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Competitive Environment and Financial Stability in the Peruvian Microfinance System

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Abstract

This paper examines the relationship between competition and financial stability for Peruvian microfinance institutions, during the 2002-2016 period. Using the Panzar and Rosse H-statistic as well as the Boone indicator for the evaluation of competition, and the Roy Z-score as a proxy for financial stability, we find a non-linear relationship (inverted U-shaped) between competition and financial stability, which validates the Martínez-Miera and Repullo approach. Furthermore, we find that competition in the Peruvian microfinance system might increase even when market concentration increases; and, according to the H-statistic, the market structure that best fits this system is monopolistic competition.

JEL codes: L11, L22, L25, G21.
Key words: Competition, Panzar and Rosse H-statistic, Boone indicator, relevant market, financial stability, Z-score, microfinance.

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1. Introduction

Since the early 2000s, several factors have affected the competitive environment of the Peruvian Microfinance System (MFS), including the favorable macroeconomic environment for financial activities, and the regulatory changes led by the Superintendence of Banks, Insurance Companies and Private Pension Funds (SBS) to create a level playing field for market participants and to promote transparency of the information available in the market. In this context, the ongoing consolidation process observed in the MFS shows the dynamism of financial institutions to adapt to an increasingly competitive environment, in their effort to be in a better position to deal with this environment and to take advantage of market opportunities.

The study of competition is relevant due to its effects on market efficiency and innovation, on financial inclusion and financial stability. Lower prices, resulting from a competitive environment, may contribute to achieve a more inclusive financial market, since products and services become more accessible. However, in a competitive environment, lower prices, together with less prudent behavior of some financial institutions, may as well negatively affect financial stability.

Some indicators observed in the 2002-2016 period may be interpreted as signals of the increasingly competitive environment for microfinance institutions (MFIs) in Peru; for instance, the average lending interest rates charged by MFIs which dropped from 38% to 24% between 2002 and 2016; and the declining MFIs' market share, together with the increasing number of financial intermediaries in every Peruvian region. In this context, competition may have adversely influenced on prudent behavior of some MFI (who were prompted to take on more risks), affecting the less efficient ones and those lacking sound strategies to move into a more competitive environment. In the aggregate, this situation exacerbated by the 2009 global financial crisis, which contracted the Peruvian aggregated demand, resulted in a decline of MFIs' profits, mostly explained by the deterioration of their loan portfolio. Unless corrective measures are stressed, there may be long term stability implications for MFIs, which are very important financial intermediaries mainly oriented to low-income populations.

Motivated by these stylized facts, this paper analyzes the relationship between competition and MFI´s financial stability, in the 2002-2016 period, with the final aim of deriving policy recommendations to strengthen MFIs. The study starts with an evaluation of both the degree and the evolution of competition in those credit markets where MFIs participate, followed by the analysis of MFI financial stability. Competition is approached by the H-statistic proposed by Panzar and Rosse, and the Boone indicator; while the financial soundness of individual MFIs is estimated using the "Z-score" posed by Roy (1952). Then, to analyze the relationship between competition and stability, we hypothesize an inverted U-shaped relation, following the Martínez-Miera and Repullo (2010) paper.

This study provides two meaningful contributions to the empirical microfinance literature. First, this study proposes a definition of the relevant market for analyzing the impact of competition on the Peruvian MFS, including the identification of the main non-MFI competitors whose financial activity impose pressures on MFIs. Second, this study fills in the gap in the literature, providing empirical analysis of competition and financial stability in the environment of the Peruvian microfinance sector.

The remainder of this paper is organized as follows. Section 2 describes the competitive environment of MFIs; section 3 depicts the stylized facts about the Peruvian MFS; section 4

presents the analytical framework, while section 5 introduces the empirical methodology. Then, section 6 and 7 discusses the main results and conclusions.

2. Competitive Environment of the Peruvian Microfinance Institutions

The focus of this study is on the analysis of how the competitive environment affects the Peruvian MFS, regulated and supervised by the SBS. This sector is comprised of financial institutions specialized on micro and small scale enterprise (MSE) lending[3], which are: Municipal Institutions (*CMs,* for its acronym in Spanish), Rural Savings and Loans Institutions (*CRACs,* for its acronym in Spanish), Micro and Small Enterprise Development Entities (*EDPYMEs*, for its acronym in Spanish), MiBanco –a microfinance bank-, and specialized finance companies[4].

In order to analyze the boundaries of competition for MFI, it is necessary to characterize the "relevant market". According to the European Union legislation (1997), this market comprises all products which consumers (the demand) may find interchangeable or substitutable within a territory were the firms (the supply) compete delivering those product under reasonably homogeneous conditions.

The demand-side substitution takes place when, in response to changes in one product conditions, customers switch to another product that also satisfies (closely enough) their preferences and needs. In credit markets, changes in effective interest rates and other contract terms may encourage customers to move from one product to another; however, there is not a clear cut definition for "the" product, and the understanding of the relevant market where competition takes place in the context of microfinance goes beyond the substitution criterion. First, as observed in the 2002-2016 period, MFIs customers have mostly demanded MSE and consumption loans; which may have been used interchangeably, considering that MFI customers are usually informal, self-employed and their household and business accounts are frequently mixed. Secondly, MFI customers are increasingly taking on more than one debt, specially coming from consumer credit institutions, who take advantage of information transparency about customers´ performance. As a result, in practice, MFIs compete for the customer priority to pay. Taking into account these considerations, the relevant market in this study will comprise both MSE and consumption loans.

On the supply-side, most firms in the Peruvian market can deliver a variety of products, including MSE and consumer credit; however, they may be oriented to different income segments of the market. Furthermore, for the potential MFI competitors, the conditions of competition may be reasonably homogeneous, because different factors have contributed to the reduction of entry barriers to serve MFI customers. Some of these factors are: MSE lending technology become more available in the market due to MFI staff mobility among specialized and non-specialized institutions, and the contracting of training and advisory services; more comprehensive customer information revealed by Credit Bureau, which facilitates "stealing customers"; and the elimination of regulatory barriers for MFI geographical expansion, beyond their original regions.[5]. To a certain extent this measure has reduced market segmentation.

To all the considerations above, we add some criteria to approach to homogeneous products and further characterize the segment of the market served by MFIs. A financial institution is a competitor of MFIs if it provides MSE or consumer loans that fulfills the following two criteria: i)

[3] A specialized microfinance institution (MFI) is that whose MSE loan portfolio accounts for 50% of the total loan portfolio, on average, during the 2003-2016 period.
[4] They are Confianza, Compartamos, Qapaq, Proempresa and Credinka.
[5] We only allude to the geographical presence, in so far as virtual credit transactions are still incipient in Peru.

the average loan do not exceed the median[6] of the average MFI loan, plus one standard deviation[7]. Note that the average MFI loan is usually lower than that of a non-MFI; and (ii) the lending interest rate for the loan offered is at least the median of the average lending interest rate charged by MFIs minus one standard deviation[8]. It is observed that MFI average lending interest rates are typically higher than those charged by non-MFIs, due to the higher average costs associated with small loans and the high risk profile of their customers (usually informal, with no credit history nor assets, than can be pledge as traditional collaterals).

Under these assumptions, the relevant competitive market for MFIs comprises 58 institutions that have operated between the 2002-2016 period; among them 39 are MFIs and the remaining 19 are non-MFIs, mostly specialized in consumer loans (see Huayta et al (2017)).

3. Stylized Facts

3.1. Competitive environment of the MFIs

The structure of the Peruvian microfinance market has evolved in the last decades, with numerous institutions entering into the market, dating back as far as the early eighties, under different licenses and ownership schemes, some of them furthered by the government by using tax incentives. The government objective was to ensure the existence of a diversity of financial service providers to attend the demands of low-income households and firms. More recently and particularly in the period under study, different factors have contributed to shape an increasingly competitive environment for MFIs. These factors may have been: the favorable macroeconomic conditions, changes in the legal and regulatory framework, as well as the dynamism of financial institutions. First, sustained GDP growth and price stability depicted a solid macroeconomic environment between 2002 and 2016, boosting the activity in the financial sector.

