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The determinants of interest rates in microfinance: age, scale and organisational charter

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The determinants of interest rates in microfinance: age, scale and organisational charter

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Abstract

This study compares the responsiveness of microcredit interest rates to age, scale of lending and organisational charter. It uses an unbalanced panel of 300 MFIs from 107 developing countries from 2005 to 2015. *Three* key trends emerge from the results of a 2SLS regression. *First*, the adoption of formal microbanking practices raises interest rates compared with other forms of microlending. *Second*, large scale lending lowers interest rates only for those MFIs that already hold legal banking status. *Third*, age of operation in excess of eight years exerts a negative impact on interest rates, regardless of scale and charter type of MFI. Collectively, our results indicate that policies which incentivise mature MFIs to share their knowledge will be more effective in helping the nascent institutions to overcome their cost disadvantages compared with reforms to transform them into licensed banks. For MFIs which already hold permits to operate as banks, initiatives to increase loan sizes are key strategic pricing decisions, irrespective of the institution's age. This study is original in its differentiation of the impact on interest rates of regulations which promote formal banking principles, credit market extension vis-à-vis knowledge sharing between mature and nascent MFIs.

JEL classification: G21; G23; G28; E43, N20

Key words: Microfinance, microbanks, non-bank financial institutions, interest rates, age, economies of scale, developing countries

INTRODUCTION

The global microfinance movement has received intense media attention in the past decade. This has thrown the spotlight on two key concerns. The f*irst* is the high interest rates charged by microfinance institutions (MFIs) by comparison with formal sector commercial banks, raising allegations of monopolistic pricing (Rosenberg *et al,* 2009; Yunus, M, 2011). The *second* is related to fears of "mission drift" as many MFIs transform into regulated profit maximizing banks with a consequent re-orientation in their services towards the better-off among their poor clients (Hartarska and Nadolnyak, 2007; Frank, 2008; Tchakoute-Tchuigoua, 2010; Mersland and Strøm 2010, Roberts, 2013;D'Espallier*et al*, 2017).

Ultimately the interplay between the characteristics of MFIs and the nature of the aforementioned concerns in the debate is an empirical matter. Unfortunately, these important issues have remained largely untested, primarily because of a lack of variation in the attributes of MFIs including the pattern of interest rates charged by different institutions. In this paper, we resolve this difficulty by using a panel framework comprising 300 financially self-sufficient MFIs (hereafter referred to as FSS-MFIs) from 107 countries across six developing regions from the Microfinance Information eXchange (MIX) database[2]. The decision to focus on financially "successful" MFI's derives from the argument by Rosenberg *et al* (2009) and Cull *et al* (2009) that the inclusion of subsidized MFIs substantially lowered the average interest rates reported in previous studies. Further, Basharat (2015) found that the role of firm characteristics in determining the lending interest rate in the microfinance industry may depend on whether the institution is financially efficient or not. Nonetheless, Cull *et al* (2009) reported that the correlation between financial outcomes in terms of operationally self-sufficiency (OSS) and financial self-sufficiency (FSS) is positively significant at circa 0.89. Such a high correlation, although not perfect, indicates that the two measures of financial performance are somewhat interchangeable.

This study contributes to the microfinance empirical literature in two ways.

First, it investigates whether the annual average interest rates observed for FSS-MFIs with the legal entitlement to conduct traditional banking activities are significantly higher

[2] Several editions of the Microbanking Bulletin (MBB) defines a financially sustainable MFI as an institution where inflation adjusted financial income minus monetary and in-kind donated goods, technical assistance and other services exceeds the sum of inflation adjusted operating costs, impaired losses on loans and the financial expenses arising from both the actual and predicted costs of acquiring goods and services for which it is not paying a market rate.

than the rates charged by MFIs with a different charter status. We differentiate between the interest rates of rural and other microbanks (hereafter referred to as MICROBANKs) vis-à-vis those of non-governmental institutions (NGOs), non-bank financial institutions (NBFIs) and credit unions/cooperatives located in Sub-Saharan Africa, North Africa and the Middle East, Eastern and Central Europe, East Asia, South Asia and Latin America regions[3]. The results should highlight the responsiveness of microcredit interest rates to changes in the regulatory frameworks which oversee the practices of MFIs in developing economies. A similar empirical study by Campion *et al* (2010) examined the relationship between operational self-sufficiency and portfolio yield in a study of twenty-nine institutions in seven Caribbean countries from 2005 to 2008. However, their study was constrained by data and methodological issues. This paper reduces these limitations by increasing the number of MFIs, countries, time periods and by using a more rigorous econometric method.

Second, statistics show that MFIs which are classified as financially self-sufficient institutions by MIX analysts tend to be older with larger levels of lending. We therefore investigate the interaction between interest rates, scale economies and years of experience of microbank *versus* nonbank credit providers. The outcome should help reveal the extent to which policy actions which promote the learning which comes from years of practice and growth in the scale of loan operation are likely to be more effective pricing strategies than initiatives which encourage microfinance institutions to transform into formal banks.

The paper is organised into *four* sections. Section I provides an overview of our dataset on the annual average interest rates of those 300 FSS-MFIs located in 107 countries which consistently reported on the MIX MARKET platform[4] information on nominal interest rates and all of its four major components — cost of funds, operating costs, loan loss provision rate and profits[5] from 2005 to 2015.The choice of time period is limited by the availability of data on all of these five variables at the time of writing. We further compare the variation in these annual average interest rates across the four categories notably,

[3]Choice of MFI charter types and regions is based on the classification by the Microfinance Information eXchange (MIX) 2009. Interested readers may have a look at the Index of Indicators and Definitions available in various issues of the MBB.

[4]To the best of our knowledge, the MIX MARKET platform contains the most reliable publicly available data on detail financial information which are comparable for a large number of individual microfinance institutions across developing countries over a relatively long time period. Indeed, Sengupta and Aubuchon (2008) noted that MIX MARKET reports on up to 2,500 MFIs serving some 67 million clients around the world.

[5] According to Gonzalez (2010), the formula for MFI interest income is expressed as follows: Interest + fee income from loans and other financial services = Cost of funds + Loan loss expense + Operating expense + Profit + Tax minus Income from non-financial activities.

MICROBANKs versus those of (i) NGOs, (ii) NBFIs and (iii) credit unions. These specific dummy variables which we have created for the different types of MFI follow from the classification by MIX MARKET analysts and utilised by Cull *et al* (2009), Hermes *et al* (2011), Nwachukwu (2014) and Basharat *et al* (2015). Section II outlines the empirical research model, hypotheses and the basic features of our estimation method. Section III presents the results of our empirical analysis and further explains the relative impact on interest rates of age, scale of operations and legal status. Section IV draws conclusions with related policies from the empirical findings.

I. Data Description

Our argument here is conducted under: (i) sample selection, (ii) sample distribution and (iii) microcredit interest rates.

1.1: Sample Selection

In this section, we summarise the key trends in the actual annual average interest income earned by our different types of FSS-MFIs of different age and scale between 2005 and 2015 using a standard descriptive statistical method. As we noted earlier, our data is obtained only from the publically available MIXMARKET website so as to ensure conformity and reliability in their measurement (Hermes *et al*, 2007; Cull *et al*, 2007; Hartarska and Nadolnyak, 2007; Gonzalez, 2007; Cotler and Almazan, 2013; Nwachukwu, 2014). Notwithstanding these benefits, these authors expressed concern regarding the self-selection bias inherent in the MIX dataset. They noted that participation by MFIs in the MIX is voluntary, and thus the database is skewed towards the more successful MFIs with adequate staff and information systems. These institutions are more likely than others to expose their private financial accounts to external examination and to satisfy the minimum requirements of auditing firms and MIX analysts. Moreover, these organisations tend to be large, focusing on financial and profitability goals compared with those MFIs which were not covered in the MIX MARKET dataset. Nevertheless, the MIX database is commonly used in the microfinance empirical literature on the assumption that those institutions which report to it collectively serve a sufficiently large fraction of active microcredit users worldwide (see for example, Honohan, 2004 and Cull *et al*, 2007).

