Integrating Market Conditions into Regulatory Decisions on Microfinance Interest Rates: Does Competition Matter?

Tristan Caballero-Montes (ORCID : 0000-0002-6694-989)

Scientific Collaborator, Université de Mons (Center for European Research in Microfinance, CERMi), Belgium

Contacts:

tristan.caballero-montes@umons.ac.be

+32 479 21 35 41

Place Warocqué 17, Mons, 7000, Belgium

Abstract

Microfinance rapidly developed and commercialized, exacerbating competition and the attention paid to profits. In response, many governments have capped microcredit interest rates. Using unique data on interest rate caps and a dataset comprising 1,115 microfinance institutions over 2015-2018, we investigate the effect of such regulatory measures on the loan sizes offered by microfinance institutions, with fixed-effect and two-stage residual inclusion regressions. Going further with a moderation analysis and multiple measurements of competition, we investigate whether market conditions affect this relationship. We find that microfinance institutions facing interest rate caps are associated with larger loans and financial exclusion, and that competition emphasizes this adverse effect. We suggest two mechanisms explaining such results, namely the deterioration of cross-subsidization possibilities and the exacerbation of risk-talking strategies of microfinance institutions, both favored by competition. Therefore, we argue against interest rate restrictions, and for the adoption a more systemic analysis of regulatory outcomes integrating market conditions.

Keywords: Microfinance; interest rate cap; regulation; competition; social outreach; moderation

1. Introduction

Microfinance institutions (MFIs) provide financial services to poor, unbanked individuals and small businesses, and concomitantly pursue financial sustainability. Although the industry was marginal four decades ago, it has substantially developed, taking an important place in the financial inclusion and development landscapes (Beck, 2020). Yet, severe crises emerged, revealing mission drift, ethical debates, and mitigated social outcomes (Armendáriz and Szafarz, 2011; Hudon and Sandberg, 2013; Guérin et al., 2018). Looking back on how microfinance evolved, two trends have had a significant influence.

On the one hand, regulation has intensified and helped MFIs develop and formalize (Arun, 2005). Yet, research shows that regulation is not always correlated with better financial

nor social outcomes (Hartarska and Nadolnyak, 2007). When it is maladapted or inappropriate, it may destabilize the industry (Ménard, 1998), and even contribute to crises (Guérin et al., 2018). Especially, more and more governments, concerned about potential drawbacks of a quest for profits, have considered limiting the rates charged by MFIs (Christen et al., 2012). However, despite their a priori honorable motivations, interest rate caps are often considered as detrimental. Based on case studies, scholars argue that caps may force MFIs to drop their costliest clients, often among the most marginalized (Acclassato, 2008; Ferrari et al., 2018). Yet, grey areas remain about whether this can be confirmed from a general, cross-country angle, and whether market conditions matter.

On the other hand, microfinance drew the attention of for-profit actors, who developed substantially. Moreover, MFIs increasingly represent an opportunity for commercial investors, often paying special attention to financial performance (Mersland and Urgeghe, 2013). This commercialization led to increased competition, with benefits but also worrying effects. Although competition encourages efficiency, reduced lending rates, and innovation (Al-Azzam and Parmeter, 2021), scholars alerted on undesired effects related to information asymmetry and risk-taking (McIntosh et al., 2005). Overall, the literature highlights ambiguous outcomes of competition in financial inclusion contexts (Assefa et al., 2013).

In this context, the goal of this paper is two-fold. First, we take a step back to study how interest rate caps affect financial inclusion. With unique data on interest rate caps and 1,115 MFIs over 2015-2018, we assess how these affect the loan size, a proxy for MFIs' outreach. Our results show that MFIs subjected to caps are associated with larger loans, a sign of the financial exclusion of the poorest. Second, we study whether competition alters this relation via a moderation analysis. Using fixed-effect regressions and the Herfindahl-Hirschman and the Lerner indexes, our findings suggest that competition amplifies this detrimental effect of caps. Our results are supported by various robustness checks, including the use of a two-stage residual inclusion.

We bring two contributions to the development and financial inclusion literature. First, although caps have been discussed, empirical – and even more quantitative – evidence of their effects are scarce. Studies are conceptual, centered on case studies, or constituted of taxonomies of caps. This is mainly due to the lack of centralized information (Ferrari et al., 2018). We combined multiple sources including initiatives analyzing regulation in

financial inclusion schemes, case studies, legal documents, press releases, country reports from field actors, and contacts with central bankers and networks. Doing so, we suggest a more global and quantitative analysis and explore the cross-country effect of interest rate caps. Second, studies on regulation focus on regulation itself, leaving aside market circumstances (Karimu et al., 2021). Yet, competition heavily influences MFIs, inducing that regulation is likely to have different outcomes in different markets. By connecting interest rate caps and competition, we contribute through a more systemic analysis of such instruments. While MFIs and competition proliferated, sometimes leading to saturation (Cull et al., 2014), the literature is almost silent on the implications for regulatory outcomes. However, studying whether and how these outcomes depend on competition in financial inclusion contexts broadens regulatory analyses.

The paper is structured as follows: Section 2 presents a literature review on interest rate caps and competition in microfinance contexts. Section 3 describes our empirical approach. Section 4 presents the data. Section 5 details our results. Section 6 concludes.

2. Microfinance and interest rate caps: Theoretical framework

2.1 The implications of interest rate caps in microfinance

As microfinance developed and commercialized, the industry drew regulatory attention (Kirkpatrick and Maimbo, 2002). Today, most microfinance markets present at least some form of regulation, with as common perspective that there is no unique framework fitting all markets but a number of consensual, core principles (Rosengard, 2011). These guide regulators and prevent damaging interventions and have been supported by the Consultative Group to Assist the Poor (CGAP)[1]. Among these principles, Christen et al. (2012:56) point that interest rate caps "can restrict access by making it impossible to serve small or remote borrowers". Compared to mainstream credit, microcredit indeed typically implies higher costs per unit. For reasons due to the socio-economic conditions of the clients served, MFIs employ distinct methodologies than traditional banks (Brihaye et al., 2019), and must face additional costs as they mobilize numerous contacts with the field, close relationships with clients, costly non-financial services, and sometimes higher default risk. Therefore, serving poor clients sustainably requires rates that may seem

[1] https://www.cgap.org/

excessive if compared to those charged by banks (Sandberg, 2012). These, however, often appear much more favorable when compared to those applied by informal markets. Still, concerned about potentially excessive interests, regulators have increasingly limited MFIs' lending rates (Ferrari et al., 2018). The main economic argument raised is that caps attenuate market failures by forcing cost reductions and efficiency and, thereby, protect clients from excessive pricing (Mitra, 2009; Benmelech and Moskowitz, 2010). From an economic theory standpoint, however, caps can alter not only credit price, but also quantity. More precisely, they can lead to shortages, with financial service providers reducing credit and focusing on clients requiring the legal rate (Vandenbrink, 1982).

Although a cap could theoretically be set at a sustainable level, the diversity and specificities of MFIs make it particularly arduous to identify such level practically. Therefore, caps often result in inappropriate one-size-fits-all approaches (Zetzsche and Dewi, 2018). Additionally, Helms and Reille (2004) argue that banking rates are typically considered as a reference for setting binding caps. All in all, caps can thus drive MFIs to exclude clients requiring rates higher than the limit to cover associated costs and risk premium, making it impossible for numerous MFIs to viably provide microcredits to the most excluded (Acclassato, 2008). The costliest clients are indeed mostly the poorest, since they contract small loans relative to their income (Schreiner, 2001; Hermes and Hudon, 2018). Cutting in the smallest loans due to a cap thus boils down to exacerbating financial exclusion (Hudon, 2007).