Secondly, with the aim of promoting a level playing field in the financial market, the SBS removed regulatory barriers for MFIs; in 2002, allowing MFI to open branches nationwide, beyond their original regional domains and, in 2008, authorizing MFI to perform a wider range of operations[9]. In addition, the SBS took several measures to improve financial transparency to enhance efficiency and to protect consumers; the following are the more important ones: i) since 2004, the SBS´s credit bureau has revealed information about performing borrowers, in addition to the information of non-performing ones, with the effect of reducing information asymmetry for the benefit of both risk management as well as competition; ii) since 2002, the SBS has issued regulations to ensure full disclosure of information about financial services, and started the implementation of preventive and corrective measures to ensure transparency and fairness in the contractual process. Regulations required the publication of the terms and conditions of the financial services supplied, including effective costs, with the aim of improving consumers' capabilities to make well-informed decisions in an environment of consumer protection and increasing competition; (iii) financial institutions in general, have reacted to market opportunities (see Huayta et al (2017)) within a

[6] Since the average loans and the lending interest rates are left-skewed distributions (except for average loans in small loans, and lending interest rates in micro loans), the central tendency statistic that best represents those variables is the median.

[7] We perform similar analysis using two and three standard deviations. The results suggest that, taking into account these scenarios, we should include as MFI competitors some non-MFIs which clearly serve high-income customers. That is why we include only the non-MFI obtained from the one standard deviation analysis.

[8] Means tests of the average loans and lending interest rates support our choice. In these tests, we verify that MFIs grant significantly lower loans and charge significantly larger interest rates than non-MFI competitors.

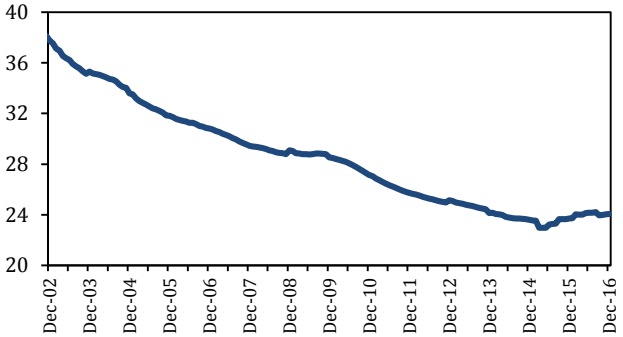
[9] In this way, *CMACs* were allowed to open branches in Lima, introducing more dynamism to the market for low income segments of the population, in the lending side, and for all segments in the deposit side.

favorable regulatory environment. On the one hand, some commercial banks, motivated by the attractive profitability ratios showed by MFIs, carried out a downscaling strategy, at first by attempting to directly provide services to low-income customers, and since 2007 by acquiring MFIs. The acquired MFIs were allowed to remain separate, with their capital strengthened and having access to their parent company's diverse funding and capital resources. On the other hand, some *EDPYMEs,* non-deposit taking institutions, have carried out an upgrading strategy, applying for another license (financial company) which allows them to mobilize deposits from the public; and finally, (iv) mergers and acquisitions of MFIs, oriented to achieve better market positioning or as an exit strategy, have being also frequent during the study period. Overall, these changes would allow MFI to benefit from scale and scope economies positioning them to face competition.

3.2. Competition signals and financial performance of MFIs

Competition may be thought as the rivalry among service providers striving to achieve profit and market share increases by varying their products, prices and other contract conditions to attract consumers. Hence, one may find a dynamic case scenario, with changing financial indicators, were financial institutions move strategically and enter or exit the market. For MFIs as a whole, some signals observed in the last 15 years would seem to indicate that they were facing higher levels of competition. In the first place, it was observed an increasing number of institutions operating in the regions and, associated to this, lower market shares of MFI that were traditionally leaders in their regions. This is the case of CMACs, which in early 2002 had most of the market shares in regional marketplaces of MSE and consumption loans; however, their presence got gradually reduced in favor of other intermediaries. This may suggest the importance of undertaking a thorough competition analysis at the regional level, unfortunately, the lack of information about costs at the regional level prevents such analysis. Secondly, during the period of study, average lending interest rate (measured by the implicit interest rate) charged by MFI showed a decreasing trend, declining from 38% in 2002 to 24% in 2016 (**Figure 1**). Thirdly, anecdotal evidence tells about non-specialized institutions practices, of offering MFIs performing borrowers to repay their loans and to borrow from them at lower interest rates.

Figure 1. MFS: Evolution of the implicit lending interest rate[10] (%)



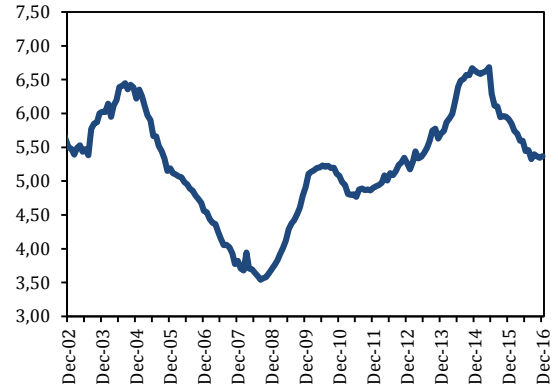
Source: SBS
Own elaboration

These developments may have affected MFIs, showing a decline in the quality of their loan portfolio as well as in their profit levels, which may risk their financial stability. The increase of MFIs past-due loans as a percentage of total loans since 2008 (**Figure 2**) may suggest a change in the risk profile of their loan portfolio, as a consequence of losing good costumers or reducing their credit

[10] Lending interest rates are the average implicit rates, calculated from financial statements. They are the sum of annualized financial revenues, divided by the 12-months moving average of loans.

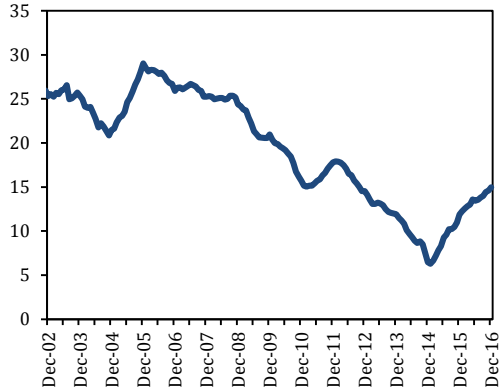
standards, probably pressured by the increasing competition and credit deceleration. Likewise, returns on equity (ROE) manifest a decreasing trend from 2005 to 2014 (**Figure 3**). Nonetheless, both the loan portfolio quality and the ROE started recovering in 2014, as a consequence of MFIs' correction in their policies, towards a more stringent admission credit policies, and the consolidation and restructuring processes involving MFIs.

Figure 2. MFS: Evolution of past-due loans (%)*



Source: SBS.
Own elaboration.
***** Seasonal adjustment using the X11-ARIMA model of Census X13.

Figure 3. MFS: Evolution of the ROE (%)



Source: SBS.
Own elaboration.

4. Literature review

4.1. Relationship between competition and financial stability

It is found in the literature two opposing views on the relationships between competition and stability in financial markets: (i) competition-fragility[11], which proposes a negative relationship; i.e, higher competition is associated with higher risks and hence more fragility; and (ii) competition-stability[12], advocating for a positive relationship between the two variables. In face of these conflicting views, a new theory emerged proposing that the relationship can be in both directions. In this spirit, Martínez-Miera and Repullo (2010) developed a static model of Cournot competition, determining a U-shaped relationship between competition and bankruptcy risk. The authors showed that, in a competitive environment, the reduction of financial revenues (due to the initial fall of lending interest rates) is counteracted by the increase of loan revenues from new borrowers with good risk profiles, improving bank profits (positive relationship). Thereupon, as long as competition intensifies, the accentuated fall of lending interest rates affects the dynamism of financial revenues from good quality loans (negative relationship). Moreover, if banks relax their credit standards trying to attract more customers, their financial revenues will further deteriorate.