The periodicity of data used in this study is dictated bya complete availability of annual data on interest rates and its aforementioned four key components. This is accessible

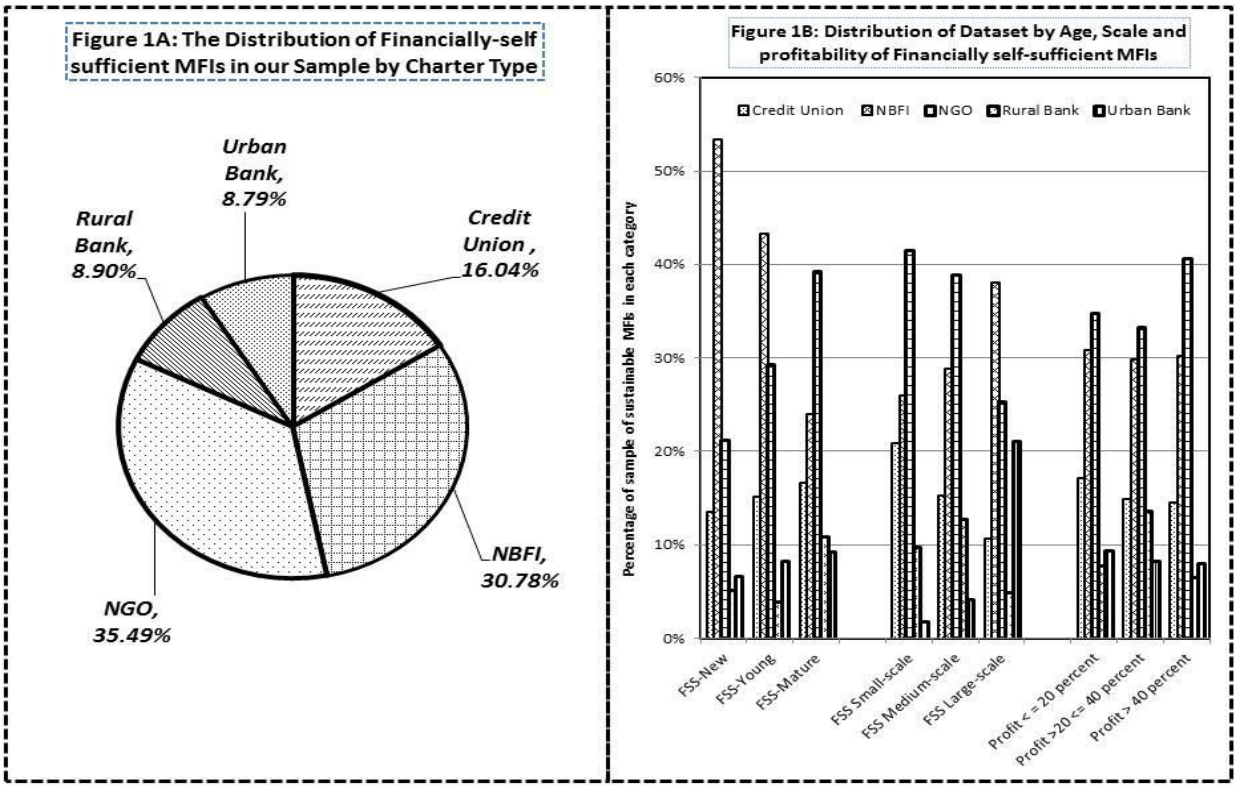
for 300 financial self-sufficient microlenders located in 107 countries throughout our six developing regions from 2005 to 2015. Given the time period considered and the number of data points which these institutions reported to MIX MARKET on nominal interest rates, its aforementioned four components and the other determinants which we have chosen to include in a subsequent regression model, we were able to generate an unbalanced cross section-time series panel data of between 2785 to 3000 observations. Appendix Table 1 reports the mean and standard deviation for all the variables which underlie our analysis for our five classes of MFIs subdivided across their age and scale of their lending operations[6].

1.2: Sample Distribution

Figures 1A and 1B show the distribution of our data set across the different types of our sustainable microcredit providers, as well as in terms of their age and scale of lending in that order. Figure 1A shows that our sample of study is dominated by NGOs and NBFIs. Collectively, these supposedly socially-orientated MFIs make up two-thirds of our dataset. The fact that these MFIs form the largest proportion of our sample, and by inference that of the developing country-microfinance industry as a whole, should not be a surprise. This indicates that the recent concentration on microbanks in the media and policy debate does not merit their relative importance.

As shown in Figure 1B, the majority of financially-viable NGOs are mature, small-medium scale programmes with a gross profit margin in excess of 40 percent. By contrast, more than half of FSS-NBFIs, which may include registered money lenders, micro-insurance, micro-equity, pawn shops, payday lenders, check cashing and currency exchange firms, are probably new initiatives which have mostly been set up in the past five years by large-scale institutions. Their profit margins are evenly spread across our chosen three sub-samples of profitability. This is probably an indication of the wide diversity of type and number of institutions, financial contracts, products and services which they offered.

[6] To conserve space, other statistics, including median, minimum, maximum, skewness and kurtosis which provide a more detailed description of the distributions of variables across our five types of MFIs are not reported here but are available from the authors on request.



1.3:Microcredit Interest Rates

Consistent with Cull *et al* (2007), interest charges (also known as yield on gross loan portfolio) on microloans (YLD) is calculated as the sum of all interest, fees and commissions actually received by an MFI weighted by the size of its outstanding gross loan portfolio (GLP). Figures 2A and 2B show the annual average interest income earned by our group of FSS-MFIs reported by the type, age and scale of their operations respectively. Unlike, Cull *et al* (2007), we use nominal rather than real interest rates in order to capture the higher risk of defaults, costs of administration and other complications faced by MFIs which charge the comparatively high rates which cover inflation. In any event, as observed by Woller and Schreiner (2002), the nominal portfolio yield (YLD) is highly positively correlated with the real yield. Thus, nominal rather than real portfolio yield is an appropriate proxy for the actual interest rate charged on loans. *Four* key patterns are observed from Figures 2A and 2B.

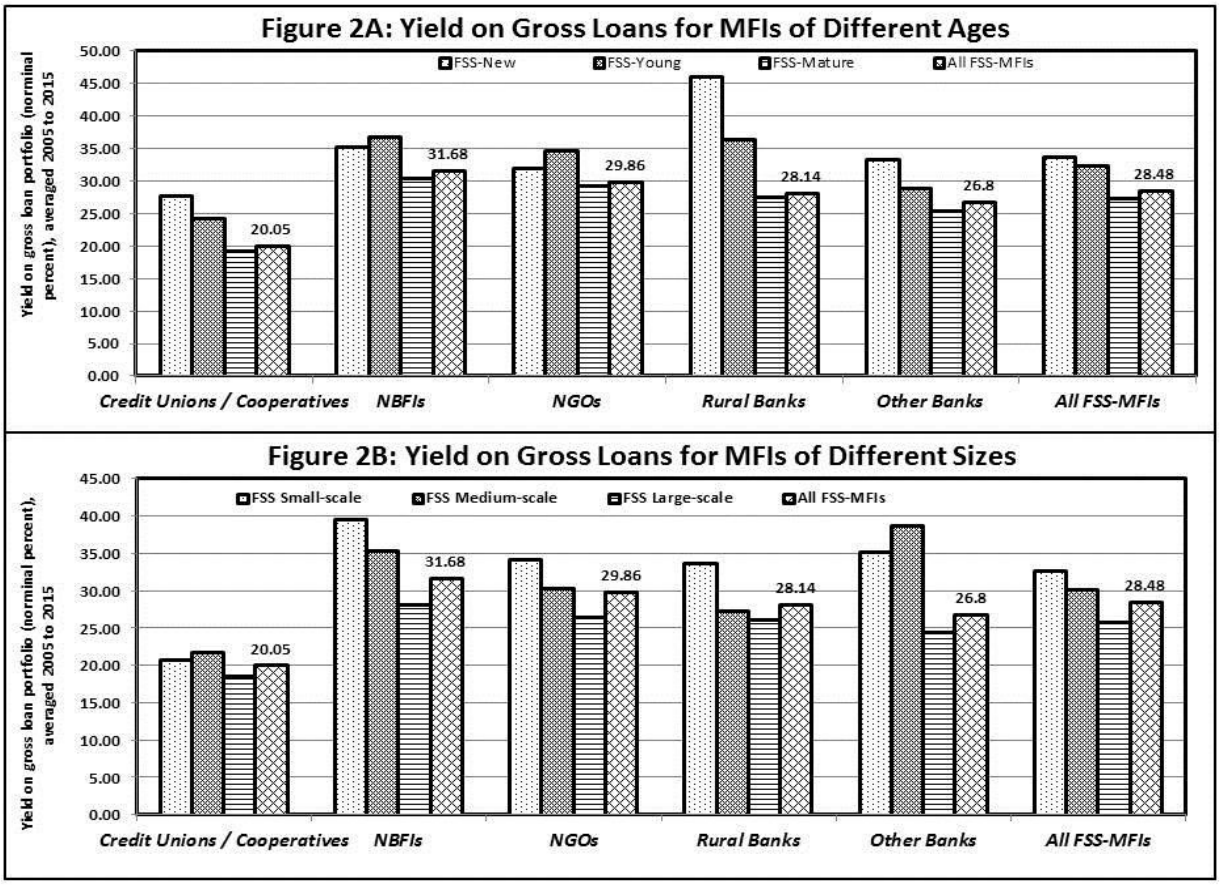
First, the statistics in both figures 2A and 2B indicate that the annual average interest income for our typical FSS-MFI was 28.48 percent of gross loan portfolio (GLP) outstanding with a standard deviation of 17.75 percent. Overall, our dataset shows that the interest charged by our group of FSS-MFIs varied considerable between minimum of 0.001 percent and maximum of 243 percent. The average value is lower than the mean interest rate of 35.4

percent and 36 percent reported by Cull *et al* (2007) and Campion *et al* (2010) respectively, perhaps reflecting the concerted effort by activists and the general media to name and shame MFIs that charge "exorbitant" rates.