Empirically, case studies have documented this adverse effect. For instance, CGAP (2004) observed in Nicaragua that micro-borrowers had less access to credit after the imposition of caps. In France, restrictions have constrained the supply of (micro)credit for long and when these were removed in early 2000s, no sign of increased interest rates was observed (Attuel-Mendès and Ashta, 2008). Via a natural experiment study, Roa et al. (2021) show that restrictions implemented in Bolivia in 2014 curtailed the supply of microcredit and loans to SMEs and, thereby, inhibited financial inclusion. Studying Latin America and the Caribbean, Campion et al. (2010) find that caps damage MFIs' outreach to women and rural clients, who generally concentrate poverty. Recently, Ferrari et al. (2018) and Samreth et al. (2021) observed a substantial increase in the Cambodian loan sizes after a cap was set below market rates. In developed countries, usury limits are used to a non-negligible extent but they do not generate more enthusiasm (Goudzwaard, 1968; Villegas, 1989; Zinman, 2010; Rigbi, 2013).

Yet, to the best of our knowledge, the intrinsic effect of interest rate caps has surprisingly not been confirmed through a quantitative, cross-country analysis focused on financial inclusion schemes. In light of the above review, we thus formulate the following initial hypothesis:

***H1**: MFIs subjected to interest rate caps are associated with larger loans*

2.2. Microfinance and competition

Beside regulatory evolutions, microfinance has rapidly commercialized, bringing in formalization, the quest for financial sustainability, and increased competition. Yet, the literature highlights contrasted outcomes of competition (Assefa et al., 2013).

With the entrance of for-profit actors, competition has encouraged adaptability (Porteous, 2006). Referring to traditional financial institutions, competitive pressure is seen as promoting better functioning microfinance markets (Claessens and Laeven, 2005). Especially, the classical economic theory paradigm considers competition as enhancing allocative and technical efficiency (Motta, 2004). Doing so, competition would help MFIs reduce costs and prices, stimulate innovation, and enhance product quality and diversity to meet clients' needs and to adapt to evolving markets (Rhyne and Christen, 1999). Studying Uganda, Bangladesh, and Bolivia, three competitive markets, Porteous (2006) explains that most operators adapted interest rates and services as new entrants arrived. Competition favored the diversification of lending methods and funding sources, the reduction of costs and interest rates, and the comparability of offers. Overall, recent research confirm that competition encouraged the reduction of lending rates and adaptation of microfinance services (Al-Azzam and Parmeter, 2021). Therefore, competition has often been considered as an alternative to interest rate caps (Miller, 2013).

From an outreach perspective, Vanroose and D'Espallier (2013) show that competition from purely commercial actors lead socially oriented MFIs to adapt and to reach niche markets, like poorer or less accessible segments. Using loan size as a proxy for depth of outreach, Cull et al. (2014) confirm that downscaling commercial banks encourage MFIs to target poorer clients and to offer smaller loans. Recently, Karimu et al. (2021) pointed that competition pushes MFIs to adopt riskier lending strategies. To some extent,

additional risks may be associated with smaller loans and marginalized clients (Rosengard, 2004), as these often lack financial literacy, identification pieces, and collateral options.

The above arguments follow a classical view defending that competition allow MFIs to better adapt to evolving markets (Baquero et al., 2018). Coming back to interest rate caps, this suggests that competition may help MFIs face such restrictions and attenuate their socially counter-productive outcome. Therefore, we highlight the following hypothesis:

***H2a**: competition attenuates the effect of interest rate caps*

Still, literature also documents less beneficial outcomes of competition (Kar and Swain, 2018), suggesting that interest rate caps could be more harmful in competitive contexts. A first drawback is to find in the deterioration of cross-subsidization, a mechanism helping MFIs serve the poor viably. Cross-subsidization consists in providing larger, more profitable loans to better-off clients while delivering smaller loans, associated with higher costs, to poorer beneficiaries (Armendáriz and Szafarz, 2011). As a profitable business, however, microfinance increasingly attracts profit-oriented operators. As these enter the market, they jeopardize cross-subsidization possibilities by reducing the basket of available better-off clients (Morduch, 1999; Navajas et al., 2003; McIntosh and Wydick, 2005) and deteriorate the ability of socially oriented MFIs to serve clients requiring the smallest loans (Kar and Swain, 2018). While, in such instances, very small loans would necessarily entail greater interest rates to deal with higher costs and risks, this is typically impossible when interest rates are legally constrained. Thereby, the deterioration of cross-subsidization in competitive markets may render caps even more binding.

Furthermore, competition favors information asymmetry and riskier lending strategies, particularly when credit information platforms are not efficient (McIntosh et al., 2005; Karimu et al., 2021). Facing competition, MFIs may loosen screening and monitoring standards, resulting in increased multiple lending and indebtedness, as shown in Bilivia (Vogelgesang, 2003) and Uganda (McIntosh et al., 2005). While riskier borrowers add to default risk and require higher rates (Stiglitz and Weiss, 1981; De Quidt et al., 2018), this may not be possible with interest rate caps in place. Consequently, clients may be pushed through risky refinancing policies – and sometimes with aggressive marketing practices – to contract larger loans allowing MFIs to cope with pricing restrictions, but triggering over-indebtedness (Kar and Swain, 2018). In saturated areas where competition is often

exacerbated (Cull et al., 2014), this is accentuated as new clients are scarce and as providing larger loans is the only option to grow (Schicks and Rosenberg, 2011).

Contrarily to what hypothesis H2a suggests, these arguments imply that competition may render interest rate caps more binding and detrimental. Overall, financial sustainability may be even more pressurized due to competition than what a cap already implies, which may exacerbate its financial exclusion effect. Hence, our last hypothesis is an alternative to H2a:

***H2b**: competition amplifies the effect of interest rate caps*

With H2a and H2b reflecting the ambivalent outcomes of competition, our rationale suggests that interest rate caps may interact with competition (Figure 2), and that regulatory outcomes can be conditioned by market circumstances. However, to date, the study by Karimu et al. (2021) is the only one to analyze the combined effect of regulation and competition in microfinance, but with a focus on credit risk. Studying Sub-Saharan Africa, they build an interaction variable combining a measure of competition and a dummy indicating whether MFIs are "regulated" or "non-regulated". The core logic of microfinance regulation is that deposit-taking MFIs follow prudential and non-prudential rules, whereas credit-only institutions are subjected to non-prudential rules only (Rosengard, 2011). Doing so, they show that being regulated reduces credit risk when competition is low, whereas it does not in competitive markets. They argue that competition prevents regulation from helping MFIs adopt reasonable risk-taking strategies. Yet, apprehending how regulation and competition interact require a more precise regulation variable since, when imposed, caps typically apply to all MFIs, regardless of whether they follow prudential rules. Analyzing regulatory outcomes based on a broad dichotomic view is thus too wide an approach to grasp the influence of competition on the effect of instruments like interest rate caps. Therefore, using a more specific variable is required, which is what we suggest.

