 22. We find that there were changes in the trend of the average number of loan disbursements and average loan sizes between before and after the interest rate cap policy. This suggests that the impact of the interest rate cap policy was transmitted to commercial banks.

Figure 22: Average loan size and average number of loan disbursements of Commercial Banks



Source: Authors' calculations using the CBC database.

The channel of transmission of the interest rate cap policy is possibly the recent intensive competition between commercial banks and MDIs/non-MDIs in consumer loan markets. We also conducted interviews with managers of 7 MDIs and 3 non-MDIs in August and September 2019. We asked the managers to say which financial institutions are their main competitors. The answers are summarized in Table 10. Interestingly, most of the MFIs answered that they are competing with commercial banks apart from other MFIs. The results also support the view that there has been recent intensive competition between MFIs and some commercial banks, and customers overlap between some commercial banks and the MFIs. Therefore, the interest rate cap policy has an indirect impact on commercial banks and the impact might be transmitted through the channel of competition between some commercial banks and the MFIs.

Table 10: Answers about the main competitors of MFIs

Interviewee	Competitior
MDI 1	N.A. (No Comments)
MDI 2	Acleda, Post Bank, ABA, Sathapana
MDI 3	AMK
MDI 4	ABA, Sathapana, Acleda, Prasac,
MDI 5	ABA
MDI 6	ABA, Prasac, ACLEDA, HKL, LOLC, WB Finance, Pri
MDI 7	ABA, Prasac, LOLC, AMRET, HKL, ACLEDA, Post E
MFI 1	ABA, Canadia, DGB, Post Bank,Prasac, and HKL
MFI 2	All of MFIs, especially Ly Hour
MFI 3	ACLEDA, Prasac, Amret, and other MDIs
MFI 4	ABA, Prince, Prasac, ACLEDA, HKL, LOLC, AMK, A

Note: In the table, names of commercial banks are colored as blue. The interviews were conducted in August and September 2019. We selected 9 largest MFIs (7 MDIs and two non-MDIs), and two relatively small MFIs to interview about the changes in operation after the interest rate cap policy.

4 Conclusions

Regarding MFI behavior, we examined the impacts on lending of non-MDIs and MDIs using the account data of loan disbursements obtained from the CBC's credit registry database. The detailed data allowed us to investigate the impact of policy implementation by exploiting variations across loan types, across financial institutions, and across regions. We found that the average loan size per loan is particularly affected by the interest rate cap policy. Especially, the largest increases in loans were observed for the smaller size, group-lending, KHR currency and non-collateral loans types, which typically cost more for non-MDIs/MDIs to extend. These findings suggest that non-MDIs and MDIs increased their loans to those costly borrowers to cover fixed costs per loan in response to the decrease in the interest rate.

In addition, the interest rate cap policy affected the outreach of MDIs and non-MDIs. We found that the interest rate cap policy had a negative impact on the number of loan disbursements, in particular, non-collateral loans, KHR currency, group-lending loans, and agricultural loans. We found that MDIs decreased or at least did not increase loan provision in both rural and urban areas. In the meantime, non-MDIs started increasing loan disbursements in urban areas and decreasing them in rural areas. Thus, the entire effects on

the lending of non-MDIs are unclear, but the outreach of non-MDIs is negatively affected by the interest rate cap policy.

As a result from regression analysis on determinants of interest rate levels, we also found that female borrowers are not necessarily a cost factor for MFIs. In addition, in the analysis on impact of interest rate cap policy, the impacts on female-related loans themselves were not large in terms of number of loan disbursement and loan sizes, although there were impacts on female-related loans in terms of the number of borrowers in a group. Those results suggest that the impact of interest rate cap policy on female-related loans was limited. However, female-related loans tend to be non-collateral, in a group lending scheme, for agricultural purposes, and small-sized which are cost factors in MFI lending and are impacted by interest rate cap policy. Thus, even though MDIs and non-MDIs did not decrease loan provision just for the reason that borrowers are female, the loans for female borrowers were also affected by the interest rate cap policy (as we saw in Figure 18). However, as the number of borrowers increased in female-related loans after the introduction of the interest rate cap policy, MDIs and non-MDIs might have struggled to keep the number of female borrowers by increasing the number of borrowers per loan disbursement, while at the same time they reduced loan disbursements.