A disentangling of data by type of MFI shows a wide variation in the average interest rate charged. Contrary to popular belief, the highest average interest rates of between 29.81 percent and 31.68 percent per annum were observed for NGOs and NBFIs in that order. This is presumably because NGOs and NBFIs are expected to lend to the poorest households without collateral and so have higher premium for risk. Moreover, these deprived clients borrow in small amounts and therefore also have greater unit administration costs, not to mention the high salary and cost of hiring foreign NGO workers, including vehicles, security, accommodation and offices. Besides, Campion *et al* (2010) remarked that these underprivileged borrowers may be more concerned with access to capital rather than "cheap" loans. They therefore could be unresponsive to price increases, permitting those MFIs which purport to serve them to offer credit at considerably high interest rates. What is more, the absence of effective regulation and public scrutiny may have allowed such socially-orientated institutions to charge interest rates which are significantly higher than their average costs, compared with commercialised microfinance banks which often attract intense media attention and possible censure. Thus, decisions on whether FSS-NGOs and NBFIs are meeting their professed social obligations must be based on the presumption that a large proportion of the relatively high profits of more than 40 percent which are reported for NGOs in Figure 1B are channelled into community-based projects which ultimately raise the economic wellbeing of their borrowers.

Second, the group of FSS-credit unions have the lowest average rates amongst our five types of MFIs at 20.05 percent a year. This is comparable to the 22.2 percent reported by Cull *et al* (2009). The relatively low interest rates levied by credit unions are to be expected. These are not-for-profit cooperative financial institutions owned by their members who pool their money to provide loans and other financial services. This should reduce the need to raise finance from more expensive external sources, leading to a lower cost of basic finance and the interest rate there from. Then too, the profits from other services, notably from marketing members' inputs and outputs, may be used to cross-subsidize interest rates and extract repayment of loans. Besides, the cooperative structure of credit unions is designed to ensure fair dealing. Consequently, interest rates which are deemed to be "excessively" high are unlikely to be countenanced by members. Additionally, members and borrowers of credit

unions are often the same people and so are jointly responsible for the administration and repayment of loans. This sense of collective liability would doubtless lead to lower default rates and management costs with a consequent decline in interest charges. Also, credit unions are often local institutions and, as shown in Figure 1B, are mostly young-mature small scale operations with more than five years' experience. They are therefore likely to offer more personalised services to borrowers and to know more about their creditworthiness.



Third, the interest rate observed for rural banks is around 1.34 percentage points lower than the mean value reported by their urban bank counterparts. Normally one would expect that the lack of competition in village micro-credit markets would enable banks there to charge interest rates that might look abnormally high when compared with those of urban bank providers. The implication is that rural microbanks, like traditional village money lenders, have acquired a comparative advantage in drawing up credit contracts which help mitigate those adverse selection and moral hazard problems that have discouraged urban providers from lending to poor borrowers. Indeed, Cull *et al* (2009) remarked that in rural Bangladesh, MFI lenders have good relationship with their borrowers helping them to acquire reliable information at a relatively low cost. Further, it is more likely that the majority of rural

banks are government-sponsored agricultural lending agencies, often with a cap on their rates (Nwachukwu, 2013).

Fourth, a further disaggregation by age and scale of operation in Figures 2A and 2B respectively indicates that interest rates tend to decline with increasing age and scale of outstanding loan portfolio for our average FSS-MFI regardless of its legal charter. Standard economic theory would lead us to suppose that reductions in costs driven by experience, learning by doing and economies of scale are responsible for the lower interest rates observed for mature and large scale MFIs. So for established institutions with more than eight years' experience, microcredit interest rates dropped to an average of 27.31 percent a year, representing a fall of 1.97 percentage points from the overall sample average of 28.48 percent GLP. In terms of scale, we calculated that the mean interest rate for our large-scale FSS-MFI was 25.78 percent per annum vis-à-vis the 28.48 percent reported for our overall sample of FSS-MFI microlenders. Taken together, the entries in Figures 2A and 2B suggest that the drop in interest rates accompanying the scale of lending was larger than the fall in rates arising from experience allied with the age of an MFI; a difference of 1.53 percentage points.

Generally speaking, the separation by type of MFI suggests that the implied inverse relationship between age and scale economies against interest rates is more pronounced across our FSS-NBFI sub-sample. The inference is that an interaction term which combines legal charter, age and scale of lending should be included in any empirical study which claims to investigate the determinants of interest charges levied by MFIs. The regression which we employ in this study to analyse how legal status, age and scale economies affect annual average interest rates of a developing country-FSS-MFI is outlined in the next section.

2. Empirical Model and Hypotheses

The argument here is carried out under the following headings:(i) model specification, (ii) independent variables of interest, (iii) control variables and (iv) empirical estimation method.

2.1: Model specification

The primary objective of this paper is to investigate how financially self-sufficient (FSS) microfinance institutions may influence their interest charges through the following three key policy initiatives: (i) the adoption of formalised banking practices, (ii) the acquisition of knowledge attained by serving clients over a long time period and (iii) the promotion of scale economies achieved by attending a growing number of borrowers and/or by increasing the

average size and duration of a loan offered to existing client base. The model which we estimated in order to quantify the influence of these three pricing strategies on annual average interest rates can be expressed in terms of the following regression equation.

$$Log(YLD_{it}) = \beta_0 + \beta_1(MATURE_{it}) + \beta_2(LSCALE_{it}) + \beta_3(MICROBANK_{it}) + \beta_4(MATURE_{it} * LSCALE_{it}) + \beta_5(MATURE_{it} * MICROBANK_{it}) + \beta_6(LSCALE_{it} * MICROBANK_{it}) + \pi_{zj}(Z_{jt}) + \alpha_i + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (Eqn\ 1)$$

The variable YLD is the interest rate charged on loans. This was defined previously in section 1.3 as total interest income divided by the gross loan portfolio[7]. It captures the *ex-ante* interest rate charged by the lender rather than the *ex-post* interest rate realized on outstanding portfolio since losses arising from loan default are not netted out of the interest revenues earned (Cull *et al*, 2009).

2.2: Independent Variables of Interest

The key independent variables in our analysis comprised: (i) the entry MATURE; a dichotomous dummy variable indicating the number of years the institution has been operating. Following the classification by MIX analysts, this variable takes a value 1if the institution has more than eight years of operation and 0otherwise. The decision to merge the NEW (i.e., age < 5 years) and the YOUNG (i.e., age between 5 and 8 years) variables to create a "NEW-YOUNG" dummy series follows from a lack of sufficient observations for each individual category in our dataset. (ii) The notation for LSCALE is a dummy variable which takes a value of 1 for large-scale institutions and 0 otherwise.(iii) The term MICROBANK is a dummy variable for formally licenced microfinance banks which takes a value of 1 if the MFI is classified as a "rural bank" or "bank" and 0 for our three other types of institutions —NGOs, NBFIs and credit unions or cooperative societies. This sub-sample of institutions which do not have an authorised license to carry out conventional banking activities are collectively hereafter referred to as "NON-BANK-MFIs". We recognize that our decision to lump together NGOs, NBFIs and Credit unions/cooperative is rather subjective and that differences in their charter status may lead to diverse cost structures with associated interest rates. Nevertheless, the decision not to include separate dummies for each type of MFI in the equation was based on the fact that there were too few observations of

[7] See Appendix Table 2 for the all the definition of variables in our analysis and their expected effect on microcredit interest rates. These definitions are abstracted from several publications of Microbanking Bulletin (MBB), a principal output for the MIX MARKET analysts and their sponsors.

them individually. The dummy variable categories which are excluded from the regression to avoid an exact linear association with the intercept term β_0 are: (i) for age, NEW and YOUNG MFIs; (ii) for scale of operation, SMALL and MEDIUM SCALE MFIs, (iii) for legal status, NON-BANK MFIs which comprise NGOs, NBFIs and Credit unions/cooperative.This means that the constant term β_0 in equation 1 represents the annual average interest charge for these omitted classes of FSS-MFIs comprising the new-young-small-medium-scale-non-bank microloan providers. Our null hypothesis is that the differential intercept coefficients $\beta_1 \; and \; \beta_2$ are less than zero. The coefficient β_3 shows how the annual average interest rate varies across MFIs by the nature of their accredited activities. We propose that the coefficient $\beta_3$will have a positive sign if the extra costs to microfinance banks of complying with formalisation and prudential regulations were passed onto their borrowers in the form of higher interest rates and fees (Christen *et al*, 2003).

As MFIs get older, they normally attempt to increase their customer base and also make progressively larger-sized loans to their existing clients with successful businesses. To investigate the significance of the implied combined effects on interest rates of age, scale economies and organisational charter, we include simultaneously in our regression model *three* interaction dummy variables. They are: (MATURE*LSCALE), (MATUREMICROBANK) and (LSCALE* MICROBANK). It is anticipated that the slope differential coefficient β_4 on the combination (MATURE*LSCALE) will have a negative sign so as to reflect the additional productivity gains enjoyed by well-established-large scale MFIs, irrespective of charter status. We predict negative sign for the differential slopes $\beta_5 \; and \; \beta_6$on the interaction terms (MATUREMICROBANK) and (LSCALE* MICROBANK) in recognition of the fact that mature and large microbanks are more likely to have improved governance and internal controls and to be better at coping with the risk and cost associated with regulation and its supervision than their new-young and small-medium scale competitors. Such should instil confidence in external finance providers, leading to a lower cost of funding with a corresponding fall in interest charges.