Several authors support the Martínez-Miera and Repullo approach. In this way, Berger et al. (2008) studied the relationship between these two variables for 23 industrialized countries, analyzing stability proxied by the "Z-score", fragility approached by non-performing loans and competition evaluated with the Lerner index. These authors showed empirical evidence in favor of both the competition-fragility approach and the competition-stability approach. Likewise, in 2009, Pérez

[11] Marcus (1984), Dermine (1986), Saunders and Wilson (1996), Marquez (2002), Salas and Saurina (2003), Levy and Micco (2003), Jimenez et al. (2007), Araya and Pino (2008), and Beck et al. (2013).
[12] Boyd and De Nicoló (2005), Boyd et al. (2006), De Nicoló and Loukoianova (2007), Beck and Laeven (2008), and Cihak et al. (2006).

analyzed the relationship for the Dominican Republic financial system using the same fragility and stability indicators, and the H-statistic. They determined similar results to Martínez-Miera and Repullo's study. Similarly, Tabak et al. (2012) found a non-lineal relationship between competition and stability when analyzing a group of Latin American countries including Peru, through Boone indicator and "Z-score" to proxy for competition and stability, respectively. Furthermore, Fernández and Garza-García (2015) verified which of these theories (either stability or fragility) prevails in the Mexican financial system; employing the same indicators as Berger et al. (2008), these authors found evidence to sustain both theories.

Therefore, there is an ample literature evaluating the relationship between competition and stability in financial markets; in some of them the Peruvian financial system is included within a group of countries[13]. However, although Peru has being worldwide recognized for having the best environment for microfinance development, specific studies on the relationship of competition and stability is scarce within the microfinance context. The need to better understand the environment in low-income financial markets motivates this study.

4.2. Competition and financial stability indicators

4.2.1 Financial stability

A number of models measures stability in the financial systems; some of them study stability of the financial system as a whole, while others do so at the entity level. They use accounting information, and capital markets and/or macroeconomic data. Credit scores, probability of default, or other indicators that reflect the whole business stability are used as an approximation to individual stability. In this research, we analyze financial stability individually, for each MFI, using accounting information. We use the "Z-score", a financial soundness indicator introduced by Roy in 1952, to proxy for stability. According to De Nicoló (2001), insolvency is defined as the likelihood that losses exceed capital:

$$p(U < -C) = p(ROA < -C/A) = \int_{-\infty}^{C/A} \varphi(ROA)\, d(ROA)$$

where C/A is the capital to assets ratio, ROA the return on assets ratio, $\varphi(ROA)$ is the probability distribution function of MFI profits, and $\overline{ROA}$ and σ_{ROA}^2 are the first and the second moments of this distribution, respectively. Using the Chebyshev's inequality, Roy (1952) proved the maximum probability of default is:

$$p(ROA < -C/A) \leq \frac{{\sigma_{ROA}}^2}{\left(\overline{ROA} + \frac{C}{A}\right)^2} = \frac{1}{Z^2}$$

where $Z = \frac{\overline{ROA}+C/A}{\sigma_{ROA}}$. Because the Z-score is inversely related to the likelihood of insolvency, it is considered as a proxy of stability (the higher the value of Z, there is more stability). The "Z-score" refers to the number of standard deviations that ROA should decrease above its expected value, before its capital ends up and the entity becomes insolvent (Roy, 1952; Hannan and Henwick, 1988; Boyd, 1993; De Nicoló et al., 2006).

Notwithstanding, the quality of the indicator will strictly depend on the truthfulness of financial statements. In addition, this individually determined indicator does not consider the interconnectedness risk (which may trigger a contagion effect or domino effect), thus representing

[13] Beck et al. (2013), Cihák et al. (2006) and Tabak et al. (2012).

an important limitation, because the insolvency of some entities might influence on the stability of others.

4.2.2 Competition

There are two approaches in the literature on the measurement of market competition, the structural approach and the non-structural approach. The first comprises the structure–conduct–performance paradigm and the efficiency hypothesis, as well as other methodologies derived from the industrial organization theory (Bikker and Haaf, 2000). In contrast, the non-structural approach which emerged from the new empirical industrial organization (NEIO), advocates for microeconomics-based methods derived from formal approaches like the firm's optimization problem. Under this approach, we can distinguish two generations.

In the first generation of NEIO, several authors have based their models on the neoclassical competition, upon the oligopoly theory. Firstly, using foundations of the Cournot model (1838) ideal competition was defined not as a long run equilibrium situation, but as an equilibrium condition by itself (León, 2014). In his model, Cournot assumed that the firm's decision variable is the output, simultaneously determined with other firms' outputs in the market (in a static way). Hence, there is a monopoly only if there is one firm; whereas if there are many homogeneous firms in equilibrium, the market tends to perfect competition. Secondly, Bertrand (1883), Chamberlin (1950) and Robinson (1933) analyzed distinct market structures existing between perfect competition and monopoly, taking into account advertising expenditure and product differentiation (Silva, 2001). In this regard, literature has widely analyzed models such as conjectural variation, Lerner, and Panzar and Rosse.

We use the competition indicator posed by Panzar and Rosse (H-statistic). This methodology proposes a model to determine market competitive structures, varying from monopoly to perfect competition (see **Table 1**). In general, optimality conditions are derived from the firms' profit maximization problem $\pi(y, z, w, t) = R(y, z) - C(y, w, t)$, where y is the vector of products, z the vector of exogenous variables of the revenue function R, w the vector of factors of production and t the vector of exogenous variables of the cost function C. For more details about the H-statistic, see Panzar and Rosse (1977, 1982 and 1987). Under long run equilibrium conditions:

Table 1. Panzar and Rosse H-statistic

H-statistic	Market structure
$H \leq 0$	Monopoly or collusive oligopoly
$0 < H < 1$	Monopolistic competition
$H = 1$	Perfect competition

Source: Panzar and Rosse (1987).

Empirical papers using the Panzar and Rosse methodology found evidence of monopolistic competition structure in international financial markets (Gutiérrez, 2007) and in the Peruvian financial market (Claessens and Laeven, 2003; Yildirim and Philippatos, 2007; and Levy and Micco, 2003). Moreover, Céspedes and Orrego (2014) found an H-statistic around 0.5 (monopolistic competition) for the Peruvian banking industry during 2001–2013. Likewise, when broadening the analysis towards Municipal savings and loans institutions, they evidence a higher degree of competition with regard to the banking industry. In the same line, Del Pozo (2008) analyzed

competition for the Peruvian MFS during 2003-2008; estimating an H-statistic between 0.412 and 0.475, he found a monopolistic competition structure as well.

The second generation of the NEIO has played a key role to analyze the dynamics of competition. According to León (2014), this generation is founded on the creative-destruction principle, which implies that a market is competitive as long as competitors are aggressive enough to encourage other firms to enhance it (in terms of management, quality, services, better products, lower prices, etc.). Initially, firms get monopolistic power and benefits, as far as competitors start to imitate and/or overcome them.

This competition approach has recently influenced the industrial organization literature, where the Boone's model has been the most noteworthy. Boone developed a model to evaluate competition by considering firms' efficiency and performance. In his model, Boone proposes a profit function $\pi(n_i, N, I, \theta) = p(n_i, N, I, \theta)^T q(n_i, N, I, \theta) - C[(n_i, N, I, \theta), n_i]$. Where N stands for the aggregated efficiency index as a function of efficiency levels $n_1(more\ efficient) \geq n_2 \ldots \geq n_I(less\ efficient)$; I is the number of firms in equilibrium; θ denotes the aggressiveness of firms in their market; p is the price; q the output; and C the cost function. For more details about the derivation of this indicator, see Boone (2000, 2008; and Boone et al. 2005). Empirically, this theoretical proposal can be verified with:

$$ln\, s = \alpha + \beta AC + \varepsilon \quad \ldots (1)$$

where "s" represents market shares and AC the average cost. The theoretical model establishes that there is a close linkage between competition and efficiency. More competition will bring more profits to the more efficient financial institutions in comparison with the less efficient ones, because the former can benefit from their cost advantages and be more aggressive. In this sense, the Boone indicator (β) shows how much market share improves as efficiency increases (lower average cost); and thus β has a negative sign. This indicator is determined based on the efficient-structure hypothesis posited by Demsetz (1973); for this reason, there is a growing interest in the Boone indicator in contrast to other measures of competition, especially when analyzing the evolution of competition.

In the empirical literature, the use of Boone's methodology is scarce[14]. Within this limited literature in Peru, Tabak et al. (2012) found evidence regarding the Peruvian financial system among 10 Latin American countries between 2001 and 2008. The results suggest that the Peruvian banking sector is the most competitive among the analyzed countries. On the other hand, Aguilar (2014) used the Boone indicator to study competition in the microcredit Peruvian market during 2003–2009. The author determined an increase in competition for the microenterprise loan market.