We document evidence that the interest rate cap policy indirectly affected the interest rates of commercial bank loans. This impact was possibly channeled through the strong competition between MFIs and commercial banks. Since some customer segments overlap between commercial banks and MFIs, commercial banks might face pressure to decrease their interest rates to keep their customers in response to the decrease in interest rates of non-MDIs and MDIs.

Lastly, we should mention the challenges and limitations in our analysis. Analysis using the CBC database revealed that loan provision decreased for costly or risky loans. However, we could not determine whether those borrowers of costly or risky loans started increasing access to informal lending. In addition, even though there was a reduction in access to formal loans, we could not successfully distinguish supply factors from demand factors as determinants of this reduction. Some borrowers might be rejected or discouraged from borrowing after the interest rate cap policy was implemented (Supply side factors). However, others might stop borrowing simply because they no longer have demand (Demand side factors). In the studies using credit registry data in other countries, some succeeded in distinguishing supply factors from demand factors. Those studies used the information in loan applications and rejections to estimate the impact of changes in bank lending policy on the rejection rate. However, in Cambodia such data are not available, and our estimation still has challenges in estimating the supply and demand factors of loan granting processes by assessing the impact of interest rate cap policies.

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Appendix: Theory of the lending behavior of outreach-oriented microfinance institutions

Outreach-oriented microfinance institutions (outreach-oriented MFIs) originally had different objective functions from profit-oriented financial institutions (profit-oriented FIs). Outreach-oriented MFIs aim to increase the number of borrowers/loan accounts from the group of traditionally unbankable people, such as those in rural areas, without land titles, and those less educated. To understand the difference in lending behavior between profit-oriented FIs and outreach-oriented MFIs, we develop the following theoretical model.

First, we define the profit function of microfinance institutions and financial institutions. For simplicity, we suppose that both entities have the same profit function and demand function for loans. To analyze difference in lending to the traditionally unbankable and bankable people, we suppose that financial institutions can identify whether households are traditionally unbankable and bankable by using the information of geographical locations, availability of collateralizable assets, and occupations. We assume the two markets in the model and define the market of bankable people as Market 1, and the market of traditionally unbankable people as Market 2. Financial institutions' revenues from Market l is denoted as $r_l A_l N_l$, where r_l is average interest rates on loans, A_l is average loan size, and N_l is the number of loans. We suppose that financial institutions impose fixed cost per loan, $\frac{c_l(N_l)}{N_l}$, where $c_l' > 0, c_l'' < 0$. We also suppose that increases in average loan size increase default rates in lending, and the increases in average loan size, A_l, impose additional costs as $k_l(A_l)$, where $k_l' > 0$,and $k_l'' < 0$.

The profit function for financial institutions can be defined as follows:

$$\Pi = \Pi_1 + \Pi_2 = r_1 A_1 N_1 - c_1(N_1) - k_1(A_1) - F_1 + r_2 A_2 N_2 - c_2(N_2) - k_2(A_2) - F_2 \quad (1)$$

where F_1 and F_2 are fixed costs to enter a market, respectively. Profit function can be separated into two part: profit from Market 1, Π_1, and Market 2, Π_2. We suppose that marginal cost to lend per loan and expected default rates are higher in Market 2 than in Market 1 ($c_1'(N) < c_2'(N)$, and $k_1'(A) < k_2'(A)$).

For the demand for loans, we suppose that borrower demand $N_l(r_l, A_l)$ decreases with rises in interest rate r_l, and also with decreasing average loan size, A_l, since the probability of default would increase as those variables increase. For simplicity of analysis, we define the inverse demand function as the following linear function of (N_l, A_l):

$$r_l = \alpha_l - \beta_l N_l - \gamma_l A_l - \sigma_l {N_l}^0, \forall l \in (1,2) \quad (2)$$

where ${N_l}^0$ denotes the number of loans provided by other financial institutions in the market.