The symbol α_i is a dummy variable representing the effects of those unobserved characteristics such as managerial quality which are unique to a particular ith MFI and which do not vary over time t. These institution-specific dummies are treated as either fixed or

random parameters depending on the outcome of a test proposed by Hausman (1978)[8]. The symbol τ_t is a dummy variable for time. These time indices are also treated as fixed or random in order to capture the dynamic changes in the rate of interest over our ten years of study. The notation ε_{it} is the white noise error term with an expected value of zero.

2.3: Control Variables and Expected Relationships

The symbol Z_j in equation 1 is a vector comprising the set of control variables drawn from a pool of potential determinants theoretically or empirically linked to performance of MFIs in underdeveloped countries (Ahlin and Lin, 2006; Cull *et al*. 2007, Cull *et al*, 2009, Campion *et al,* 2010, Mersland, R. and Strøm, R. Ø, 2009; Nwachukwu, 2014). Generally speaking, Christen and Rosenberg (2000), Peck and Rosenberg (2000), Wollerand Schreiner (2002) indicated that several previous empirical studies which use the MIX MARKET dataset have consistently found ten institutional characteristics to be important drivers of interest rates on microloans aside from our dummies for age, scale and legal status. These ten conditioning variables have been added simultaneously to our extended regression in equation 2 below.

$$\begin{aligned} Log(YLD_{it}) = {} & \beta_0 + B_1(MATURE_{it}) + \beta_2(LSCALE_{it}) + \beta_3(MICROBANK_{it}) \\ & + \beta_4(MATURE_{it} * LSCALE_{it}) \\ & + \beta_5(MATURE_{it} * MICROBANK_{it}) + \beta_6(LSCALE_{it} * MICROBANK_{it}) \\ & + \pi_1 Log(FELR_{it}) + \pi_2 Log(OPER_{it}) + \pi_3(PFLR_{it}) + \pi_4 Log(PROFTR_{it}) \\ & + \pi_5 Log(PAR30_{it}) + \pi_6 Log(WBR_{it}) + \pi_7 Log(BPSM_{it}) \\ & + \pi_8 Log(1 + ECAR_{it}) + \pi_9 Log(ALPBP_{it}) + \pi_{10} Log(ALPBPSQ_{it}) + \alpha_i \\ & + \tau_t + \varepsilon_{it} \ldots \ldots (Eqn\ 2) \end{aligned}$$

Appendix Table 2 provides a summary of expected impact of these control variables on nominal interest rates. Two key trends emerge.

First, eight out of the ten control variables in equation 2 are expected to be positively associated with interest rates. They are: (i) the ratio of the cost of funds to gross loan portfolio for an MFI $(FELR_{it})$, (ii) the ratio of operating expenses to gross loan portfolio$(OPER_{it})$, (iii) the percentage of money set aside by MFIs to cover potential loan defaults$(PLFR_{it})$, (iv) the proportion of an MFI's loans that have one or more principal instalments unpaid for more than thirty days past their due date $(PAR30_{it})$, (v) the profit margin measured as net operating income relative to gross loan portfolio, (vi) the proportion of women borrowers

[8] The results of the Hausman test for fixed versus random model is not reported here in order to conserve space.

which supposedly captures the depth of outreach to the underprivileged population (vii) The ratio of equity capital to total assets $(ECAR_{it})$ and (viii) the average loan size per borrower relative to the per capita GNI of the country in which the institution is located $(ALPB_{it})$. Collectively, these variables capture the efficiency with which the MFI relates to its external capital providers as well as in the delivery and recovery of its loans from customers.

Second, we expect a negative connection between interest rate and the remaining two conditioning variables (i) the ratio of borrowers to staff members$(BPSM_{it})$ and (ii) the square of an average loan-size per borrower per capita GNI $(ALPBSQ_{it})$. The decision to include this quadratic term follows from the observation by Armendáriz and Morduch (2010) that the greatest challenge facing most MFIs is how to recompense for the high fixed cost of lending in small amounts. Overall, these two variables were used in previous studies (Nwachukwu 2014; Cotler and Almazan; 2013) as a proxy for an institution's outreach to the more educated and wealthier borrowers with the capability to service larger loan sizes and to keep records of their business earnings and repayment history. Any subsequent reduction in operational costs and the risk of default should lower interest rates.

2.4:Empirical Estimation Method

To test the validity of the above-mentioned hypotheses on the relationship between nominal interest rates and its key determinants, we employ two estimation techniques. The *first* is the standard Ordinary Least Squares (OLS) method. The *second* is the Two-stage Least Squares (2SLS) approach. With the three policy variables of interest – age of inception, scale of operation and charter status relatively time invariant, a random effect rather than fixed effect unbalanced panel data model is employed.

A key requirement of the conventional random effect model is that all the explanatory variables in equation 2 are strictly exogenous in the sense that their values are determined outside the microcredit pricing system and so are uncorrelated with the unobservable MFI characteristics(α_i). But representations in Section 1 imply that this is a rather simplistic assumption. Our discussions there suggest that age and scale of operation may be correlated with other microfinance characteristics including organisational charter. Besides, arguments in Rosenberg (2007), Hudon (2007), Cull *et al* (2009), Campion (2010) and Cull*et al* (2011) suggest that there is probably a causal link between interest income and the institutional characteristics contained in our information conditioning set.

Empirically, the result of a Hausman test for exogeneity indicates that all the control variables described in section 2.3 are indeed jointly determined within our regression model and so must be treated as endogenous variables[9]. This is to be expected as these variables represent the institutional features which managers seek to influence in order to achieve optimal pricing for their niche market. Thus, the treatment of these variables as exogenous in a number of articles, including the influential paper by Cull *et al* (2007) which uses an Ordinary Least Squares (OLS) estimator, may be deemed to be invalid.

One technique frequently used for the estimation of systems of equations when contemporaneous variables are specified as endogenous is the Two Stage Least Squares (2SLS). The perennial problem of choosing valid instruments from freely available data is resolved by employing two period lagged values of all the variables in our conditioning set. These lagged instruments should be highly correlated with the endogenous regressors but contemporaneously uncorrelated with the error term in equation 2 (*i.e.*, strictly exogenous). Ideally, the restrictions placed on the choice of appropriate instruments and lag lengths should be informed by financial and economic theories. But often these concepts are at best vague or at worst non-existent. As a result, searching for exogenous variables to be used as instruments in simultaneous specifications has been carried out in an *ad hoc* manner. It has been argued that the measurement error associated with such an unplanned selection of external instruments could be minimised by using the VAR approach (Sims, 1980; McNees, 1986). With respect to lag lengths, our priority was to include as many cross-sections of MFIs as possible in our regression analysis while ensuring that each of these institutions has full data for our measures of interest rate and its four key components.

We recognise that the elements in equation 2 which are expressed at natural logarithm levels may contain unit roots and so should have been differenced to induce stationarity. Nonetheless, the resolution to run the regression at level follows that the objective of this article is to examine the relationship between interest rates and key MFI characteristics. Differencing would have resulted in a loss of any long-run information on the correlation between these variables. In any event, the transformation of all the regressors into natural logarithm series helps to lessen the problem of spurious regression by ensuring that the variables follow a linear trend and are integrated (Asteriou and Hall, 2007, Brooks, 2008).

[9] Once again, for the sake of brevity, the results of the Hausman test for exogeneity are not reported here, but are available on request from the authors.

The summary statistics for all the variables underpinning our study at natural logarithm levels are reported in Appendix Table3. From the standard deviations of the continuous variables in the conditioning set, we can conclude that there is sufficient variation in the dataset to ensure that acceptable estimated relationships would emerge. Appendix Table 4 presents the contemporaneous pairwise correlation matrix of our selected variables. We estimate the Kendall tau (τ) rank correlation coefficient which deals with the problem of outlying observations and ties in the orderings of data. We note that the degree of interdependence between our explanatory variables is relatively low at under 0.5. This suggests that problems arising from multicollinearity are not a key concern in our regression model (Kennedy, 2008). Indeed, multicollinearity is rarely a problem in dynamic panels which pool a large cross-section of institutions from different countries. Such a data arrangement reduces the likelihood that the same common trend will be prevalent in the regressors in the specification.