5. Empirical approximation

The analysis is based on a large panel, with monthly information from 2002 to 2016, for 19 non-MFI and 39 MFI in the competition analysis. Regarding the stability analysis, we use quarterly information from 2002 to 2016, for the 39 MFI. The data is an unbalanced panel as it considers incumbent entities during the analyzed period as well as those entities that no longer operate due to liquidation or mergers.

[14]Van Leuvensteijn et al. (2007), Cihak et al (2006), Castellanos and Garza-García (2013)

5.1. Indicators of competition

5.1.1 Panzar and Rosse H-statistic

Following Claessen and Laeven (2003); Levy Yeyati and Micco (2007); and Del Pozo (2008), the estimation of the H-statistic to measure the level of competition is obtained from the following equation:

$$\ln(P_{it}) = \beta_0 + \beta_1 \ln(w_{1,it}) + \beta_2 \ln(w_{2,it}) + \beta_3 \ln(w_{3,it}) + \beta_4 \ln(w_{4,it}) + W + u_i + \varepsilon_{it} \dots (2)$$

where P is the lending interest rate of the entity that belongs to the relevant market; w_1 denotes the labour cost; w_2 funding cost; w_3 cost of capital; w_4 loan loss provisions cost; and W represents the vector of control variables, which includes the logarithms of the capital to assets ratio, exchange rate (er) and interbank interest rate $(ibkir)$; u_i represents the compound disturbance term and ε_{it} the idiosyncratic error term. In relation to the cost of capital, we consider the shareholder's opportunity cost[15] estimated with the annual average rate of fixed term deposits offered in the financial system. On the other hand, we include the loan loss provisions cost that entities reasonably separate for expected losses. Although provisions do not entail a real cash outflow, its accounting treatment reduces the available capital to lend; for this reason, it is considered as a source of costs. These variables are detailed in **Appendix 1**.

The H-statistics is based on factor price elasticities:

$$H = \sum \frac{w_{j,it}}{P_{it}} \frac{\partial P_{it}}{\partial w_{j,it}} = \sum \frac{\partial P_{it}/P_{it}}{\partial w_{j,it}/w_{j,it}} = \sum \frac{\partial \ln(P_{it})}{\partial \ln(w_{j,it})} = \beta_1 + \beta_2 + \beta_3 + \beta_4 \dots (3)$$

Nevertheless, the conclusions of the Panzar and Rosse model will only be valid once the long run equilibrium condition is met (similar to Claessen and Laeven, 2003).

$$\ln(ROA_{it}) = \theta_0 + \theta_1 \ln(w_{1,it}) + \theta_2 \ln(w_{2,it}) + \theta_3 \ln(w_{3,it}) + \theta_4 \ln(w_{4,it}) + S + u_i + \varepsilon_{it} \dots (4)$$

where ROA denotes the profit variable. Thus, in the long run equilibrium, the following should be fulfilled $\theta_1 + \theta_2 + \theta_3 + \theta_4 = 0 \dots (5)$

According to Céspedes and Orrego (2014), the evolution of competition is determined founded on equation (2), including the vector of quarter dummy variables (D), which takes the value of 1 during the quarter Tr, and zero, otherwise.

$$\ln(P_{it}) = \beta_0 + \sum_{Tr} \left(\beta_{1_{Tr}} D_{Tr} \ln(w_{1,it}) + \beta_{2_{Tr}} D_{Tr} \ln(w_{2,it}) + \beta_{3_{Tr}} D_{Tr} \ln(w_{3,it}) + \beta_{4_{Tr}} D_{Tr} \ln(w_{4,it})\right) + S + u_i + \varepsilon_{it} \dots (6)$$

Thus, the H-statistic for each quarter is:

$$H_{Tr} = \beta_{1_{Tr}} + \beta_{2_{Tr}} + \beta_{3_{Tr}} + \beta_{4_{Tr}} \dots (7)$$

[15] Although this is differentiated by entity and represents a higher risk than the fixed term deposit, we use this indicator due to limitations in the required information to develop a more suitable methodology such as the capital asset pricing model (CAPM).

5.1.2 The Boone Indicator

The Boone indicator is based on the estimation of the marginal cost. This is obtained from a costs function, whose inputs and outputs can be defined from two approaches. The first is the production approach (Benston, 1965; Bell and Murphy, 1968), where the number of outputs (loans and deposits) is a result of the use of inputs (capital and labour). This approach cannot be used in this study because the information on the number of financial products is not available[16]. Instead, this study will follow the financial intermediation approach (Benston et al., 1982), under which financial institutions receive funds from depositors to offer loans, so that production costs must include financial and operative costs.

$$\ln C_{it} = \beta_0 + \sum_{k=1}^{4} \beta_k \ln w_{k_{it}} + \beta_5 \ln y_{it} + \frac{1}{2}\sum_{k=1}^{4}\sum_{j=1}^{4} \delta_{kj} \ln w_{k_{it}} \ln w_{j_{it}} + \frac{1}{2}\delta_{55} \ln^2 y_{it} + \sum_{k=1}^{4} \delta_{k5} \ln w_{k_{it}} \ln y_{it} + \theta_1 \ln(trend) + \theta_2 \ln^2(trend) + NonIMF_i + Entity + \varepsilon_{it} \quad \dots (8)$$

In this line, marginal cost (MC) is obtained through an empirical specification similar to Van Leuvensteijn et al. (2007)'s, based on a translog cost function that is derived from a second-order Taylor approximation around its mean.

In order to ensure linear homogeneity, this function must fulfill the following symmetry and linearity restrictions: $\delta_{kj} = \delta_{jk}$; $\sum_{k=1}^{4} \beta_k = 1$; $\sum_{k=1}^{4} \delta_{kj} = 0$; $\sum_{k=1}^{4} \delta_{k5} = 0$

After solving equation (8), the result is:

$$\begin{aligned}\ln C_{it} = {} & \beta_0 + \beta_1 \ln w_{1_{it}} + \beta_2 \ln w_{2_{it}} + \beta_3 \ln w_{3_{it}} + \beta_4 \ln w_{4_{it}} + \beta_5 \ln y_{it} + \frac{1}{2}\delta_{11} \ln^2 w_{1_{it}} + \frac{1}{2}\delta_{22} \ln^2 w_{2_{it}} \\ & + \frac{1}{2}\delta_{33} \ln^2 w_{3_{it}} + \frac{1}{2}\delta_{44} \ln^2 w_{4_{it}} + \frac{1}{2}\delta_{55} \ln^2 y_{it} + \delta_{12} \ln w_{1_{it}} \ln w_{2_{it}} \\ & + \delta_{13} \ln w_{1_{it}} \ln w_{2_{it}} + \delta_{14} \ln w_{1_{it}} \ln w_{2_{it}} + \delta_{23} \ln w_{1_{it}} \ln w_{2_{it}} + \delta_{24} \ln w_{1_{it}} \ln w_{2_{it}} \\ & + \delta_{34} \ln w_{1_{it}} \ln w_{2_{it}} + \delta_{15} \ln w_{1_{it}} \ln y_{it} + \delta_{25} \ln w_{2_{it}} \ln y_{it} + \delta_{35} \ln w_{3_{it}} \ln y_{it} \\ & + \delta_{45} \ln w_{4_{it}} \ln y_{it} + \theta_1 \ln(trend) + \theta_2 \ln^2(trend) + NonIMF_i + Entity + \varepsilon_{it} \dots (9)\end{aligned}$$

where C denotes the total cost of an entity that belongs to the relevant market and y corresponds to the output. The w variables represent the same input costs used in the H-statistic estimation. The trend variable $(trend)$ is also included, together with its squared value to control for the effects of technological changes. Additionally, the dummy $NonMFI$ is included to obtain the specific characteristics of the non-MFI competitors of MFI.