[Figure 1 here]

3. Empirical approach

Our empirical approach investigates the framework from Figure 1. To do so, we use a linear regression model specified as follows:

$$ALS_{i,t} = \beta_0 + \beta_1 RATECAP_{ij,t} + \beta_2 COMP_{ij,t} + \beta_3 RATECAP_{ij,t} * COMP_{ij,t} + \lambda X_{i,t} + \gamma Z_{ij,t} + \eta_i + \mu_t + \varepsilon_{i,t} \quad (1)$$

where $ALS_{i,t}$ is the average loan size offered by MFI i in year t; $RATECAP_{ij,t}$ is a dummy indicating whether MFI i faces an interest rate cap in year t; $COMP_{ij,t}$ is a variable assessing the degree of competition; $X_{i,t}$ and $Z_{ij,t}$ are vectors of common organization- and country-level control variables; and η_i and μ_t represent MFI- and time-specific fixed effects, respectively.

As a measure of depth of outreach, the average loan size is the most common proxy (Cull et al., 2007; 2014; Mersland and Strøm, 2010; Kar and Swain, 2014; Arrassen, 2017; Hermes and Hudon, 2018; Reichert, 2018). As often, we divide ALS by the GDP per capita, to use comparable measures across countries (Cull et al., 2007).

RATECAPij,t is our main independent variable. Given the variety of caps and objects they refer to (Maimbo and Henriquez Gallegos, 2014), the wide range of interest rates and cost structures across regions (Kneiding and Rosenberg, 2008), and our multiple data sources (see Section 4), using a level variable was irrelevant. Rather, following Baquero et al. (2018), we built a dummy accounting for the presence of a legal restriction faced by MFIs, allowing to investigate the potential cross-country effect inherent to interest rate caps (Maimbo and Henriquez Gallegos, 2014). Additionally, we distinguish between “hard” and “soft” (or “de facto”) caps. Whereas the former are imposed by laws or official controls, the latter result from pressures of public operators or public opinion drawing prices down, political declarations from regulators threatening to regulate prices, or as conditional requirements to access funding (Helms and Reille, 2004; Kneinding and Rosenberg, 2008). Yet, due to their nature, documented data are typically not available. Therefore, our study focuses on hard caps, based on a thorough collection of information carried out considering interest rate caps as legal constraints.

$COMP_{i,t}$ represents the degree of competition, and $RATECAP_{ij,t}$*$COMP_{i,t}$ is an interaction variable capturing the combined effect of an interest rate cap and competition. We first measure competition based on a “structural”, market-based approach (Kar and Swain, 2018). This consists in observing market structures to apprehend competition and boils down to considering market concentration as proxy of market power or competition. In this perspective, the Herfindahl-Hirschman Index (HHI) is one of the most used indicators, including in the microfinance literature (Wagner and Winkler, 2013; Kar and Swain, 2014;

Baquero et al., 2018; Dannon et al., 2019; Al-Azzam and Parmeter, 2021). Compared to other concentration ratios, it considers all the firms of an industry, not only the largest ones, and allows to better account for their size by penalizing large market shares via squared weights (Purkayastha et al., 2017). The HHI is calculated as:

$$HHI_{ij,t} = \sum_{i=1}^{n} MS_{i,t}^2 \quad (2)$$

where $MS_{i,t}$ is the market share of MFI i (using loan portfolio) in year t. We compute the HHI for each country and each year to account for both cross-sectional and time variations (Kar and Swain, 2014). The HHI takes values between 0 (perfect competition) and 1 (monopoly). To ease interpretation, we multiply it by -1 so that an increase in HHI indicates an increase of competition (Assefa et al., 2013). In the robustness analysis (Section 5), we also use the Lerner Index to apprehend competition from a firm-based perspective.

Finally, we include common controls. First, we consider variables characterizing MFIs. We control for size (ASSETS), whether MFIs collect savings (SAVINGS, dummy), operational efficiency (OER, operating expense ratio), financial sustainability (OSS, operational self-sufficiency), and credit risk (PAR30, portfolio at risk 30 days). We also include common country-level variables characterizing the economic environment, including the GDP growth rate (GROWTH), the inflation rate (INFLATION), the population density (POP), the percentage of labor force in the population (LABOR), and the amount of remittances received in percentage of GDP (REMITTANCES). These have been used in major cross-country studies analyzing the determinants of loan size or using it as dependent variable to proxy depth of outreach (Conning, 1999; Olivares-Polanco, 2005; Cull et al., 2007; Hartarska and Nadolnyak, 2007; Mersland and Strøm, 2010; Ahlin et al., 2011; Assefa et al., 2013). Moreover, we include the credit to GDP ratio (CREDIT) and the number of ATMs per 100,000 inhabitants (ATM), as variables describing the financial sector development, since it may condition MFIs' outreach (Assefa et al., 2013; Vanroose and D'Espallier, 2013; Cull et al., 2014). Appendix 1 provides details on all variables.

As for the estimation method, we use panel data, and performed a Breusch-Pagan test which revealed that panel regressions are more appropriate than pooled-OLS regressions. Running a Hausman Test (Hausman, 1978), we failed to reject the absence of individual time-invariant effects, indicating that fixed-effects (FE) regressions are more appropriate. In a final step, we control for endogeneity problem caused by potential reverse causality between ALS and RATECAP with a two-stage residual inclusion (2SRI)

approach, as suggested by Hausman (1978) and used by Terza et al. (2008) and Karimu et al. (2021), among others.

4. Data and descriptive statistics

Our dataset was built out of multiple sources. First, detailed information on microfinance regulation is scarce (Trujillo et al., 2014), and data on interest rate caps in microfinance schemes are not centralized (Ferrari et al., 2018). We thus gathered data on interest rate caps through multiple channels for this research, especially. We started with the Global Microscope on Financial Inclusion[2] and MFTransparency[3], analyzing regulatory environments in multiple developing countries. We double-checked and complemented this with Maimbo and Henriquez Gallegos (2014), Sinha (2016), Ferrari et al. (2018), and Zetzsche and Dewi (2018), which provide international inventories of caps. We also reviewed national legal documents, websites of central banks and press releases, and had contacts with central bankers, microfinance networks, and international support organizations. Although we collected information for 101 countries, only 83 remained after consolidating with our other data sources for 2015-2018. As detailed in Appendix 2, 36 countries had caps during the whole period, and 40 had none. Still, caps are not static: 6 countries set a cap during the period, while 1 removed one. Second, we used MFI-level data from the MIX Market. The MIX is to date the largest effort to collect microfinance data and has been used in major studies (Cull et al., 2007; Hartarska and Nadolnyak, 2007; Ahlin et al., 2011; Roberts, 2013; D'Espallier et al., 2017). Third, we used World Bank's open data for broad economic and country variables. On this basis, we built a consolidated dataset comprising 1,124 MFIs over 2015-2018, for a total of 3,135 observations. Due to punctual errors related, among others, to currency conversion, we winsorized observations at the top and bottom 5% for our loan size variable. We also removed observations with a HHI equal to 1, as they reflected a lack of data, rather than perfectly monopolistic markets. After all adjustments, the final dataset includes 1,115 MFIs and 3,091 MFI-year observations.