3. Estimation Results and Discussion

The outcomes of our estimation for equation 2 using the OLS and 2SLS methods are presented in Columns 1 and 2 of Appendix Table 5 in that order. The regression in Column 2 highlights how the sign, size and statistical significance of the coefficients vary with the correction of bias associated with endogenous variables. It is noteworthy that the 2SLS regression in Column 2 has the highest adjusted R-squared, indicating that 86.18 percent of the variation in interest rates is explained. Also, we deduce from the relatively high F-statistic with associated p-value that the null hypothesis that *all* of the slope coefficients (excluding the constant) are zero is rejected at the 5 percent confidence level. Further, a Durbin-Watson statistic of 2.18 indicates an absence of first-order serial correlation in the disturbance terms. Moreover, the relatively high J-statistic of 0.29 indicates the suitability of the instrumental variables used in the 2SLS regression. Consequently, our argument here on the determinants of microloan interest rates is confined to the estimated coefficients from the 2SLS regression presented in Column 2. The key findings may be summarised as follows:

3.2.1. Age of inception of MFI and microcredit interest rates: The results in Appendix Table 5 indicate that the age of an MFI is inversely related to interest rates. This result is in line with the finding of Basharat *et al* (2015). We reported in Column 2, that the average interest rate for a mature MFI with more than eight years of experience is 0.017 percentage points lower than the rate for new-young institutions, other things being equal. This negative

differential slope rises to 0.03 percent, significant at 5 percent when age is combined with the scale dummy (i.e., MATURE*LSCALE). As noted by Cull *et al* (2007) and Campion *et al* (2010), this finding implies that knowledge accrued over time becomes increasingly important as an institution grows in size. The most likely explanation is that the negative correlation is capturing the cost-reducing effect of a movement along a learning curve over time. Established MFIs are more likely to have built up accurate information on the credit risk profile of their borrowers. They would therefore be able to adjust their lending practices, including the amount and terms of borrowing to suit the peculiar features of each customer. Consequently, it was advised by Campion *et al*, (2010) that nascent MFIs can leapfrog the difficulties associated with the early stages of a learning curve by investing in market surveys to gather client opinion on various aspects of the services which they have received. Interestingly, the differential slope coefficient on the MATURE*MICROBANK interaction term is insignificant. It appears that the impact on interest rate of experience acquired with the passage of time does not depend on whether the MFI has banking status or not.

3.2.2. Scale of operation of MFI and microcredit interest rates: With respect to the US$ amount of gross loan portfolio outstanding, three findings are evident. *First*, large scale by itself as measured by the LSCALE term is statistically insignificant. *Second,* the importance of scale economies amongst our sub-sample of mature MFIs as captured by the MATURE*LSCALE variable is significant at the 5 percent confidence level. The inference is that institutions need to have had at least eight years' experience to avoid the errors that come from growing the number of borrowers and/or by increasing the average size and duration of a loan offered. *Third,* the significantly negative coefficient on the LSCALE*MICROBANK series is large at0.09 percent compared with the slope of the other covariates which capture the relevance of scale economies in loan pricing. The suggestion is that microbanks have higher fixed costs in the form of buildings, vehicles, computers and other IT equipment which can be spread over an increasing size and number of loans. The negative coefficient indicates that these lower costs are passed on to borrower in line with Bottomley (1964a, 1964b, 1975). However, according to Gonzales (2007), Rosenberg *et al* (2009) and Campion *et al* (2010), these gains from economies of scale are exhausted beyond a certain point and unit costs begin rise. Hence, the negative coefficient here indicates that the dollar value of loan portfolio outstanding for the majority of our FSS-MFIs is below this cut-off point.

3.2.3. Microbanking and microcredit interest rates: The significant positive coefficient of 0.29 on the MICROBANK dummy in Column 2 conforms with the assertion by Christen

et.al (2003) that the extra costs of becoming a formal regulated microbank are passed on to borrowers through a higher annual average interest rate. However, as noted in section 3.2.2 above, MFIs with banking status are able to mitigate the predicted regulatory costs through economies of scale achieved by growing the dollar value of their outstanding loan portfolio. We reported that the annual interest rates for large-scale microbanks is 0.09 percentage point lower than the rate charged by their small-medium scale nonbank competitors.

3.2.3. Other MFI characteristics and microcredit interest rates: *A*nalysis of our regression model in Column 2 identified eight out of our ten control variables as statistically significant drivers of interest rates at the conventional 5 percent level, after accounting for the concurrent impact of all the regressors in equation 2, including age, scale and legal status.

Consistent with Bottomley (1964a and 1975), Rosenberg *et al* (2009), Cotler (2010) and Basharat (2015) all the four components of interest have significant positive coefficients. The most important element in terms of size and level statistical significance of the estimated coefficients is the net profit margin variable (LPROFTR). A one percentage point increase in anticipated net profit per unit of loan portfolio by our typical FSS-MFI will raise nominal interest rates by 0.12 percent, compared with 0.073 for operating costs (LOPELR), 0.03 for loan loss provisions (LPFLR) and 0.014 for cost of funding (LFELR). Contrary to the claim by Rosenberg *et al* (2009), the finding here suggests that the quest for higher profits is the most important reason for the differences in the lending interest rates among financially self-sufficient MFIs. Such may be taken as evidence of "*mission drift*" unless we presume that the higher profit is re-invested in the expansion of outreach to underserved poorer communities. Other statistically significant positive determinants of interest rates in ascending order of their estimated slope coefficients are (i) the average loan size variable (LALPB), (ii) the percentage of female borrowers (LWBP) and (iii) borrowers per staff ratio (LBPSM). Consistent with Cull *et al* (2009) and Basharat *et al* (2015), these findings confirm that an increase in both the breadth and depth of outreach leads to a rise in interest charges.

By contrast, interest rates are driven downwards by our measure of outreach to wealthier borrowers as represented by the square of loan size variable (LALPBSQ), even after controlling for the other firm characteristics in equation 2. The implication is that microlenders which target the better-off households and their medium scale enterprises with large loan sizes have succeeded in lowering operating costs, in particular administrative and

loan recovery expenses which are then passed on to their clients in the form of lower interest rates (Rosenberg *et al,* 2009; Cull *et al*, 2009; Cotler, 2010 and Basharat *et al*, 2015).

Conclusions and Policy Recommendations

This paper has contributed to the debate on the pricing of microloans by investigating how interest rates respond to: (i) knowledge which comes from the age of inception of an institution, (ii) scale economies arising from the number and size of dollar loan portfolio outstanding and (iii) the adoption of conventional banking practices. It focuses on annual time-series panel data for 300 financially self-sufficient MFIs from 107 countries across six developing regions from 2005 to 2015. The result of a random effect 2SLS estimator with related policies may be broadly summarised as follows:

First, with respect to the explanatory power of our key variables of interest — age, scale and organisation charter, the result suggest that the conversion of MFIs into legally regulated banks has the greater significant relationship with the lending interest rates. These annual interest charges are pushed up, on average by 0.29 percentage points when MFIs transform into banks after controlling for age, scale and other determinants commonly cited in the microfinance literature. However, we found evidence that the costs incurred by microbanks may be significantly reduced by spreading them over a large number and dollar value of loan portfolios. One key policy recommendation is, therefore, to assist microbanks to grow their customer base and size of loans up to the cut-off point where evidence from Gonzales (2007), Rosenberg *et al* (2009) and Campion *et al* (2010) suggests that the implied cost competitive advantage vanishes. An example of initiative to increase scale of operations is for the authorities to loosening controls on the type of products and services which banks within and outside of the microfinance industry are allowed to offer. Such deregulation should incentivise large and well-established MFIs to takeover smaller-new-young firms in order to combine their more diverse range of products offered in different markets. Armendáriz and Szafarz, (2009) reported that cross-subsidization of expenses from various market segments and products helped to lower interest rates to the poorest clients.

Second, in line with the findings of Rosenberg *et al* (2009), Cotler (2010) and Basharat *et al* (2015),the pursuit of higher profit goals by FSS-MFIs has a more noticeable positive impact than any of the other four components of interest rates, after controlling for other firm characteristics, in particular loan size and gender of the clientele. Such may be taken as evidence of "*mission drift*", indicating that profit-driven shareholders are using their

involvement to exert pressure on the strategic pricing policy of MFIs. Therefore to reduce the fear that FSS-MFIs are deviating from their original mission, the authorities may implement the following five key policy actions which could help foster competition within the sector and/or encourage profit earned to be re-invested in the institution itself rather than distributed to shareholders or senior management. They are: (i) increasing taxes levied on profits which are not re-invested in welfare maximisation initiatives, (ii) setting up of a regulatory body which oversees accountability and transparency in the recording and timely publication of the audited accounts of MFIs, dividend payments and the names of their major recipients, (iii) creating independent price comparison websites and agencies which rank the performance of MFIs on the basis of achievement of their globally stated social-objectives, (iv) advertising in national newspapers, on television, billboards, Facebook, Twitter and the other social media to encourage borrowers to seek out alternative lenders and to switch to cheaper providers and (v) campaigning aggressively in the popular media to name and shame the directors and shareholders of MFIs that charge "excessively" high interest rates.

Third, the robustness of the positive sign of our measures of the general poverty level (size of loan), depth of outreach (percentage of women borrowers) and staff productivity (borrower to staff ratio), after controlling for the quality of portfolio loans outstanding suggests that a shift to socially-orientated objectives typically leads to higher interest rates. Consequently, important policy recommendations here are derived from strategies which could be used by MFIs and their sponsors to overcome the challenges which are inextricably linked with any involvement with the poor and their microbusinesses. Such policy initiatives may require that: (i) governments offer financial assistance and technical advice to MFIs on how to manage the risk associated with income generation in those microenterprises where the poorest population predominate and to design the range of products offered accordingly, (ii) MFIs themselves invest in modern technologies such as internet and mobile phone banking in order to lower their operating costs per borrower. Besides, using mobile vans to reach more low-income clients in remote rural areas rather than setting up branches there could further lower unit transaction costs and (iii) MFIs should be incentivised to hire local officers with a specialised knowledge of the culture and locality in which borrowers live and work in order to improve ease of access to, and communication with illiterate borrowers.