Profit-oriented financial institutions

We suppose that profit-oriented FIs maximize the following objective function:

$$\max_{A_1,N_1,A_2,N_2} \Pi_1 + \Pi_2$$

$$\begin{gathered} \text{s.t.} \\ \Pi = \Pi_1 + \Pi_2 = r_1 A_1 N_1 - c_1(N_1) - k_1(A_1) + r_2 A_2 N_2 - c_2(N_2) - k_2(A_2) \\ r_l = \alpha - \beta_l N_l - \gamma_l A_l - \sigma_l {N_l}^0, \forall l \in (1,2) \\ \Pi_l \geq 0 \end{gathered} \tag{3}$$

In this model, financial institutions maximize the profit function in Markets1 and 2, respectively. We denote $({A^p}_1, {N^p}_1, {A^p}_2, {N^p}_2)$for the set of optimal choice of (A_1, N_1, A_2, N_2) by profit-oriented FIs.

Outreach-oriented microfinance institutions

Outreach-oriented MFIs maximize the number of loans in the market for traditionally unbankable households, while they need to keep sustainability of their operations. We propose that outreach-oriented MFIs have the following objective function:

$$\max_{A_1,N_1,A_2,N_2} N_2$$

$$\begin{gathered} s.t.: \\ \Pi = \Pi_1 + \Pi_2 + G \geq 0 \\ \Pi = \Pi_1 + \Pi_2 = r_1 A_1 N_1 - c_1(N_1) - k_1(A_1) + r_2 A_2 N_2 - c_2(N_2) - k_2(A_2) \\ r_l = \alpha_l - \beta_l N_l - \gamma_l A_l - \sigma_l {N_l}^0, \forall l \in (1,2) \end{gathered} \tag{4}$$

where G is the subsidy for outreach-oriented MFIs from governments or international organizations. $\Pi = \Pi_1 + \Pi_2 + G \geq 0$ is a budget constraint to keep MFI operations sustainable. Using the Lagrangean multiplier, we can rewrite Problem (4) as the following maximization problem:

$$\begin{gathered} \max_{N_1,N_2,A_1,A_2} \mathcal{L} = N_2 + \lambda \\ \Pi_1 + \Pi_2 + G \\ s.t.: \\ \Pi = \Pi_1 + \Pi_2 = r_1 A_1 N_1 - c_1(N_1) - k_1(A_1) + r_2 A_2 N_2 - c_2(N_2) - k_2(A_2) \\ r_l = \alpha_l - \beta_l N_l - \gamma_l A_l - \sigma_l {N_l}^0, \forall l \in (1,2) \end{gathered} \tag{5}$$

The first order condition of the maximization problem regarding $A_1$and N_1 is as follows:

$$\frac{d\mathcal{L}}{dA_1} = \lambda \frac{d\Pi_1}{dA_1} = 0 \tag{6}$$

$$\frac{d\mathcal{L}}{dN_1} = \lambda \frac{d\Pi_1}{dN_1} = 0 \tag{7}$$

We denote (A_1^*, N_1^*) which satisfies both of the conditions (6) and (7) when $\lambda > 0$, and Π_1^* for the profit in Market 1 when $(A_1, \mathrm{N}_1) = (A_1^*, \mathrm{N}_1^*)$. The optimal values, (A_1^*, N_1^*), maximize the profit in Market 1, and profit from Market 1, Π_1^* , equals the profit in Market 1 of profit-oriented FIs, Π_1^p.