Prior to regressions, we ran mean-comparison tests on portfolio yield, average loan size, and operating expense ratio. Portfolio yield proxies the cost to borrowers and, since we

[2] https://www.centerforfinancialinclusion.org/global-microscope-2020
[3] https://www.mftransparency.org/

use MFI-level data, this is the most common way for approaching the effective interest rates charged by MFIs (Roberts, 2013). We applied mean-comparison tests to both the nominal and real portfolio yields. These tests point at statistically significant differences between countries with capped rates and those where rates are freely determined (Table 1). While MFIs in countries where rates are not capped charge around 31%, those facing a cap charge around 18%, which corroborates previous research suggesting that caps constrain interest rates (Baquero et al., 2018; Al-Azzam and Parmeter, 2021). As hypothesized, MFIs with capped rates are also associated to larger loans, with a difference of USD 394, on average. This is also supported by the higher operating expense ratio faced by MFIs operating in markets where rates are not legally constrained (29.5%, against 17.2%). Moreover, Table 2 shows that the average HHI is 0.276, suggesting relatively moderate competition in microfinance, globally (Kar and Swain, 2014). Overall, values from Table 2 for portfolio yield, average loan, and HHI corroborate other studies (Cull et al., 2007; Assefa et al., 2013; Roberts, 2013; Kar and Swain, 2014; Baquero et al., 2018; Dannon et al., 2019; Al-Azzam and Parmeter, 2021).

[Table 1 here]

[Table 2 here]

5. Results

Table 3 displays regressions of Equation 1 for pooled-OLS (Regressions 1 and 2) and fixed-effect estimations (Regressions 3 and 4). For both, we present models with and without interactions. We use standard errors (SEs) that are robust to heteroskedasticity and serial correlation, and clustered at the MFI-level.

In all regressions from Table 3, we observe a positive and highly significant coefficient of RATECAP. All things being equal, this indicates that MFIs operating in markets where interest rates are capped are associated with larger loans. Given MFIs' business model, high operational costs are generally inevitable. The poorest clients typically generate additional costs due to their remoteness or as they require very small loans and complementary, costly non-financial services. This result thus suggests that by constraining interest rates, caps jeopardize financial sustainability. To maintain profit steady or to keep breaking even, MFIs may tend to offer larger loans and target less costly

clients. This is supported by the earlier-detailed t-tests, which suggested that MFIs operating in capped markets tend to charge lower prices and to face lower costs than those operating with free rates (Baquero et al., 2018; Al-Azzam and Parmeter, 2021). From a risk perspective, it could also be argued that MFIs adapt clients' risk profile to the newly, legally set interest rate by focusing on better-off, less risky clients who access larger loans and lower rates (Stiglitz and Weiss, 1981; Acclassato, 2008). As loan size is a proxy for depth of outreach (Schreiner, 2002), this suggests that MFIs facing caps are associated with better-off clients than MFIs operating with free rates, a typical sign of a drift away from their financial inclusion mission (Armendáriz and Szafarz, 2011), as hypothesized by H1.

[Table 3 here]

Then, integrating HHI into the rationale, our regressions first suggest unclear findings[4]. The coefficient of HHI is negative and only slightly significant in Regression 1, using pooled OLS and excluding the interaction with RATECAP. However, the positive and significant coefficient of HHI in Regression 3 using fixed effects indicates that, all things being equal, the higher HHI, the larger ALS. Although the direct effect of competition is not our focal point, this suggests that less concentrated – more competitive – markets are associated with MFIs providing larger loans. This corroborate previous research showing that competition deteriorates outreach (Navajas et al., 2003; Vogelgesang, 2003; McIntosh and Wydick, 2005; McIntosh et al., 2005; Assefa et al., 2013; Kar and Swain, 2018). Additionally, Regression 4 using fixed effects indicates a positive conditional effect of HHI. However, this coefficient is not significant. This may be explained by the fact that the effect of competition might be more perceptible in capped markets. This is not surprising, since caps are sometimes set with the argument of cooling down "overheating" markets (Zetzsche and Dewi, 2018; Caballero-Montes et al., 2021).

Furthermore, we consider the interaction between RATECAP and HHI, via Regressions 2 and 4 in Table 3. The positive and significant coefficient of RATECAP*HHI suggests that as HHI increases, the effect of RATECAP on ALS increases too. This suggests that competition is associated to an amplification of the initial effect attributed to RATECAP, which confirms H2b. This result may be explained by two mechanisms which render

[4] Ambiguous results can suggest multicollinearity. However, the Variance Inflation Factors (VIFs) are all very close to 1, suggesting no multicollinearity issue (Kleinbaum et al., 1988).

interest rate restrictions even more binding in more competitive markets. A first mechanism refers to how competition affects cross-subsidization. When competition increases, the basket of better-off, more profitable clients is shared among more operators, reducing cross-subsidization possibilities for socially oriented MFIs to finance smaller, costlier loans (Navajas et al., 2003). Consequently, to keep providing smaller loans, charging greater interest rates on these loans and widening the interest rate spread across different profiles of clients would be required (McIntosh and Wydick, 2005). When interest rates are legally constrained, however, this becomes harsher, or even impossible. In increasingly competitive markets, caps thus appear as even more binding as they make it impossible for MFIs to overcome the deterioration of cross-subsidization.

A second mechanism then refers to the risk side of the coin. Research shows that competition encourages riskier lending strategies (Karimu et al., 2021), including relaxing lending requirements (Vogelgesang, 2003; McIntosh et al., 2005), and targeting more marginalized clients (Vanroose and D'Espallier, 2013; Cull et al., 2014). Doing so, however, requires charging higher interest rates, to cope with additional risk or increased defaults (Stiglitz and Weiss, 1981; De Quidt et al., 2018). Following this second rationale, competition may render interest rate caps even more binding once again, since it is harsher or even impossible to increase rates when these are capped. MFIs facing competition may thus provide poor clients with adapted terms and conditions, including larger loans with lower interest rates aligning on the maximum rates allowed (Kneiding and Rosenberg, 2008), which raises concerns as for transparency and over-indebtedness risk. This is illustrated by the evolution of some saturated markets, such as Cambodia, where competition is exacerbated and where loan sizes increased after a cap was set recently (Ferrari et al., 2018; Caballero-Montes et al., 2021).

Once identified, we must then analyze for which levels of competition this interaction manifests. We thus "probe" the marginal effect of RATECAP and its significance for different values of the moderating variable (Hayes, 2018), namely HHI. As Figure 2 shows, the confidence interval comprises 0 for values from -1 to -0.57, indicating that the moderation effect is not significant in this interval. In markets characterized by such concentration levels, the moderation effect of HHI tends to be statistically insignificant. Al-Azzam and Parmeter (2021) suggest that HHI values above 0.25 already indicate market concentration. From a theoretical perspective, one could hypothesize that such concentrated, monopolistic markets may be less affected by interest rate caps, as they

leave more room for making profits or improving efficiency (Motta, 2004). Yet, the cumulative frequency of the HHI distribution shows that observations with values between -1 and -0.57 only represent 12.7% of our sample. In other words, 87.3% of observations present values closer to 0, for which the moderation effect is significant. Besides, as MIX Market is based on self-reported data, the observations included in this interval may also suffer from a lack of data collection, pushing upwards the HHI, rather than reflecting monopolistic situations. All in all, with caution as for mono/oligopolistic markets where interest rate caps could be less constraining, the identified moderation effect thus seems to be relevant for most market structures observed in our data.