Arguments in this paper provide some new insights on the differential impact of age, scale economies and legal status on microcredit interest rates. Nevertheless, we acknowledge that there are some limitations to this study. *First*, we accept the self-selection bias inherent

in the database from MIX MARKET. *Second*, a lack of data on the key variables of interests in this study forced us to group together NGOs, NBFIs and Credit unions/cooperative into a dummy for NON-BANK MFIs. This was despite the fact that their different charter status may lead to diverse management and cost structures with associated interest rate charges. Thus, an important direction for a future research will be to include separate dummies for each type of MFI in a multivariate regression model. *Third,* we are unable to carry out empirical testing on the effect on interest rate of each of our aforementioned policy propositions. Such a rigorous statistical investigation is very difficult because of a lack of data at local market levels for individual MFIs over time from widely available databases such as MIX MARKET. This policy evaluation must be the subject of further research which uses information collected from questionnaires, field visits and interviews with senior management of MFIs to assess how they adjust interest rates to reflect age of inception, dollar value of loan portfolio, ownership structure and their "double bottom line" financial and social objectives.

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Appendix Table 1: Mean and [Standard deviation]of Selected Sustainable MFI Characteristics used in the Study (2005-2015)

Items		*Credit Unions*	*NBFIs*	*NGOs*	*Rural Banks*	*Other Banks*	*MIX-MFIs*
1.	***Yield on GLP (nominal, %); YLD***						
a	New	27.67 [16.17]	35.33 [24.10]	31.965 [23.06]	46.05 [20.30]	33.405 [20.41]	33.77 [22.78]
b	Young	24.3 [13.75]	36.71 [23.71]	34.63 [17.56]	36.43 [16.43]	28.8 [24.30]	32.43 [21.30]
c	Mature	19.32 [9.19]	30.34 [16.51]	29.23 [15.97]	27.48 [10.50]	25.43 [16.74]	27.31 [15.56]
d	Small scale	20.66 [13.64]	39.49 [24.29]	34.11 [19.13]	33.73 [12.16]	35.15 [35.70]	32.68 [20.73]
e	Medium scale	21.77 [9.39]	35.39 [19.56]	30.33 [14.34]	27.31 [11.26]	38.76 [16.75]	30.13 [16.33]
f	Large scale	18.61 [5.65]	28.12 [16.14]	26.52 [14.13]	26.09 [9.15]	24.48 [16.08]	25.78 [15.02]
g	All MFI sample	20.05 [10.93]	31.68 [20.16]	29.86 [16.71]	28.14 [11.51]	26.80 [19.11]	28.48 [17.75]
2	***Financial expense (% GLP);FELR***						
a	New	6.63 [8.84]	5.13 [6.86]	3.44 [11.90]	4.31 [5.44]	4.83 [5.71]	4.46 [8.42]
b	Young	6.88 [8.01]	6.44 [10.54]	4.29 [4.79]	6.33 [4.72]	7.02 [4.37]	6.96 [8.24]
c	Mature	5.17 [5.40]	6.51 [4.52]	5. 92 [15.02]	7.19 [4.83]	7. 92 [5.02]	6. 66 [10.46]
d	Small scale	5.52 [6.75]	5.82 [9.60]	4.58 [10.76]	7.02 [6.00]	4.07 [5.28]	5.87 [9.39]
e	Medium scale	7. 41 [7.05]	6.52 [6.30]	5. 53 [4.35]	7.33 [4.31]	5.67 [6.31]	6.23 [5.60]
f	Large scale	4.38 [3.88]	7.43 [4.30]	7.96 [23.57]	7.09 [3.37]	7.39 [4.65]	7. 58 [12.66]
g	All MFI sample	5.58 [6.39]	6.28 [7.13]	5.88 [13.70]	7.78 [4.93]	7.73 [5.08]	6. 02 [9.85]
3	***Operating expense (% GLP);*** OPELR						
a	New	28. 84 [29.24]	39.32 [54.54]	42.77 [54.35]	37.49 [24.20]	51.87 [56.96]	40.07 [52.14]
b	Young	18.56 [15.32]	28.55 [23.27]	28.02 [20.04]	29.61 [18.83]	29.16 [35.44]	26.03 [22.97]
c	Mature	15.36 [11.94]	22.29 [19.73]	24.78 [20.16]	17.89 [9.66]	19.62 [12.73]	21.08 [18.04]
d	Small scale	18.56 [19.04]	37.09 [44.37]	32.48 [30.75]	21.83 [14.56]	55.43 [60.12]	30.73 [33.92]
e	Medium scale	14.34 [8.46]	27.29 [20.10]	23.17 [14.47]	19.59 [11.73]	42.89 [42.33]	24.02 [18.42]
f	Large scale	13.96 [8.03]	18.41 [14.62]	17.12 [11.70]	16.22 [8.32]	18.65 [13.76]	17.37 [12.97]
g	All MFI sample	16.17 [14.85]	26.71 [29.74]	26.32 [23.75]	19.88 [12.32]	24. 43 [28.19]	24. 61 [24.86]
	Provision for loan impairment (% GLP);PFLR						
a	New	1.72 [8.34]	1.15 [3.25]	1.49 [3.16]	0.46 [0.99]	4.73 [9.33]	1.79 [5.02]
b	Young	1.04 [2.24]	2.18 [4.00]	1.65 [2.90]	1.68 [2.67]	3.34 [4.42]	2.14 [3.51]

c	Mature	1.88 [2.68]	2.47 [4.04]	3.51 [45.20]	0.35 [1.90]	2.48 [5.80]	2.75 [29.45]
d	Small scale	1.68 [4.35]	1.59 [4.26]	1.64 [8.60]	0.13 [1.91]	2.95 [14.26]	1.91 [6.77]
e	Medium scale	1.75 [2.51]	2.86 [4.04]	2.33 [3.94]	0.76 [2.23]	2.71 [5.27]	2.97 [3.76]
f	Large scale	1.37 [2.00]	2.76 [3.40]	6.72 [82.58]	0.56 [1.34]	2.25 [4.42]	3.34 [42.46]
g	All MFI sample	1.72 [3.53]	2.28 [3.90]	2.79 [39.66]	0.57 [1.94]	2.77 [6.15]	2.71 [24.50]
4	***Net profit (% GLP);PROFTLR***						
a	New	-1.71 [23.36]	-2.15 [35.81]	-2.18 [25.40]	4.46 [5.97]	-6.65 [21.53]	-2.46 [30.32]
b	Young	2.76 [11.12]	4.14 [11.95]	4.09 [12.86]	7.65 [9.65]	1.35 [11.25]	3.38 [12.02]
c	Mature	2.77 [8.30]	3.87 [12.52]	0.42 [110.92]	5.65 [4.74]	5.59 [10.86]	2.74 [72.35]
d	Small scale	1.19 [14.64]	0.87 [29.43]	1.75 [26.10]	5.11 [5.89]	-0.71 [31.08]	1.87 [24.41]
e	Medium scale	1.46 [5.29]	4.15 [13.55]	3.26 [10.48]	5.22 [5.71]	0.33 [13.53]	3.66 [10.75]
f	Large scale	2.45 [4.55]	4.23 [6.60]	-4.63 [202.09]	4.73 [3.11]	3.66 [8.72]	1.35 [103.79]
g	All MFI sample	1.93 [11.16]	2.23 [19.34]	0.53 [97.63]	5.68 [5.39]	2.08 [13.24]	1.94 [61.05]
5	***Portfolio at risk after 30 days (% GLP);PAR30***						
a	New	3.33 [4.19]	3.02 [7.94]	1.38 [3.22]	13.24 [14.03	5.47 [9.67]	3.22 [7.45]
b	Young	5.76 [5.98]	5.17 [8.79]	3.07 [6.10]	9.48 [8.90]	4.61 [8.72]	4.53 [7.75]
c	Mature	8.36 [10.14]	6.49 [8.40]	7.41 [11.33]	10.37 [12.69]	5.04 [8.40]	7.01 [10.47]
d	Small scale	7.68 [10.93]	5.73 [8.72]	6.41 [11.07]	12.27 [15.35]	8.95 [14.51]	6.22 [11.02]
e	Medium scale	7.48 [7.46]	6.55 [9.75]	6.53 [10.56]	11.51 [9.66]	6.15 [9.71]	6.94 [9.87]
f	Large scale	7.39 [6.38]	5.25 [7.25]	5.16 [8.90]	8.35 [10.49]	4.13 [7.57]	5.94 [7.92]
g	All MFI sample	7.78 [9.20]	5.44 [8.48]	6.68 [10.46]	10.36 [12.46]	5.88 [8.62]	6.89 [9.78]
6	***Average loan balance per borrower (per capita GNI);ALPBP***						
a	New	1.25 [1.76]	1.18 [3.35]	0.37 [0.44]	0.13 [0.37]	2.45 [5.68]	1.37 [3.11]
b	Young	1.29 [1.77]	0.52 [1.80]	0.63 [0.39]	0.27 [0.52]	2.45 [4.35]	0.54 [1.96]
c	Mature	1.67 [2.45]	0.95 [1.36]	0.54 [0.66]	0.39 [0.57]	1.86 [6.80]	0.72 [2.42]
d	Small scale	1.37 [2.60]	0.76 [2.51]	0.44 [0.29]	0.92 [0.51]	0.63 [0.81]	0.79 [1.80]
e	Medium scale	1.69 [2.22]	0.93 [1.57]	0.49 [0.42]	0.93 [0.48]	1.84 [4.17]	0.97 [1.56]
f	Large scale	1.42 [1.26]	0.68 [1.74]	0.93 [1.09]	0.32 [0.77]	2.28 [6.82]	1.91 [3.47]
g	All MFI sample	1.85 [2.27]	0.84 [2.01]	0.39 [0.61]	0.98 [0.56]	2.13 [6.25]	0.84 [2.43]
7	***Female borrower (% total borrowers);WBP***						
a	New	57.36 [27.09]	62.93 [26.32]	77.73 [32.39]	47.20 [24.09]	41.35 [21.85]	63.13 [29.39]