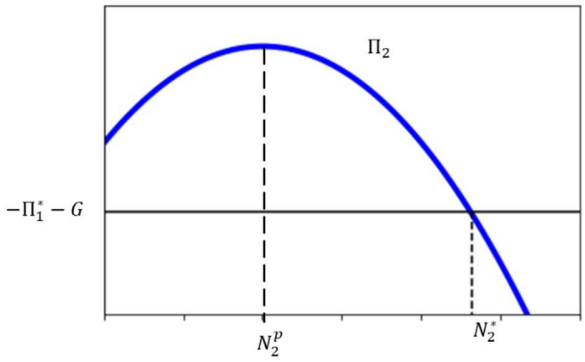
For Market 2, the first order conditions (A_2, N_2) are obtained as follows:

$$\frac{d\mathcal{L}}{dA_2} = \lambda \frac{d\Pi_2}{dA_2} = 0 \tag{8}$$

$$\frac{d\mathcal{L}}{dN_2} = 1 + \lambda \frac{d\Pi_2}{dN_2} = 0 \tag{9}$$

Condition (9) implies that outreach-oriented MFIs increase $N_2$the until the budget constraint, $\Pi_2 \leq -\Pi^*{}_1 - G$, becomes binding, meaning that outreach-oriented MFIs make a profit from Market 1, and make a loss in lending in Market 2. This implies that outreach-oriented MFIs cross-subsidize between households in Market 1 and Market 2 to increase the loan provision to households in Market 2. If we denote N_2^* for the optimal N_2 of the maximization problem above, the conditions also imply that outreach-oriented MFIs provide more loans in Market 2 than profit-oriented FIs ($N_2^* < N_2^p$), as illustrated in Figure A1.

Figure A1. Profit and Number of Loans



By expanding (8), we obtain the following condition.

$$\alpha_2 N_2 - \beta_2 N_2^2 + 2\gamma_2 N_2 A_2 - \frac{dk_2}{dA_2} = 0 \tag{10}$$

Through total differentiation of (10), we can obtain $\frac{dA_2}{dN_2} = -\frac{\alpha_2+2\gamma_2 A_2}{2\gamma_2 N_2 - k^{''}} < 0$. As long as the condition (10) holds, A_2 is a decreasing function in N_2. Thus, $A_2^* < A_2^p$. This implies that outreach-oriented MFIs provide loans in Market 2 as the preferable loan condition for the borrowers of the market, compared with profit-oriented FIs.

<u>The case of interest rate cap policy</u>

Next, we consider the case that the government restricts the interest rate on loans as $r_l = r^{**}$. The maximization problem for outreach-oriented MFIs becomes:

$$\max_{A_1,N_1,A_2,N_2} N_2$$

$s.t.:$

$$\begin{gathered}\Pi = \Pi_1 + \Pi_2 + G \geq 0 \\ \Pi = \Pi_1 + \Pi_2 = r_1 A_1 N_1 - c_1(N_1) - k_1(A_1) + r_2 A_2 N_2 - c_2(N_2) - k_2(A_2) \\ r_l = \alpha - \beta N_l - \gamma A_l - \sigma {N_l}^0 \\ r = r^{**}\end{gathered} \tag{11}$$

Using the Lagrangean multiplier, we can rewrite this maximization problem in the following form:

$$\begin{aligned}\max_{A_1,N_1,A_2,N_2} \mathcal{L} = N_2 &- \lambda(\Pi_1(r_1(N_1,A_1),N_1,A_1) + \Pi_2(r_2(N_2,A_2),N_2,A_2) + G) \\ &+ \mu_1\big(r^{**} - r_1(N_1,A_1)\big) + \mu_2(r^{**} - r_2(N_2,A_2))\end{aligned}$$

$s.t.:$

$$\begin{gathered}\Pi = \Pi_1 + \Pi_2 = r_1 A_1 N_1 - c_1(N_1) - k_1(A_1) + r_2 A_2 N_2 - c_2(N_2) - k_2(A_2) \\ r_l(N_l, A_l) = \alpha - \beta N_l - \gamma A_l - \sigma {N_l}^0\end{gathered} \tag{12}$$

The first order conditions are as follows:

$$\frac{d\mathcal{L}}{dA_1} = \lambda\frac{d\Pi_1}{dA_1} - \mu_1\frac{dr_1}{dA_1} = 0 \tag{13}$$

$$\frac{d\mathcal{L}}{dN_1} = \lambda\frac{d\Pi_1}{dN_1} - \mu_1\frac{dr_1}{dN_1} = 0 \tag{14}$$