The estimation of total cost is carried out through constrained ordinary least squares using dummy variables at the entity level $(Entity)$, akin to a panel data model with fixed effects. Once the total costs function is estimated, marginal cost is obtained from equation (9): $MC_{it} = \frac{\partial(C_{it})}{\partial y_{it}} = \frac{C_{it}\partial(C_{it})/C_{it}}{y_{it}\partial y_{it}/y_{it}} = \frac{C_{it}}{y_{it}}\frac{\partial(\ln C_{it})}{\partial \ln y_{it}}$

$$MC_{it} = \frac{C_{it}}{y_{it}}\left(\beta_5 + \delta_{55} \ln y_{it} + \delta_{15} \ln w_{1_{it}} + \delta_{25} \ln w_{2_{it}} + \delta_{35} \ln w_{3_{it}} + \delta_{45} \ln w_{4_{it}}\right) \dots (10)$$

[16] Although the number of credit accounts could be approximate using the existing credit bureau, it would not be exact since this bureau does not provide information at the loan operation level. Meanwhile, the number of deposit accounts could not be approximate calculated due to the standing legislation about bank secrecy in Peru.

Unlike some other authors[17] who use average cost in the Boone's equation, we use marginal cost, as it best reflects efficiency[18]. Following Van Leuvensteijn et al. (2007) and Aguilar (2014) to analyze the evolution of competition, a Boone indicator is determined for each quarter, where D is the vector of quarterly dummy variables, equal to 1 in the Tr quarter and zero, otherwise. Both considerations are introduced in Boone's equation (equation (1)), that results in:

$$ln\, s_{it} = \alpha + \sum_{Tr} (\beta_{Tr} D_{Tr} \ln MC_{it}) + u_i + \varepsilon_{it}, \ldots (11)$$

where s_{it} denotes the shares of each entity in the credit market.

5.2. Competition and financial stability of microfinance institutions

In order to evaluate the inverted U-shaped relationship, we introduce the competition indicators and their quadratic terms into the quarterly panel data model:

$$Z_{it} = \beta_0 + \beta_1 K_t + \beta_2 K_t^2 + \beta_3 \pi_t + \beta_4 \sigma_t + \beta_5 \ln A_{it} + \beta_6 SME_{it} + \beta_7 y_{it} + \beta_8 Liq_{it} + \beta_9 Eff_{it} + u_i + \varepsilon_{it} \ldots (12)$$

The financial stability at the entity level is determined with "*Z-score*"[19] $\left(Z_{it} = \frac{\overline{ROA}_{it} + \frac{C}{A_{it}}}{\sigma_{ROA_{it}}}\right)$, where C is capital and A assets. For each entity, we calculate the first moment $\left(\overline{ROA}_{it}\right)$ and the second moment $\left(\sigma_{ROA_{it}}\right)$ of ROA. As there is no consensus regarding the adequate period for building "Z-score", we propose three reference periods: the past year $\left(Z_{1_{it}}\right)$, the past two years $\left(Z_{2_{it}}\right)$ and the past three years $\left(Z_{3_{it}}\right)$.

The competition variables (K_t) are those previously estimated. Moreover, the quadratic term (K_t^2) will allow the evaluation of the inverted U-shaped relationship between competition and stability. The relationship between stability and K_t is expected to be positive, whereas negative with K_t^2. Regarding control variables, we consider the inflation rate (π_t) and the economic activity, measured by GDP (σ_t). It is expected a negative association of MFIs financial stability with inflation, while a positive one with GDP. We also included internal variables to control for observable characteristics of MFI (based on the empirical studies of Araya and Pino, 2008; Beck et al., 2013; Berger, 2008; and Pérez, 2009):

a. MFI asset size, natural logarithm of the MFI assets $(ln\mathrm{A_{it}})$, to evaluate the importance of economies of scale. A positive relationship is anticipated.
b. The share of MSE loans in the MFI total loan portfolio (SMEit) is used to assess the effect of the degree of specialization. The expected effect is uncertain because although specialization increases the efficiency on the main activity, it reduces diversification and generates more vulnerability towards shocks that affect the main activity.
c. Credit risk, past − due loans ratio (PDL_{it}); to wit the proportion of past-due portfolio in the total loan portfolio. A negative relationship is expected.
d. Liquidity risk, liquidity ratio (Liq_{it}), to a control for liquidity risk management of the MFI. The expected sign is uncertain (Molyneux and Thornton, 1992; and Bourke, 1989) since, even

[17] Boone et al. (2005), Cihak et al (2006), and Castellanos and Garza-García (2013).
[18] Similar to Van Leuvensteijn et al. (2007) and Tabak et al. (2012).
[19] The Z-score might be approximated by $Z_{it} = \frac{\overline{RORWA}_{it} + \frac{RC}{RWA_{it}}}{\sigma_{RORWA_{it}}}$, where RC corresponds to regulatory capital, RWA to risk-weighted assets, and RORWA is calculated as the net profits over the RWA.

though it is positive for stability that liquid assets cover short-term liabilities, excess of liquidity entails less profit due to the opportunity cost of such funds.

e. Efficiency, proportion of labour expenses in the total loan portfolio (Eff_{it}). A positive relationship is expected.

Additionally, u_i represents the compound disturbance term and ε_{it}, the idiosyncratic error term. The construction of each variable is detailed in **Appendix 1**. The summary of statistic is the in **Appendix 2**.

6. Empirical Results

Initially, we performed some tests for contrasting the presence and assessment of seasonality in every variable of each entity, using the X11-ARIMA model from the Census X-13 process. We analyzed the following tests in order to determine whether the variables needed seasonal adjustment: F-test for stable seasonality, non-parametric test of Kruskal-Wallis, mobile seasonal contrast and combined contrast of identifiable seasonality. Meanwhile, we use Q indicator to measure the quality of seasonal adjustments. According to these tests, 91% of the series required a seasonal adjustment, and 39% of them had an appropriate seasonal adjustment.

Consequently, we evaluated some unit root tests for panel data, considering intercept and trend, using the methods proposed by Levin, Lin, and Chu; Breitung; Im, Pesaran, and Shin; Fisher augmented Dickey–Fuller; and Fisher Phillips-Perron (see **Appendix 3**). Under these tests, we conclude that there is not enough evidence for unit root presence, except in three variables (loans, total cost and assets), significant at the 0.1 level. However, considering the logarithms of these three variables, there is no detection of unit roots at the 0.01 significance level. With regard to the aggregated time series, we carried out the seasonal adjustment to the cost of capital, interbank interest rate, exchange rate, GDP and inflation rate. After evaluating some unit root tests, such as the augmented Dickey–Fuller, Phillips-Perron, Elliot-Rothenberg-Stock and Kwiatkowslki-Phillips-Schmidt-Shin, we cannot reject the presence of a unit root in GDP, inflation rate, and exchange rate; therefore, first differences were needed to make them stationary.

6.1. Competition

6.1.1 Level of competition

First, we verify the existence of the long run equilibrium (equation 5) in the Panzar and Rosse methodology using a fixed effects model and correcting for autocorrelation, heteroskedasticity and correlation among panels (with Driscoll-Kraay standard errors), as a result of the Hausman test[20]. Thus, the $\theta_1 + \theta_2 + \theta_3 + \theta_4 = 0$ hypothesis cannot be rejected; verifying the long run condition (0.01 significance level). Then, the level of competition in the MFS (Equation 3) is estimated using fixed effects (as suggested by the Hausman test) correcting for autocorrelation, heteroskedasticity and correlation among panels (with Driscoll-Kraay standard errors), to determine price elasticity of inputs. As shown in **Table 2**, the estimation of H $(\beta_1 + \beta_2 + \beta_3 + \beta_4 = 0.764)$ suggests that the monopolistic competition is the market structure that best fits the Peruvian MFS.

[20] In all regressions, in order to detect problems of autocorrelation and correlation among panels, we use a balanced panel considering only the institutions that have always operated in the market. Then, relevant conclusions of this sample are extended to the general database.

Table 2. H-statistic: Panzar and Rosse model

Variable	Coefficients
Ln (lab) β_1	0.375***
	(0.0321)
Ln (fund) β_2	0.313***
	(0.0253)
Ln (cap) β_3	0.0672**
	(0.0298)
Ln (prov) β_4	0.0086***
	(0.00300)
Ln(exchange rate)	-0.126
	(0.170)
Ln(interbank int. rate)	-0.0292
	(0.0228)
Ln (capital/asset)	0.0527**
	(0.0213)
Constant	1.589***
	(0.112)
N° observations	8,334
R^2	0.7525

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

6.1.2 Evolution of Competition

The evolution of competition is based on the H-statistic and the Boone indicator. The latter requires the estimation of the marginal costs (equation 10), derived from the total cost function (equation 9). We performed this estimation using constrained ordinary least squares with dummy variables at the entity level (with Huber-White sandwich robust standard errors), which resembles a data panel model with fixed effects (see **Table 3**). Therefore, using quarterly data, we determine the Boone indicator based on equation 11. Moreover, the H-statistic is also determined (equation 7), through fixed effects (as suggested by the Hausman test), correcting for autocorrelation, heteroskedasticity and correlation among the panels (with Driscoll-Kraay standard errors).