b	Young	54.82 [23.52]	61.81 [25.95]	79.83 [42.65]	53.90 [26.68]	42.53 [18.63]	64.39 [33.52]
c	Mature	56.70 [215.47]	59.53 [24.71]	75.19 [23.70]	50.57 [32.18]	57.55 [23.44]	65.42 [88.58]
d	Small scale	51.83 [22.42]	61.07 [24.73]	79.15 [30.25]	43.16 [29.29]	53.89 [24.45]	66.76 [29.97]
e	Medium scale	77.48 [348.81]	60.52 [25.52]	74.23 [25.14]	54.13 [31.25]	61.72 [27.32]	68.67 [136.01]
f	Large scale	39.92 [19.33]	58.85 [25.84]	74.48 [26.26]	61.45 [31.30]	50.49 [22.36]	59.83 [26.88]
g	All MFI sample	56.19 [180.57]	60.21 [25.38]	76.51 [28.07]	48.85 [31.14]	50.72 [23.67]	63.61 [75.61]
8	***Borrower per staff member;BPSM***						
a	New	71.18 [76.97]	103.11 [132.10]	149.33 [116.95]	111.73 [87.81]	423.95 [1939.97]	143.81 [630.63]
b	Young	104.50 [115.52]	127.30 [119.37]	155.57 [92.49]	107.71 [75.71]	116.96 [448.25]	130.99 [170.20]
c	Mature	118.81 [129.54]	138.29 [139.15]	158.03 [128.78]	107.36 [115.20]	113.80 [87.80]	139.98 [128.78]
d	Small scale	82.44 [89.05]	103.46 [129.57]	149.74 [122.74]	96.82 [141.11]	45.35 [47.38]	118.11 [122.72]
e	Medium scale	141.56 [163.76]	114.23 [89.86]	159.27 [129.57]	113.26 [56.18]	182.71 [558.22]	139.54 [165.13]
f	Large scale	142.97 [120.95]	160.58 [153.30]	171.53 [113.07]	120.38 [122.57]	162.57 [790.60]	160.75 [385.06]
g	All MFI sample	111.65 [123.65]	128.14 [133.23]	157.92 [122.92]	107.72 [110.71]	153.45 [724.60]	137.57 [248.59]
9	***Equity capital (% total assets);ECAR***						
a	New	24.53 [20.67]	44.91 [32.04]	49.06 [44.82]	25.76 [18.01]	41.20 [26.20]	42.04 [34.32]
b	Young	27.28 [20.13]	40.47 [29.74]	43.07 [34.13]	15.34 [9.36]	22.95 [21.00]	36.54 [29.85]
c	Mature	29.94 [81.53]	28.76 [21.23]	37.05 [26.52]	15.62 [8.26]	20.83 [21.57]	30.81 [39.76]
d	Small scale	31.96 [80.52]	48.54 [32.75]	44.76 [33.23]	19.59 [11.46]	36.53 [45.30]	40.81 [46.89]
e	Medium scale	30.74 [72.28]	35.72 [22.75]	36. 45 [26.33]	13.73 [7.53]	37.98 [25.51]	32.83 [36.21]
f	Large scale	20.05 [12.93]	22.87 [15.45]	29.18 [22.00]	13.79 [4.85]	19.27 [15.40]	23.90 [17.48]
g	All MFI sample	28.83 [69.42]	35.86 [26.91]	38.85 [29.70]	16.21 [9.45]	23.01 [23.11]	33.28 [37.59]

Notes: (i) Definitions of variables are provided in Section 2 in the text. Datais abstracted from MIX market database at: www.mixmarket.com. (ii) The categories New, Young and Mature MFIs have been in operation for 1 to 4 years, 5 to 8 years and more than 8 years respectively. (iii) The group of Small scale MFIs have gross loan portfolio (GLP) outstanding of less than US$2million in SSA, Asia, ECA and MENA. The figure for Latin America is less than $4 million. Medium-scale MFIs have GLP of between US$2million and US$8 million in SSA, Asia, ECA and MENA. The corresponding figure of Latin America is between US$4 million and US$15 million. Large scale MFIs in SSA, Asia, ECA and MENA have GLP of more than US$8 million while those in Latin America have GLP of more than US$15 million. Numbers reported in [……] are standard deviations

Appendix Table 2: Independent Variables and Expected Relationships

Variable Symbol	Variable Name	Expected Relationship
MATURE	A dummy variable which captures that the number of years the institution has been in operation. It takes a value of 1if the institution has more than eight years of operation and 0 otherwise	**-**
LSCALE	A dummy variable which captures the size of the gross loan portfolio outstanding in US$. It takes a value of 1 for MFIs which are classified as large scale in the MIX market database and 0 otherwise.	**-**
MICROBNK	A dummy variable which takes a value of 1 if the MFI is classified as a "rural bank" or "bank" and 0 for our three other types of institutions — NGOs, NBFIs and credit unions or cooperative societies.	**+**
LFELR	The natural logarithm of financial expenses percentage of gross loan portfolio	**+**
LOPER	The natural logarithm of operating expenses as a percentage of gross loan portfolio	**+**
LPFLR	The natural logarithm of provision for loan impairment as a percentage of gross loan portfolio	**+**
LPROFTR	The natural logarithm of net profit as a percentage of gross loan portfolio	**+**
LPAR30	The natural logarithm of provision for loan impairment as a percentage of gross loan portfolio	**+**
LWBR	The natural logarithm of women borrowers as a percentage of total borrowers	**+**
LBPSM	The natural logarithm of borrower per staff member	**-**
LECAR	The natural logarithm of one plus equity capital as a percentage of total assets in order to reduce the range of variation and surmount the problems associated with negative observations. According to MIX, the equity variable is adjusted for donations and other forms of subsidies.	**+**
LALPB	The natural logarithm of average loan balance per borrower per capita of gross national income (GNI)	**+**
LALPBSQ	The natural logarithm of the square of average loan balance per borrower per capita of gross national income (GNI)	**-**

Appendix Table 3: Descriptive statistics of variables at natural logarithm levels used in the regression

	LYLD	MATURE	LSCALE	MATURE* LSCALE	MICRBNK	MATURE* MICRBNK	LSCALE* MICRBNK	LFELR	LOPELR	LPFLR	LPROFTR	LPAR30	LWBP	LBPSM	LECAR	LALPB
Mean	**0.252**	**0.740**	**0.364**	**0.306**	**0.130**	**0.101**	**0.074**	**-3.019**	**-1.674**	**0.024**	**0.027**	**-3.519**	**-0.566**	**4.672**	**0.2593**	**-2.302**
Median	**0.243**	**1.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**-2.777**	**-1.711**	**0.015**	**0.038**	**-3.297**	**-0.468**	**4.745**	**0.2187**	**-2.337**
Max	**1.059**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.062**	**1.128**	**0.651**	**1.939**	**0.000**	**0.375**	**8.933**	**2.507**	**7.082**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**-9.145**	**-5.203**	**-0.358**	**-2.888**	**-9.210**	**-6.266**	**1.099**	**-2.735**	**-11.756**
Std. Dev	**0.141**	**0.439**	**0.481**	**0.461**	**0.336**	**0.301**	**0.261**	**1.060**	**0.698**	**0.038**	**0.153**	**1.421**	**0.578**	**0.760**	**0.179**	**2.375**
Skewness	**0.489**	**-1.095**	**0.564**	**0.841**	**2.202**	**2.653**	**3.265**	**-1.844**	**-0.125**	**3.615**	**-6.388**	**-0.851**	**-2.626**	**-0.478**	**-0.466**	**0.159**
Kurtosis	**4.145**	**2.200**	**1.318**	**1.706**	**5.848**	**8.037**	**11.66**	**7.958**	**3.990**	**42.73**	**99.59**	**4.366**	**17.618**	**4.995**	**29.70**	**3.077**
Jarque-Bera [prob.value]	**375.74 [0.000]**	**902.18 [0.000]**	**680.10 [0.000]**	**746.10 [0.000]**	**4560.21 [0.000]**	**8875.83 [0.000]**	**19518.82 [0.000]**	**6331.20 [0.000]**	**172.88 [0.000]**	**270438.3 [0.000]**	**1574384 [0.000]**	**790.09 [0.000]**	**40012.46 [0.000]**	**811.71 [0.000]**	**118390.8 [0.000]**	**17.839 [0.000]**
No. Obs	**3000**	**3000**	**3000**	**3000**	**3000**	**3000**	**3000**	**3000**	**3000**	**3000**	**3000**	**2780**	**2790**	**2890**	**2800**	**2785**