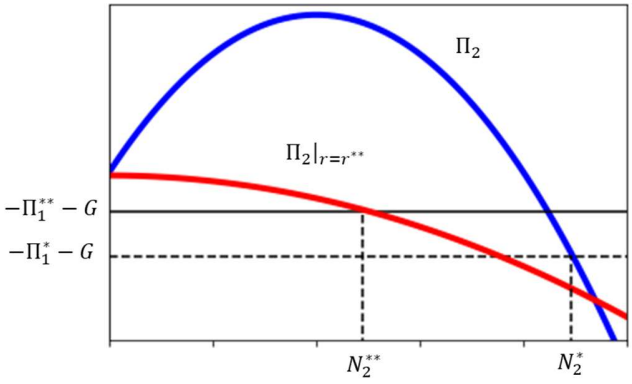
$$\frac{d\mathcal{L}}{dA_2} = \lambda\frac{d\Pi_2}{dA_2} - \mu_2\frac{dr_2}{dA_2} = 0 \tag{15}$$

$$\frac{d\mathcal{L}}{dN_2} = 1 + \lambda \frac{d\Pi_2}{dN_2} - \mu_2 \frac{dr_2}{dN_2} = 0 \tag{16}$$

Conditions (13) and (14) suggest that $\frac{d\Pi_1}{dA_1} < 0$, and $\frac{d\Pi_1}{dN_1} < 0$, meaning that $A_1^{**} > A_1^* = A_1^p$, and $N_1^{**} > N_1^* = N_1^p$. This implies that outreach-oriented MFIs increase the number of loans and the average loan size in Market 1 under the interest rate cap policy compared to being under no restriction on interest rates. In response to a decrease in the interest rate, MFIs try to mitigate the reduction in profit by increasing the number of loans and average loan size.

By transforming Condition (16), we can obtain $\frac{d\Pi_2}{dN_2} = \frac{1}{\lambda}\left(-1 + \mu_2 \frac{dr_2}{dN_2}\right)$. In the case that the interest rate is lower than the interest rate under the situation of no interest rate cap ($r^{**} < r_1{}^*$), MFIs would make a smaller profit in Market 1 ($\Pi_1^{**} < \Pi_1^*$) if the interest rate cap is imposed. This implies that the budget constraint to keep sustainability in operations, $\Pi_1 + \Pi_2 + G \leq 0$, becomes tighter, and the slack variable of the budget constraint λ is larger than λ^* in the case of no interest rate cap in the equilibrium. From condition (9) and (16), we can see that $\frac{d\Pi_2}{dN_2}(N_2^{**}, A_2^{**}, r_2^{**}) > \frac{d\Pi_2}{dN_2}(N_2^*, A_2^*, r_2^*)$ as long as $\lambda^{**} > \lambda^*$, implying that the number of loans is smaller in Market 2 under the interest rate cap, and the number of loans MFIs can provide in Market 2 also becomes smaller, as illustrated in Figure A2. Furthermore, the bidding condition of the interest rate cap in Market 2 also decreases profits in Market 2. As the interest rate cap becomes tighter in Market 2, μ_2 becomes larger, leading to a decrease in N_2, even though the profit in Market 1 does not change.

Figure A2. Profit and Number of Loans under the interest rate cap



Condition (15) suggests that $\frac{d\Pi_2}{dA_2} < 0$. Similarly, by compering (15) with (8), we can see that $A_2^{**} > A_2^*$. This implies that MFIs would increase their average loan size in response to both a decrease in the interest rate in Market 2 and a decrease in the profit from Market 1.

According to the above analysis, we can draw the following implications:

- For outreach-oriented MFIs, in response to the interest rate cap profits from a group of low-risk borrowers (Market 1) and a group of high-risk borrowers (Market 2) would decrease if the interest rate cap is lower than the rate MFIs are currently setting. The reduction in profits would in turn reduce the number of loans and increase the average size of loans for a group of high-risk borrowers.

In response to the interest rate cap, MFIs would increase both the number of loans and the average size of loans for a group of low-risk borrowers to mitigate the reduction in profits.