Table 3. Marginal cost estimation

Variable	Coefficients
Ln (labour)	0.6512***
Ln (funding)	0.2328
Ln (capital)	-0.1408
Ln (provisions)	0.2567***
Ln (loans)	1.0894***
Ln (labour)^2	0.0518***
Ln (funding)^2	0.0036
Ln (capital)^2	0.0254
Ln (provisions)^2	0.017***
Ln (loans)^2	-0.0061***
Ln (labour)*Ln (funding)	-0.1188***
Ln (labour)*Ln (capital)	-0.0268
Ln (laboral)*Ln (provisions)	-0.0536***
Ln (funding)*Ln (capital)	-0.002
Ln (funding)*Ln (provisions)	0.0391***
Ln (capital)*Ln (provisions)	-0.0335***
Ln (labour)*Ln (loans)	-0.0195***
Ln (funding)*Ln (loans)	0.0161**
Ln (capital)*Ln (loans)	0.0065
Ln (provisions)*Ln (loans)	-0.0031***
Ln(Trend)	-0.2015***
Ln(Trend)^2	0.0377***
nonMFI	0.3234***
Constant	-3.1106***
N° observations	8,357
R^2	0.9955

Robust standard errors in parentheses.

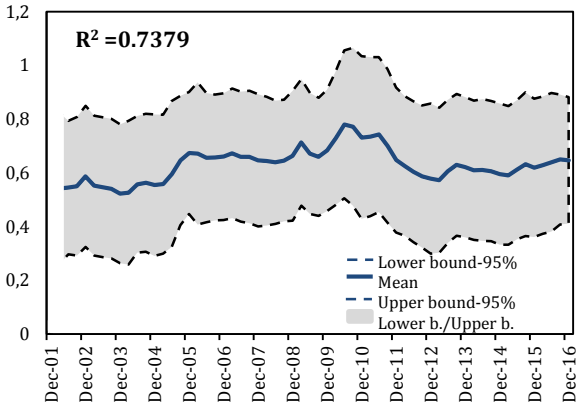
*** p<0.01, ** p<0.05, * p<0.1

Note: The high value of R^2 of this regression is due to the multicollinearity caused by incorporating the squares of the variables, which is a characteristic of translog functions. However, this would not be a serious limitation since the coefficients are only used to determine the marginal cost.

As shown in **Figure 4** and **Figure 5**, between 2003 and mid-2010, competition indicators show an increasing trend, which would be a consequence of regulatory actions favoring competition, and the downscaling and upgrading processes, involving institutions competing in the microfinance market. In contrast, between the second half of 2010 and mid-2014, competition showed a negative trend, probably reflecting the decline in the economic dynamism, which would explain the lower growth of MFI loans. Finally, since 2015, the increasing competition levels observed, would be related to the consolidation strategies, particularly with the merger of two of the largest MFI, showing that this market may reach higher competition levels, even when concentration increases.

It should be noted that the competition indicators used are negatively associated with the average lending interest rate (see **Appendix 4**).

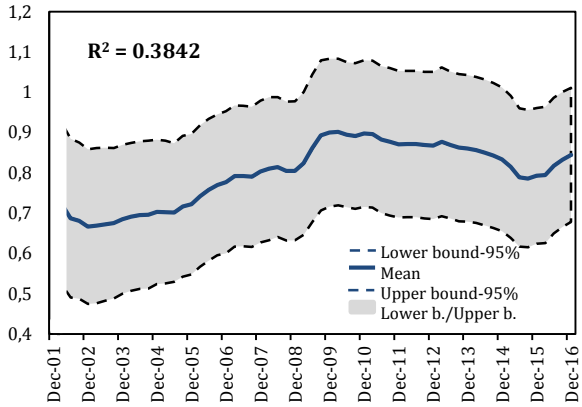
Figure 4. Evolution of competition of the MFS: H statistic*



Own elaboration.

* The higher value, the higher competition

Figure 5. Evolution of competition of the MFS: Negative of Boone indicator*



Own elaboration.

* The higher value, the higher competition

6.2. Competition and stability

The estimated competition indicators are introduced within the stability regressions (equation 12). In the resulting regressions, the problems of heteroskedasticity, panel correlation and serial correlation identified were corrected using fixed effects specifications in all cases (according to the Hausman test), with Driscoll-Kraay standard errors.

The results obtained with the H-statistic and Boone indicator suggests that the relationship between competition and stability is an inverted U-shaped curve[21] (see **Table 4**). Additionally, we found a positive relationship between financial stability and MFI size, suggesting the existence of economies of scale. Moreover, stability is positively related to efficiency, implying that the most efficient firms have greater ability to remain in the market. Likewise, specialization and stability have positive relationship, reinforcing the idea of the importance of the know how to serve MSE segments. In contrast, as expected, we observe negative relationships between stability and credit risk (portfolio deterioration affects the MFI stability in the long run) and with liquidity risk (high liquidity ratios involve lower profits, due to the opportunity cost of funds).

[21] We obtain similar results using $Z_{it} = \frac{\overline{RORWA}_{it} + \frac{CR}{RWA_{it}}}{\sigma_{RORWA_{it}}}$ as dependent variable. **Appendix 5** visually shows the relationship between competition indicators and MFI financial stability. Although models present low R^2, they do not imply a serious problem since the models will not be used for forecasting purposes.

Table 4. Competition and stability
(Dependent variable: Z-score)

Variable	H-statistic			Boone indicator		
	Z_1	Z_2	Z_3	Z_1	Z_2	Z_3
Competition	814.6**	717.2***	823.3***	1479**	1267**	1244***
	(379.5)	(257.4)	(303.9)	(571.4)	(475.7)	(342.7)
Competition^2	-690.8**	-596.8***	-651.3***	-992.5***	-850.7***	-812.2***
	(288.8)	(197.0)	(231.4)	(347.0)	(296.6)	(215.5)
Size *Ln* (assets)	10.69***	4.268***	2.011*	14.04***	8.208***	4.343***
	(2.276)	(1.274)	(1.046)	(3.422)	(1.481)	(0.744)
Specialization (SME loans/total loans)	0.19	0.0661	0.068*	0.232*	0.111*	0.103**
	(0.128)	(0.0623)	(0.0375)	(0.121)	(0.0654)	(0.0388)
Credit risk (past-due loans ratio)	-1.585***	-0.909***	-0.662***	-1.601***	-0.982***	-0.777***
	(0.341)	(0.166)	(0.160)	(0.350)	(0.200)	(0.156)
Liquidity risk (liquidity ratio)	-0.0049***	-0.0022*	-0.0008	-0.0046***	-0.0019*	-0.0005
	(0.00127)	(0.00113)	(0.000783)	(0.00133)	(0.00113)	(0.000806)
Efficiency (-Labour expenses/total loans)	1.139***	0.455***	0.217***	1.037***	0.378***	0.17***
	(0.231)	(0.103)	(0.0547)	(0.229)	(0.0986)	(0.0501)
GDP	1.917	-19.37	48.86	26.53	51.27	121.5**
	(140.9)	(95.84)	(56.09)	(157.3)	(92.35)	(51.64)
Inflation rate	174.7	-7.453	-226.4**	173.2	-41.91	-268.3***
	(307.9)	(171.7)	(111.2)	(316.2)	(158.6)	(93.36)
Constant	-353.9***	-245.9***	-264.8**	-728.3***	-576.9***	-525.2***
	(129.4)	(87.84)	(112.9)	(205.2)	(181.8)	(141.5)
N° observations	1,837	1,683	1,533	1,837	1,683	1,533
Adjusted R^2	0.101	0.0799	0.0571	0.105	0.0958	0.0806
F-Test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

When analyzing the relationship between competition and MFI financial stability, holding everything else constant, we found that competition levels greater than 0.59 (H) or 0.74 (Boone) have been associated with deterioration of the MFI financial stability (see Huayta et al (2017)). These thresholds coincide with the increase of transparency in the credit bureau, suggesting that borrowers' credit records may have been recklessly used to compete, negatively affecting financial stability. However, future relationship between competition and MFI stability may differ, since microfinance market conditions are changing. The recently observed competition dynamics suggests that many MFIs have learnt from their past mistakes, they are being more prudent in the loan origination process and are implementing consolidation strategies to enhance their market positioning. This situation may define a competitive environment for MFIs compatible with higher financial stability.