[Figrue 2 here]

Finally, we observe significant controls corroborating previous research. First, larger MFIs are associated with larger loans, which corroborates Assefa et al. (2013). This may indicate potential signs of a drift towards better-off clients although, all things being equal, such institutions may also mobilize cross-subsidization. Then, labor force participation and remittances seem to positively affect loan size. As shown by Ahlin et al. (2011), this may reflect rivalries between domestic economic activity and microfinance, or the fact that households with additional earnings opportunities access larger loans[5]. Especially, when labor force participation increases, this may allow households to access larger loans. Results are however ambiguous as for the effect of financial sector depth, especially regarding the number of ATMs per 100,000 inhabitants and the credit to GDP ratio, although the latter is only significant at 90% in our Regression 4, using fixed effects.

Robustness analysis

We applied several robustness checks. First, we used an alternative, firm-based approach to competition, consisting in observing how firms behave as an indication of the competition they face (Kar and Swain, 2018). Although market concentration is essential, it may not be the only factor influencing competition. Especially, it may not perfectly account for geographical dispersion (Van Leuvensteijn et al., 2007), meaning that HHI may imperfectly capture the effect of local mono/oligopolies, for instance. In this perspective, we use the Lerner Index, which has often been used in the financial and

[5] Still, this may be nuanced since *REMITTANCES* is significant in Regression 1 only.

microfinance literatures (Koetter et al., 2012; Assefa et al., 2013; Dannon et al., 2019; Al-Azzam and Parmeter, 2021; Karimu et al., 2021). It is computed as:

$$LERNER_{i,t} = \frac{(P_{i,t} - MC_{i,t})}{P_{i,t}} \quad (3)$$

where $P_{i,t}$ is the output price, namely the ratio of revenues from loans to gross portfolio, and $MC_{i,t}$ is the marginal cost. To compute MC, we define a translog cost function (Al-Azzam and Parmeter, 2021):

$$\ln C_{i,t} = \alpha_0 + \alpha_1 \ln Q_{i,t} + \frac{1}{2}\alpha_2 (\ln Q_{i,t})^2 + \sum_{k=1}^{3} \beta_k \ln W_{k,i,t} + \frac{1}{2}\sum_{k=1}^{3} \beta_k (\ln W_{k,i,t})^2 + \sum_{k=1}^{3} \gamma_k \ln Q_{i,t} * \ln W_{k,i,t} + \sum_{k<l} \sum \gamma_{k,l} \ln W_{k,i,t} * \ln W_{l,i,t} + \delta_1 TREND + \frac{1}{2}\delta_2 TREND^2 + \delta_3 \ln Q_{i,t} * TREND + \sum_{k=1}^{3} \eta_k \ln W_{k,i,t} * TREND + \zeta_1 \ln PAR30_{i,t} + \zeta_2 \ln ASSETS_{i,t} + \zeta_3 SAVINGS_{i,t} + \zeta_4 COUNTRY + \zeta_5 YEAR + \varepsilon_{i,t} \quad (4)$$

where $C_{i,t}$ is the total cost (total expenditures to gross portfolio), and $Q_{i,t}$ is the output (gross portfolio). We consider the cost of three inputs (W_k): cost of labor (W_1, personnel expenses to gross portfolio), cost of physical capital (W_2, administrative expenses to net fixed assets), and cost of financial capital (W_3, financial expenses to liabilities). We also include the PAR30, total assets, and a dummy for the collection of savings to account for differences in risk strategies, size, and service offers, respectively (Assefa et al., 2013; Al-Azzam and Parmeter, 2021). A time trend is also included to account for changes in performance induced by technological change (Karimu et al., 2021). Finally, we add vectors of dummies to capture potential country and time effects influencing cost structures (Al-Azzam and Parmeter, 2021). The first derivative of $\ln C_{i,t}$ with regard to $\ln Q_{i,t}$ is then defined as:

$$\frac{\partial \ln C_{i,t}}{\partial \ln Q_{i,t}} = \frac{\partial C_{i,t}}{\partial Q_{i,t}} * \left(\frac{Q_{i,t}}{C_{i,t}}\right) \quad (5)$$

Equation 5 represents the elasticity of $C_{i,t}$ with regard to $Q_{i,t}$. The first term of the product (derivative of $C_{i,t}$ with regard to $Q_{i,t}$) is the marginal cost. Isolating MC and deriving Equation 5, $MC_{i,t}$ is obtained by using the parameters estimated when regressing Equation 4 (Appendix 4):

$$MC_{i,t} = \left(\frac{C_{i,t}}{Q_{i,t}}\right) * \left(\alpha_1 + \alpha_2 \ln Q_{i,t} + \sum_{k=1}^{3} \gamma_k \ln w_{k,i,t} + \delta_3 trend\right) \quad (6)$$

Once generated, $MC_{i,t}$ is reinjected in Equation 3 to compute the Lerner Index for each MFI-year observation. Appendix 5 shows summary statistics of the variables used for the estimation of the cost function and the calculation of the index. The index ranges between 0 and 1[6]. The intuition is that firms in highly competitive markets (index close to 0) are price takers, inducing that P is close to MC. Conversely, firms in mono/oligopolies set prices above the marginal cost, inducing values closer to 1 (Elzinga and Mills, 2011). The mean value for LERNER is 0.67 (Appendix 5), which corroborates Assefa et al. (2013), among others. Moreover, Table 4 shows that the results are close to those obtained with HHI for both the direct effect of RATECAP and the interaction variable[7].

[6] We observed 17 negative observations, which we treated as outliers as a negative value can be observed only if the marginal cost is greater than the marginal return, which would indicate a heavily subsidized MFI (Assefa et al., 2013). We ran regression while computing *LERNER* with and without these observations, and this did not affect the results. We removed these observations from the dataset to remain with values between 0 and 1.

[7] The correlation between *RATECAP* and *LERNER* is relatively weak (8.90%) and all Variance Inflation Factors (VIFs) are very close to 1, suggesting no multicollinearity issue (Kleinbaum et al., 1988).

As complementary robustness checks, we ran additional fixed-effect regressions with other dependent variables (Appendix 4), including with ALS adjusted with the gross national income (GNI) per capita, as well as without any adjustment. We observed very similar results as those obtained with the GDP per capita adjustment. We also used the percentage of women clients reached as indicator of depth of outreach (Reichert, 2018; Hermes and Hudon, 2018). As shown in Appendix 4, the negative and significant coefficient suggests similar results than when using the average loan size. We still note that the interaction effect is not significant. Research shows that women clients are discriminated based on loan sizes, rather than based on the possibility to contract loans (Agier and Szafarz, 2013). Therefore, additional competition may encourage MFIs to discriminate based on the size of the loans offered. This way, it would amplify the effect of interest rate caps without materializing in the percentage of women clients, but in the average loan size offered, as we argued.