LYLD = the natural log of the logarithm of nominal portfolio yield variable; **MATURE** is a dummy variablewhich takes a value of1 if the institution has more than eight years of operation and 0 otherwise. **LSCALE** is dummy variable which takes a value of 1 for MFIs which are classified as large scale in the MIX market database and 0 otherwise. **MATURE*LSCALE** is the product of the dummies for mature with large scale MFIs. **MICRBNK** is a dummy variable which takes a value of 1 if the MFI is classified as a "rural bank" or "bank" and 0 for our three other types of institutions —NGOs, NBFIs and credit unions or cooperative societies. **MATURE*MICRBNK** is an interaction term which is created by multiplying the dummies for mature with microbank MFIs. **LSCALE*MICRBNK** is the product of the dummiesfor large scale with microbank MFIs. **LFELR** is the natural logarithmoffinancial expenses percentage of gross loan portfolio. **LOPELR** is the natural ofoperating expenses as a percentage of gross loan portfolio.**LPFLR** is the natural logarithm ofprovision for loan impairment as a percentage of gross loan portfolio. **LPROFTR**is the natural logarithm ofNet profit as a percentage of gross loan portfolio. **LPAR30** is the natural logarithm ofprovision for loan impairment as a percentage of gross loan portfolio. **LWBP** is the natural logarithm ofwomen borrowers as a percentage of total borrowers. **LBPSM** is the natural logarithm ofbborrower per staff member. **LECAR** is the natural logarithm ofEquity capital as a percentage of total assets. **LALPB** is the natural logarithm of aaverage loan balance per borrower per capita of gross national income.

Appendix Table 4: Pairwise Correlation Analysis: Kendall's tau-b: Sample 2005 to 2010

	LYLD	MATURE	LSCALE	MATURE* LSCALE	MICRBNK	MATURE* MICRBNK	LSCALE* MICRBNK	LFELR	LOPELR	LPFLR	LPROFTR	LPAR30	LWBP	LBPSM	LECAR	LALPB
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1															
2	-0.094***	1														
3	-0.064***	0.173***	1													
4	-0.071***	0.394***	0.878***	1												
5	-0.003	0.031**	0.163***	0.128***	1											
6	-0.022*	0.198***	0.158***	0.207***	0.866***	1										
7	-0.018	0.044***	0.372***	0.307***	0.730***	0.663***	1									
8	0.159***	-0.003	0.100***	0.085***	0.108***	0.109***	0.096***	1								
9	0.478***	-0.129***	-0.222***	-0.216	-0.004	-0.052***	-0.049***	-0.042***	1							
10	0.148***	-0.015	0.028**	0.017	-0.017	-0.042***	0.012	0.026**	0.167***	1						
11	0.176***	0.004	0.034***	0.034**	0.038***	0.051***	0.016	0.001	-0.052***	-0.124***	1					
12	-0.034***	0.121***	-0.059***	-0.016	0.004	0.016	-0.029**	-0.008	0.066***	0.247***	-0.188***	1				
13	0.099***	0.009	-0.086***	-0.074***	-0.107***	-0.064***	-0.093***	0.002	0.121***	-0.022**	0.011	-0.132***	1			
14	-0.035***	0.080***	0.126***	0.122***	-0.057***	-0.022*	-0.017	-0.026**	-0.112***	-0.016	0.051***	-0.132***	0.285***	1		
15	0.119***	-0.069***	-0.203***	-0.194***	-0.155***	-0.168***	-0.135***	-0.308***	0.153***	-0.002	0.153***	-0.028**	-0.013	-0.035***		
16	-0.210***	0.005	0.135***	0.122***	0.121***	0.100***	0.124***	-0.018*	-0.225***	-0.014	-0.013	0.085***	-0.389***	-0.349***	-0.059***	1

Notes: (i) Asterisks *,**,*** indicate the statistical significance at the 10%, 5% and 1% confidence levels respectively. No asterisk means that the coefficient is not statistically different from zero. (ii) Included observations after adjustment: 3000. (iii) Definitions of variables and expected effects on interest income are provided in Appendix Table 2. **LYLD** = the natural log of the logarithm of nominal portfolio yield variable; **MATURE** is a dummy variablewhich takes a value of1 if the institution has more than eight years of operation and 0 otherwise. **LSCALE** is dummy variable which takes a value of 1 for MFIs which are classified as large scale in the MIX market database and 0 otherwise. **MATURE*LSCALE** is the product of the dummies for mature with large scale MFIs. **MICRBNK** is a dummy variable which takes a value of 1 if the MFI is classified as a "rural bank" or "bank" and 0 for our three other types of institutions —NGOs, NBFIs and credit unions or cooperative societies. **MATURE*MICRBNK** is an interaction term which is created by multiplying the dummies for mature with microbank MFIs. **LSCALE*MICRBNK** is the product of the dummiesfor large scale with microbank MFIs. **LFELR** is the natural logarithmoffinancial expenses percentage of gross loan portfolio. **LOPELR** is the natural ofoperating expenses as a percentage of gross loan portfolio.**LPFLR** is the natural logarithm ofprovision for loan impairment as a percentage of gross loan portfolio. **LPROFTR**is the natural logarithm ofNet profit as a percentage of gross loan portfolio. **LPAR30** is the natural logarithm ofprovision for loan impairment as a percentage of gross loan portfolio. **LWBP** is the natural logarithm ofwomen borrowers as a percentage of total borrowers. **LBPSM** is the natural logarithm ofbborrower per staff member. **LECAR** is the natural logarithm ofEquity capital as a percentage of total assets. **LALPB** is the natural logarithm of aaverage loan balance per borrower per capita of gross national income.

Appendix Table 5: Regression Results

	Column 1	***Column 2***
Explanatory variables	***OLS. Regression***	***2SLS. Regression***
CONSTANT	0.378 [0.000]***	0.3616 [0.000]***
MATURE	-0.010 [0.100]*	-0.017 [0.052]**
LSCALE	0.007 [0.457]	0.011 [0.743]
MICROBANK	0.237 [0.004]***	0.291 [0.0001]***
MATURE*LSCALE	-0.013 [0.168]	-0.026 [0.040]**
MATURE*MICROBANK	0.007 [0.731]	0.031 [0.385]
LSCALE* MICROBANK	-0.003 [0.844]	-0.090 [0.028]**
LFELR	0.015 [0.000]***	0.014 [0.000]***
LOPELR	0.081 [0.000]***	0.0729 [0.000]***
LPFLR	0.0884 [0.036]**	0.031 [0.047]**
LPROFTR	0.124 [0.000]***	0.124 [0.000]***
LPAR30	0.001 [0.407]	0.005 [0.061]*
LWBP	0.014 [0.003]***	0.047 [0.025]**
LBPSM	0.008 [0.135]	0.012 [0.050]**
LECAR	0.025 [0.081]*	-0.014 [0.444]
LALPB	-0.194 [0.955]	0.224 [0.054]**
LALPBSQ	0.098 [0.609]	-0.114 [0.049]**
Cross-sections included	300	300
Total panel (unbalanced) observations	2700	2000
Adjusted R-squared	0.7679	0.8618
F-statistic [probability]	13.91[0.000]***	19.65 [0.000]***
Probability (J-statistic)	……..	0.2879
Durbin-Watson statistics	1.382	2.177

Notes: (i) Asterisks *,**,*** indicate statistical significance at the 10%, 5% and 1% confidence level respectively, (ii) Numbers in [….] are the estimated probability values, (iii) The dependent variable of all the models are the natural logarithm of nominal portfolio yield variable (LYLD), (vi) The lower number of observations in 2SLS vis-à-vis the OLS method is due to adjustments in data available for the variables used as instrument in the regression analysis .

Definitions of variables are provided in Appendix 2. For brevity, estimates for cross-section and time-period dummies are not reported here, but are available from the author on request.

The equation which is analysed here is summarised in equation 2 as follows:

$$Log(YLD_{it}) = \beta_0 + B_1(MATURE_{it}) + \beta_2(LSCALE_{it}) + \beta_3(MICROBNK_{it}) + \beta_4(MATURE_{it} * LSCALE_{it}) + \beta_5(MATURE_{it} * MICROBNK_{it}) + \pi_1 Log(FELR_{it}) + \pi_2 Log(OPER_{it}) + \pi_3(PFLR_{it}) + \pi_4 Log(PROFTR_{it}) + \pi_5 Log(PAR30_{it}) + \pi_6 Log(WBR_{it}) + \pi_7 Log(BPSM_{it}) + \pi_8 Log(1 + ECAR_{it}) + \pi_9 Log(ALPB_{it}) + \pi_{10} Log(ALPBSQ_{it}) + \alpha_i + \tau_t + \varepsilon_{it} \ldots\ldots (Eqn\ 2)$$