7. Concluding Remarks

According to the H-statistic, monopolistic competition is the market structure that best fits the environment of the MFS during the period 2002-2016. Moreover, both the H-statistic and the Boone indicator suggest an increasing competition in the MFS during 2003-2010, apparently motivated by regulatory actions promoting competition and by the dynamism of financial institutions. However, during the following sub-period ending in 2014, competition showed a declining trend, coinciding with the slowdown of the Peruvian economy, which negatively affected MFI credit growth. Afterwards, since 2015, competition showed a positive trend possibly related to the consolidation strategies observed in the MFS; specially the merger of two of the largest MFIs. This manifests that the microfinance market may reach higher competition levels even when concentration increases.

On the other hand, the inverted U-shaped relationship between competition and stability shows that competition may encourage stability; but after a certain level, greater competition might weaken the stability of some MFI, although causality was not shown. It has been observed in the Peruvian MFS that the increasing competition drove diverse type of responses. The positive effect is that institutions were forced to be more efficient and to cut down the costs to counteract lower interest rates. However, increasing competition propelled some institutions to take a reckless behavior in an attempt to keep their market share; which, at the end, deteriorated their portfolio quality, weakening their financial situation. But also, some of them merged with other institutions to improve their market positioning or just to remain in the market; other response is to restructure operations and organization. In fact, these processes are still underway.

The prevalence of positive or negative responses may explain the U-shaped relationship between competition and stability found in the period under analysis. Moreover, at the firm level, this relationship may differ, depending on the firm's responses to the changing environment.

In terms of policy implications, it is important that regulators and market participants carry out key actions in order to achieve an enabling environment for a healthy microfinance development. On the regulatory-side, policies should maintain a balance between fostering competition and preserving stability. Hence, the SBS need to keep promoting a level playing field in the financial market, improving financial transparency to enhance market efficiency and consumer protection, as well as continue guaranteeing prudential regulation and supervision that safeguard financial stability.

On the MFIs-side, there is a need to bolster both staff and risks management, as well as to take advantage of efficiency gains. As strong competition for the MFS might lead to over-indebtedness in some cases or customer mobility in others, MFIs should: (i) develop or improve a compelling customer relationship management through customer loyalty strategies; (ii) improve their screening processes that effectively take into account their customers' willingness and capacity to pay; and (iii) expand their scope into unserved markets, always ensuring a proper credit risk management. Considering that borrowers of the financial system only represent around one third of adult population, MFIs may benefit from serving the unbanked market, especially taking advantage of their know-how. On the other hand, as shown in this study, credit and liquidity risk and efficiency management are key elements for MFI to achieve financial stability. Taking into account that credit technology is labour intensive and there is a high credit officers' turnover, the personnel management should be accompanied by an adequate control of operating expenses and employee incentives programs. In addition, since firms' size is positively associated with MFI

financial stability (as a result of scale and scope economies), it is important for MFIs to develop healthy and sustainable growth strategies.

Finally, as MFI customers may be tempted to take more loans than they can afford, the actions taken by the MFIs and those promoted by the SBS, ought to be complemented with financial literacy campaigns altogether (performed by SBS, financial institutions, ministries, private associations, NGOs, and other agents) emphasizing in responsible management of personal finance, and promoting greater transparency on products and services offered by the financial system. This would help reduce delinquent borrowers, improving MFI´s loan portfolio quality and, consequently, their stability.

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Appendix 1: Definition of variables

N°	Variable		Definition	Source
1	Lending interest rate	p	Annualized financial revenues/12-months moving average of loans	SBS
2	Total cost (S/ million)	C	Sum of annualized funding, loan loss provision, and labour expenses	SBS
3	Loans (S/ million)	y	Gross loan portfolio.	SBS
4	Labour cost	w_1	Annualized staff expenses/12-months moving average of loans .	SBS
5	Funding cost	w_2	Annualized deposits and debts expenses/12-months moving average of deposits and debts.	SBS
6	Cost of capital	w_3	Annualized fixed deposit expenses of the financial system/12-months moving average of the fixed deposits of the financial system	SBS
7	Loan loss provision cost	w_4	Annualized loans provisions expenses/12-months moving average of loans.	SBS
8	Return on assets	ROA	Annualized net revenue/12-months moving average of assets.	SBS
9	Market share	$Shar$	Gross loan portfolio/ gross loan portfolio of the relevant market.	SBS
10	Financial Stability (Z- score)	Z_1	(Average ROA over past year+capital to assets ratio)/ROA standard deviation over past year.	Own, based on SBS information
11	Financial Stability (Z- score)	Z_2	(Average ROA over past two years+capital to assets ratio)/ROA standard deviation over past two years .	Own, based on SBS information
12	Financial Stability (Z- score)	Z_3	(Average ROA over past three years+capital to assets ratio)/ROA standard deviation over past three years.	Own, based on SBS information
13	IMF assets size (S/ million)	$Ln(A)$	Natural logarithm of total assets	SBS
14	Specialization (SME loans/total loans)	SME	Small and micro loans (SME)/total loans.	SBS
15	Credit risk (past-due loans ratio)	PDL	Past-due loans/gross loan portfolio. Past-due loans consider corporate, business and medium loans (over 15 days); small, micro, mortgage and consumption loans (over 30 days).	SBS
16	Liquidity risk (liquidity ratio)	Liq	Liquid assets/short-term liabilites.	SBS
17	Efficiency (-Labour expenses/total loans)	Eff	Negative of annualized labour expenses/ 12-months moving average of loans	SBS
18	Capital/assets	$\frac{C}{A}$	Capital to assets ratio	SBS
19	Exchange rate	er	Exchange rate at the end of the month.	SBS
20	Interbank interest rate	$ibkir$	Interbank interest rate in local currency.	BCRP
21	GDP (constant 2007 S/ million)	σ	Real gross domestic product (base year 2007).	BCRP
22	Inflation rate (2009 = 100)	π	Lima customer price index (base year 2009).	BCRP
23	Dummy nonMFI	$Non-MFI$	1, if it is a non-MFI that competes with MFI 0, otherwise.	Own, based on the relevant market

Appendix 2: Summary statistics of variables

Variable		N° observations	Mean	Standard deviation	Minimum	Maximum
Lending interest rate	(p)	8,479	32.2	13.6	3.3	115.9
Total cost (S/ million)	(C)	8,515	145.2	300.5	0.2	3,403.4
Loans (S/ million)	(y)	8,646	759.9	2,126.8	0.0	26,382.3
Cost of capital	(w_1)	8,646	3.7	0.9	2.7	6.0
Funding cost	(w_2)	8,409	7.1	2.8	0.0	30.8
Labour cost	(w_3)	8,499	18.0	15.9	2.3	475.2
Loan loss provision cost	(w_4)	8,515	5.1	5.7	0.0	95.8
Return on assets	(ROA)	8,515	46.9	4.6	0.1	67.9
Market share	$(Shar)$	8,646	2.1	4.7	0.0	40.3
Financial Stability (Z- score)	Z_1	1,850	66.9	65.1	-4.4	648.8
Financial Stability (Z- score)	Z_2	1,696	37.8	35.0	-0.3	321.9
Financial Stability (Z- score)	Z_3	1,546	27.8	23.4	-0.2	199.3
H-statistic	H	1,999	0.629	0.061	0.522	0.780
Boone indicator	B	1,999	-0.798	0.076	-0.902	-0.667
IMF assets size (S/ million)	A	2,878	1,080,000	3,290,000	1,756	42,573,338
Specialization (SME loans/total loans)	SME	1,995	72.6	19.1	0.0	100.0
Credit risk (past-due loans ratio)	PDL	2,873	6.8	6.8	0.0	100.0
Liquidity risk (liquidity ratio)	Liq	2,861	371.0	5,361.6	0.0	239,587
Efficiency (-Labour expenses/total loans)	Eff	2,836	27.1	18.0	4.1	456.5
Capital/assets	$\frac{C}{A}$	8,646	20.7	17.0	3.3	99.6
Exchange rate	er	8,646	3.1	0.3	2.6	3.6
Interbank interest rate	$ibkir$	8,646	3.8	1.1	1.0	6.6
GDP (constant 2007 S/ million)	σ	2,878	90,763	22,326	55,138	131,814
Inflation rate (2009 = 100)	π	2,878	100.6	12.9	81.5	125.7