Finally, we control for potential endogeneity associated to reverse causality between ALS and RATECAP. We use a two-stage residual inclusion approach (Hausman, 1978). As mentioned by Karimu et al. (2021:483), it allows to "deal with issues of endogeneity when there are no suitable available instruments". This consists in estimating a second-reduced-form equation for RATECAP, which residuals are generated from and added to the original equation as an additional covariate, and which "are substituted for the unobserved confounders" (Terza et al., 2008:534). This leads to estimate Equation 7:

$$RATECAP_{ij,t} = \beta_0 + ALS_{i,t} + COMP_{ij,t} + \theta X_{i,t} + \beta_k GOV_{ij,t} + \eta_i + \mu_t + \varepsilon_{i,t} \quad (7)$$

where RATECAP is the dependent variable, and where ALS controls for potential reverse causality in our original model. As suggested by Karimu et al. (2021), we included competition and explanatory variables from Equation 4 ($X_{i,t}$), as competition and firm characteristics can influence the definition of regulation. Additionally, we included variables characterizing regulatory contexts ($GOV_{ij,t}$), as political motivations are likely to influence regulation, and so the implementation of interest rate caps (Miller, 2013; Gul et al., 2017). We used the aggregate World Governance Indicators (WGI) of control of corruption, government effectiveness, and rule of law, extracted from the World Bank. We then generated residuals from Equation 7 and included them in Equation 1, using both

HHI (Table 3) and LERNER (Table 4). Our results, suggest that the relationships identified earlier between RATECAP, ALS, HHI, and LERNER, hold with this approach. We note that the size of the coefficients is logically sensitive to the inclusion of these residuals, given their negative coefficient, inducing a slightly less significant interaction coefficient.

6. Conclusion

Interest rate restrictions have sparked debates in microfinance. Yet, studies have been mostly conceptual, centered on case studies, or made of taxonomies. Besides, while regulatory outcomes are likely to depend on market conditions, the combined effect of regulation and competition has surprisingly almost not been studied. However, as microfinance develops – up to saturation in some areas – questioning which regulation and market dynamics are desirable to support the industry becomes essential.

Thanks to unique, multi-source data, we investigated the relationship between interest rate caps on loan size which, to the best of our knowledge, had not been studied from a quantitative and cross-country perspective. We show that MFIs facing caps are associated with larger loans, suggesting that they tend to serve better-off, less marginalized clients. This finding argues against the use of caps in microfinance, due to their adverse effect result from the one-size-fits-all approach they typically rest upon. Going further, we argue that competition amplifies this phenomenon, since interest restrictions may be even more binding in competitive markets. They may indeed prevent MFIs from increasing rates to overcome the deterioration of cross-subsidization, or to cope with additional credit risk, both favored by competition. Regulatory measures are of course intrinsically constraining and always imply (political and economic) trade-offs. Yet, in some instances, i.e. in competitive industries, inappropriate measures may be more harmful than beneficial, and might encourage undesirable social outcomes, like financial exclusion or over-indebtedness. In this respect, our paper shows the importance of adopting a systemic approach when studying the outcomes of regulatory choices, especially when these address financially distressed individuals. Doing so, we hope that this research brings insights helping policy-makers make better informed decisions.

Further research may still refine our analyses. First, although the MIX is still to date the largest effort to collect cross-country microfinance data, it relied on self-reported information. This may induce missing data or punctual errors, as noted earlier.

Consequently, further research may benefit from other data to confirm or extend our analyses. Second, using the loan size to proxy depth of outreach is the most common approach (Hermes and Hudon, 2018), but poverty is a multi-faceted concept. Although discussing the role of competition allowed to investigate that increased loan sizes may also refer to risky refinancing strategies and not only financial exclusion, further research may mobilize additional indicators. We mobilized the percentage of women clients, another typical indicator of depth of outreach in the microfinance literature. We found a negative effect of imposing of interest rate caps on the percentage of women clients, but no interaction with the level of competition. This may be due to the fact that financial exclusion and discrimination of women can materialize via the size of the loan they receive, rather than the provision of a loan itself (Agier and Szafarz, 2013). Third, competition in microfinance comes not only from MFIs but also from informal lenders, commercial banks, and more recently digital or mobile operators, possibly inducing contrasted outcomes for MFIs. Although some authors approached this issue (Vanroose and D'Espallier, 2013; Cull et al., 2014), it is still understudied. Further research may thus address how the natures and sources of competition affect traditional MFIs, with a view to better integrating all sorts of operators into regulators' reflections, and optimizing regulatory decisions.

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Competing interests

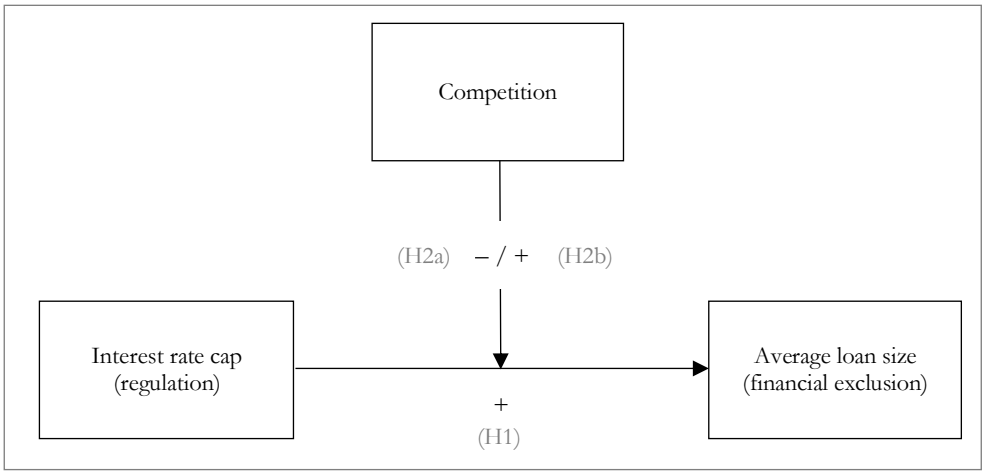
The authors have no competing interest to declare.

Data availability statement

"The data that support the findings of this study are available from the corresponding author upon request."

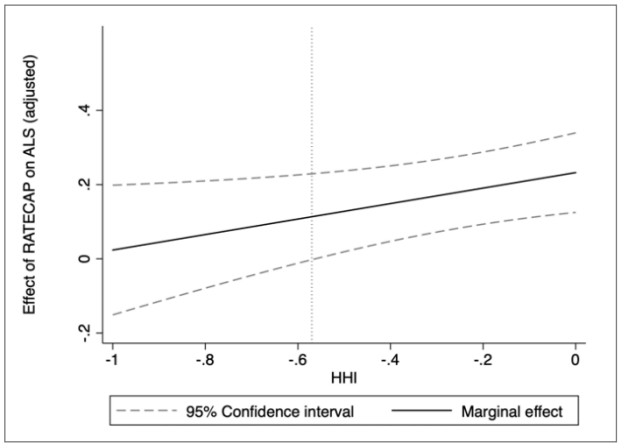
Figures

Figure 1. Theoretical framework



Source: The author

Figure 2. Marginal effect of *RATECAP* on *ALS*



Tables

Table 1. Preliminary mean-comparison tests, by state of RATECAP

Variable	N	No cap	Cap	Difference
Portfolio yield (nominal)	2,466	0.397	0.246	*0.151**
Portfolio yield (real)	2,496	0.307	0.176	*0.131**
ALS (USD)	2,686	1,330.104	1,723.772	*-393.669**
ALS adj. GDP p.c.	2,674	0.474	0.549	*-0.056**
Operating expense ratio	2,456	0.295	0.172	*0.123**

*Notes: *99% significance level.*

Table 2. Summary statistics

Variable	N	Mean	SD	Min	Max
MFI-level variables					
Portfolio yield (nominal)	2,601	0.312	0.189	0	1.553
Portfolio yield (real)	2,637	0.233	0.183	-0.185	1.430
Average loan size (USD)	2,840	1,569.129	1,985.495	132	7,266
Average loan size adj. GDP per capita	2,932	0.546	0.704	0.035	2.772
Average loan size adj. GNI per capita	2,827	0.550	0.713	0.035	2.816
Percentage of female clients	2,277	0.638	0.264	0.071	1
Total assets (log)	3,091	16.811	2.143	8.524	22.786
Savings (dummy)	2,739	0.519	0.500	0	1
Operational self-sufficiency	2,590	1.152	0.367	0.001	10.698
Operating expense ratio	2,676	0.229	0.234	0.0002	4.927
PAR30	2,918	0.073	0.119	0	1
Country-level variables					
Interest rate cap (dummy)	2,918	0.550	0.498	0	1
Herfindahl-Hirschman Index	3,050	0.276	0.213	0.066	0.999
GDP growth rate	3,083	0.042	0.028	-0.059	0.104
Inflation rate	2,867	0.041	0.036	-0.024	0.295
Population density (inhabitants per km^2)	3,086	174	233	2	1227
Remittances to GDP	3,083	0.063	0.072	0.0002	0.332
Labor force participation	3,073	0.636	0.102	0.385	0.865
Credit to GDP	3,015	0.417	0.231	0.055	1.611
ATMs per 100,000 inhabitants (log)	2,918	3.208	1.015	0.273	5.151

Table 3. Regressions of ALS (adjusted with GDP per capita) using HHI

ALS (adjusted)	*Pooled OLS*		*Fixed effects*		*Fixed effects (2SRI)*	
	(1)	(2)	(3)	(4)	(5)	(6)
RATECAP	0.081***	0.280***	0.168***	0.232***	1.394***	1.458***
	(0.036)	(0.046)	(0.051)	(0.055)	(0.320)	(0.340)
HHI[a]	-0.158*	-0.604***	0.186***	0.043	-0.098*	-0.185**
	(0.085)	(0.110)	(0.056)	(0.069)	(0.053)	(0.085)
*RATECAP*HHI*[a]		0.763***		0.209**		0.207*
		(0.152)		(0.097)		(0.124)
MFI-level controls						
ASSETS	0.08'***	0.081***	0.087***	0.086**	-0.009	-0.010
	(0.008)	(0.007)	(0.024)	(0.024)	(0.027)	(0.027)
SAVINGS	0.054*	0.056*	0.001	0.006	0.046*	0.052**
	(0.031)	(0.031)	(0.018)	(0.019)	(0.024)	(0.025)
OSS	-0.154**	-0.144**	-0.032	-0.031	-0.037	-0.040
	(0.065)	(0.064)	(0.041)	(0.041)	(0.033)	(0.034)
OER	-0.393***	-0.357***	-0.037	-0.036	-0.023	-0.021
	(0.120)	(0.119)	(0.042)	(0.042)	(0.021)	(0.021)
PAR30	0.409***	0.445***	0.071	0.073	0.064	0.065
	(0.140)	(0.140)	(0.071)	(0.071)	(0.069)	(0.069)
Country-level controls						
GROWTH	-0.212	-0.068	0.165	0.102	0.661*	0.663*
	(0.657)	(0.665)	(0.324)	(0.323)	(0.069)	(0.378)
INFLATION	-0.832**	-1.156***	0.219	0.228	0.130	0.109
	(0.375)	(0.387)	(0.196)	(0.193)	(0.225)	(0.228)
POP	-0.001***	-0.001***	-0.001	-0.002	0.005**	0.006**
	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.003)
LABOR	0.580***	0.781***	1.473***	1.542***	-0.371	-0.370
	(0.189)	(0.192)	(0.469)	(0.458)	(0.456)	(0.454)
REMITTANCES	0.264	0.270	0.664	0.859	1.367**	1.519**
	(0.298)	(0.298)	(0.671)	(0.657)	(0.667)	(0.680)
CREDIT	0.412***	0.430***	0.211**	0.156*	-0.288**	-0.332**
	(0.106)	(0.103)	(0.091)	(0.657)	(0.119)	(0.132)
ATM	-0.210***	-0.200***	-0.361**	-0.390**	-0.545***	-0.562***
	(0.024)	(0.024)	(0.161)	(0.159)	(0.196)	(0.201)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.479***	-0.723***	-1.064*	-1.161**	0.555	0.506
	(0.218)	(0.225)	(0.544)	(0.536)	(0.642)	(0.638)
Residuals from Equation 7					-1.282***	-1.298***
					(0.314)	(0.317)
R squared	0.288[b]	0.299[b]	0.135	0.139	0.364	0.367
Overall significance (Prob > F)	0.000	0.000	0.000	0.000	0.000	0.000
# Observations	1,906	1,906	1,906	1,906	1,282	1,282
# MFIs	806	806	809	809	616	616

Notes: [a]HHI multiplied by (-1) to ease interpretation; [b]adjusted R^2; significance at 1% (***), 5% (***), and 10% (*); "Yes" if included.

Table 4. Regressions of ALS (adjusted with GDP per capita) using LERNER

ALS (adjusted)	*Fixed effects*	*Fixed effects and 2SRI*
RATECAP	0.496***	1.644***
	(0.159)	(0.347)
LERNER[a]	-0.362*	-0.493***
	(0.193)	(0.175)
*RATECAP*LERNER*[a]	0.401**	0.319*
	(0.195)	(0.171)
Firm-level controls	Yes	Yes
Country-level controls	Yes	Yes
Time dummies	Yes	Yes
Constant	-0.420	-1.320***
	(0.702)	(0.322)
R squared	0.150	0.414
# Observations	1,153	1,153
# MFIs	562	562
Overall significance (Prob > F)	0.000	0,000

Notes: [a] LERNER multiplied by (-1) to ease interpretation; significance at 1% (***), 5% (***) and 10% (*); "Yes" if included.

Appendixes

Appendix 1. Variables description

	Variable	Description	Source
Firm-level variables	*Portfolio yield (nominal)*	Sum of interest, fees, and commissions / Gross loan portfolio	MIX Market
	Portfolio yield (real)	(Nominal portfolio yield - inflation rate) / (1 + inflation rate)	MIX Market
	Average loan size	Gross loan portfolio / number of active borrowers (USD)	MIX Market
	Average loan size adj. GDP p.c.	Average loan size / GDP per capita	MIX Market
	Average loan size adj. GDP p.c.	Average loan size / GNI per capita	MIX Market
	Percentage of women clients	Number of active female borrowers / Number of active borrowers	MIX Market
	Total assets	Total assets, expressed in logarithms	MIX Market
	Savings	Dummy variable (1 if MFIs collect savings, 0 if not)	MIX Market
	Operational Self-Sufficiency (OSS)	Ratio of financial revenues / operating expenses, financial expenses, and loan loss provision expenses	MIX Market
	Operating Expense Ratio (OER)	Operating expenses over gross loan portfolio	MIX Market
	Portfolio-at-Risk ratio over 30 days (PAR30)	Portfolio at risk over 30 days or more / gross loan portfolio	MIX Market
	Lerner Index	Price minus marginal cost, divided by price	Based on MIX Market
Country-level variables	*Interest rate cap*	Dummy variable (1 if rates are capped, 0 if not)	Own data
	Herfindahl-Hirschman Index	Herfindahl-Hirschman Index, based on gross loan portfolio	Based on MIX Market
	GDP growth rate	GDP growth rate	WDI
	Labor force	% of economically active people in the country	WDI
	Inflation	Inflation rate	WDI
	Population density	Inhabitants per km^2	WDI
	Remittances	Remittances received over GDP	WDI
	Credit to GDP ratio	Domestic credit over GDP	WDI
	ATM	Number of ATMs per 100 000 inhabitants, expressed in logarithms	WDI
	Control of corruption *Government effectiveness* *Rule of Law*	Aggregate governance indicators of quality of institutions	WGI