Appendix 3: Summary of variables

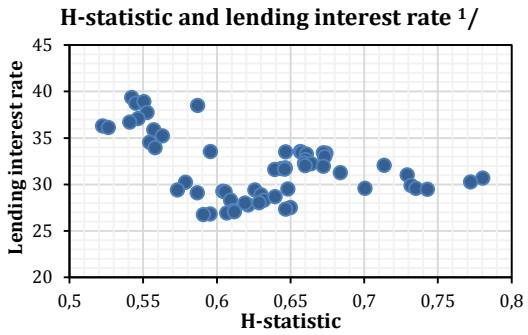
Variable		Unit root tests [1]/ (p-values)												
		Levin, Lin, and Chu			Breitung			Im, Pesaran, and Shin			Fisher Augmented Dickey - Fuller [2]/			Phillips - Perron Fisher [2]/
		AIC	SIC	HQC	AIC	SIC	HQC	AIC	SIC	HQC	AIC	SIC	HQC	
Competition	Labour cost	1.000	0.018	0.988	1.000	1.000	1.000	0.050	0.001	0.005	0.000	0.000	0.000	0.000
	Loans [3]/	0.937	1.000	0.999	0.688	0.998	0.978	1.000	1.000	1.000	0.999	1.000	1.000	1.000
	Funding cost	0.822	0.000	0.054	0.186	0.025	0.104	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Total cost[3]/	0.998	0.988	0.999	0.193	0.617	0.365	1.000	1.000	1.000	0.999	0.987	0.999	1.000
	Loan loss provisions	1.000	0.036	0.660	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Lending interest rate	0.055	0.000	0.000	1.000	1.000	1.000	0.022	0.010	0.004	0.000	0.000	0.000	0.036
	ROA	1.000	0.541	1.000	0.764	0.560	0.685	0.007	0.000	0.000	0.002	0.000	0.000	0.010
	Market share	0.000	0.007	0.014	0.996	1.000	1.000	0.985	1.000	1.000	0.001	0.193	0.167	0.044
	Capital to assets ratio	0.661	0.014	0.173	0.997	0.998	0.998	0.002	0.000	0.004	0.000	0.000	0.000	0.000
Stability	Z_1	0.000	0.000	0.000	0.033	0.002	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.002
	Z_2	0.152	0.002	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.302
	Z_3	0.996	0.439	0.727	0.299	0.145	0.109	0.062	0.031	0.035	0.001	0.000	0.000	0.918
	Assets [3]/	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.996	0.951	0.948	1.000
	SME	0.835	0.020	0.327	0.986	0.999	0.998	0.000	0.000	0.000	0.000	0.000	0.000	0.113
	Past-due loans ratio	0.001	0.000	0.000	0.565	0.968	0.730	0.004	0.000	0.000	0.000	0.000	0.000	0.000
	Liquidity	0.000	0.000	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Efficiency	1.000	0.999	1.000	0.997	1.000	1.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000

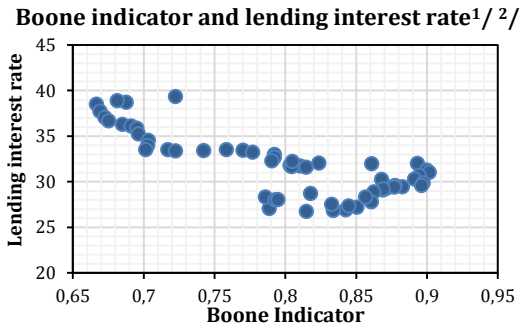
1/ We included intercept and trend in each test. Besides, it was automatically selected the band-with of Newey-West and Bartlett kernel. In Levin, Lin, and Chu; and Breitung, the null hypotesis is one common unit root. In Im, Pesaran, y Shin; Fisher augmented Dickey -Fuller; and Fisher Phillips - Perron, the null hypotesis is an individual unit root.

2/ The likelihoods of Fisher are calculated using a Chi-square asymptotic distribution. Other methods assume asymptotic normality.

3/ When evaluating unit root tests in the logarithms of these variables, we can affirm that they are consistent with the stationarity assumption. Only in total cost, this is confirmed with the Fisher Phillips - Perron test considering intercept.

Appendix 4: Correlation between lending interest rates and competition indicators

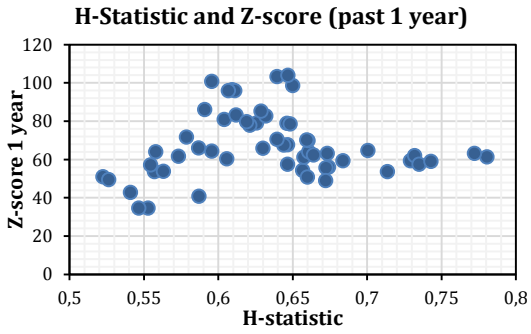


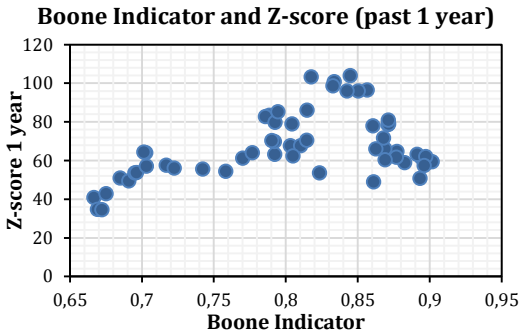


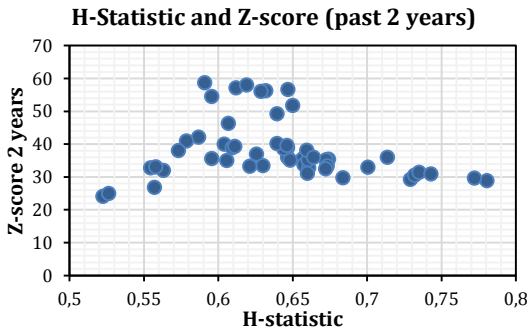
1/Quarterly lending interest rate.
Own elaboration

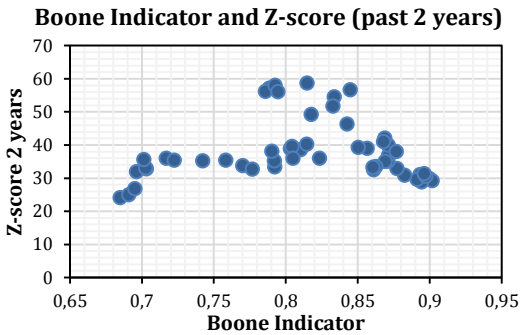
2/ Negative Boone indicator.
Own elaboration

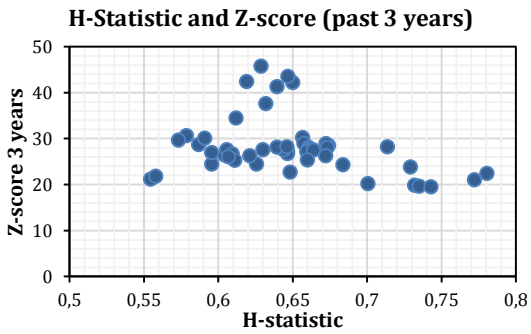
Appendix 5: Correlation between competition and stability indicators (Z-score*)

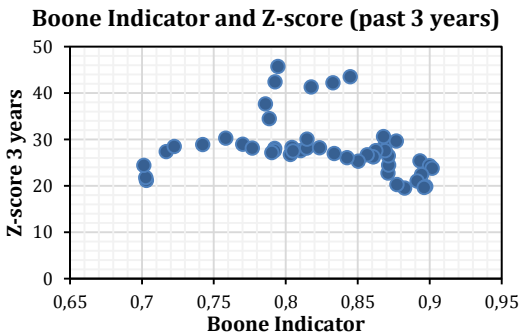












* Z-score quarterly average.
Own elaboration