Appendix 2. Use of interest rate caps around the world (2015-2018)

Countries with cap(s) during the whole period	N	Countries without cap during the whole period	N	Countries that imposed caps during the period	N	Countries that removed caps during the period	N
Argentina	17	Bosnia and Herzegovina	17	Cambodia (2017)	71	Zambia (2016)	10
Armenia	25	Burundi	22	Georgia (2017)	18		
Azerbaijan	68	China (but soft cap)	24	Kenya (2016)	47		
Bangladesh	96	Democratic Republic of Congo	18	Nepal (2017, soft cap before)	38		
Benin	34	Costa Rica	26	Sri Lanka (2018, soft cap before)	7		
Bolivia	74	Dominican Republic (but soft cap)	31	Zimbabwe (2016)	3		
		Ethiopia (but soft cap)	7				
Brazil	71	Fiji	4				
Bulgaria	9	Ghana (but soft cap)	41				
Burkina Faso	34	Indonesia	21				
Cameroon	26	Jamaica	6				
Chile	10	Jordan	15				
Colombia	82	Kosovo	18				
		Lao PDR (but soft cap)	35				
Republic of Congo	3	Lebanon	4				
		Liberia	7				
Ecuador	197	Madagascar	30				
Egypt	19	Malawi	12				
El Salvador	15	Mexico	254				
Guatemala	44	Moldova	25				
Honduras	68	Mongolia	15				
India	307	Montenegro	5				
Ivory Coast	13						
Kazakhstan	17	Morocco	18				
Kyrgyz Republic	47	Nicaragua	88				
Mali	17	Nigeria	47				
Myanmar	36	Pakistan (but soft cap)	114				
Niger	27	Panama	21				
Paraguay	17	Peru	171				
Poland	2	Philippines	95				
Russia	62	Romania	4				
Senegal	43	Rwanda	21				
		Samoa	3				
		Serbia	5				
South Africa	3	Tajikistan	95				
Syrian Arab Republic	8	Tanzania	17				
Togo	15	Turkey	1				
Tunisia	4	Uganda	25				
Uruguay	1	Ukraine	1				
Venezuela	4	West Bank and Gaza	15				
Vietnam	43	Yemen	5				
Total	1558		1383		184		10

Appendix 3. Pooled-OLS regression of the total cost function

Independent variables	***lnC***
lnQ	0.493***
	(0.098)
lnW_1	0.173
	(0.172)
lnW_2	0.123
	(0.118)
lnW_3	-0.245
	(0.212)
Trend	-0.036
	(0.174)
$(lnQ)^2$	0.005
	(0.005)
$(lnW_1)^2$	-0.002
	(0.016)
$(lnW_2)^2$	-0.023***
	(0.007)
$(lnW_3)^2$	0.048**
	(0.023)
$Trend^2$	-0.014
	(0.056)
$lnQ*lnW_1$	-0.008
	(0.007)
$lnQ*lnW_2$	0.005
	(0.004)
$lnQ*lnW_3$	0.058*
	(0.009)
*lnQ*Trend*	0.006
	(0.006)
lnW_1*Trend	-0.004
	(0.012)
lnW_2*Trend	0.004
	(0.008)
lnW_3*Trend	-0.005
	(0.019)
ASSETS	0.548***
	(0.038)
PAR30	0.299**
	(0.136)
SAVINGS	0.112***
	(0.032)
Time dummies	Yes
Country dummies	Yes
Constant	-1.340
	(1.182)
R squared	0.972
# Observations	1,561
Overall significance (Prob > F)	0.000

Notes: Robust SEs in parentheses; Significance at 1% (***), 5% (***), and 10% (*); "Yes" if included.

Appendix 4. Complementary fixed-effect regressions with alternative dependent variables (robustness checks)

Independent variables	**ALS (adj. GNI p.c.)**	**ALS (no adjustment)**	**% Women borrowers**
RATECAP	0.233***	382.193***	-0.025**
	(0.057)	(147.409)	(0.013)
HHI	0.053	110.223	0.001
	(0.073)	(180.398)	(0.028)
*RATECAP * HHI*	0.202**	641.963**	-0.022
	(0.101)	(299.233)	(0.039)
MFI-level controls			
ASSETS	0.089***	191.426***	0.013
	(0.025)	(51 .215)	(0.013)
SAVINGS	0.007	42.691	-0.001
	(0.019)	(69.119)	(0.010)
OSS	-0.031	122.935	-0.009
	(0.042)	(111.191)	(0.013)
OER	-0.039	-107.344	0.012
	(0.042)	(90.525)	(0.010)
PAR30	0.078	3.753	-0.026
	(0.074)	(241.099)	(0.023)
Country-level controls			
GROWTH	0.127	-237.930	-0.111
	(0.335)	(826.245)	(0.158)
INFLATION	0.253	-1,137.217**	-0.059
	(0.198)	(514.497)	(0.101)
POP	0.002***	-15.725***	-0.001
	(0.002)	(3.696)	(0.001)
LABOR	1.603***	7,063***	0.225
	(0.481)	(1628.760)	(0.216)
REMITTANCES	0.878	1,018.492	-0.058
	(0.689)	(1,373.228)	(0.231)
CREDIT	0.155	1,410.439***	-0.034
	(0.099)	(347.073)	(0.050)
ATM	-0.416**	-550.264**	0.096**
	(0.164)	(263.134)	(0.046)
Time dummies	Yes	Yes	Yes
Constant	-1.202**	-2,096.759	0.275
	(0.567)	(1,510.115)	(0.230)
R squared	0.138	0.332	0.016
# Observations	1,906	1,906	1,640
# MFIs	809	809	748
Overall significance (Prob > F)	0.000	0.000	0.039

Notes: Significance at 1% (***), 5% (***), and 10% (*); "Yes" if included.

Appendix 5. Summary statistics for variables used in the cost function

Variable	Description	N	Mean	SD	Min	Max
Total cost	Sum of operating and financial expenses (USD)	2,569	2.03e+07	5.20e+07	347	6.64e+08
Gross loan portfolio	Gross loan portfolio (USD)	3,051	1.23e+08	4.21e+08	375	7.56+e09
Cost of labor	Personnel expenses / staff number (USD)	1,721	16,725.470	30,780.49	0	718,289.300
Cost of physical capital	Administrative expenses / net fixed assets	2,535	7.077	119.050	0	5961.813
Cost of financial capital	Financial expenses / borrowings	2,705	0.158	2.659	0	131.284
Output price	Revenues from loans / gross loan portfolio	2,260	0.351	2.848	0	135.273
Marginal cost	Marginal cost of lending 1 USD	1,607	0.096	0.081	0.007	1.400
Lerner Index	Price minus marginal cost divided by price	1,454	0.670	0.104	0.007	0.976