

Currency Risk and Microcredit Interest Rates

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ABSTRACT

Foreign currency debt provides additional access to capital and offers funds in favorable and flexible terms to microfinance institutions (MFIs). Yet, we find that the use of foreign currency debt, on average, leads to higher microcredit interest rates. We also find that MFIs operating in countries with pegged exchange rate regimes and profit MFIs are better able to mitigate foreign currency risk. The results of the paper suggest that local currency debt is a better option for MFIs if the goal is to provide microcredit at lower interest rates.

JEL classification: G2, O2

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1. Introduction

Microfinance has long been considered as a tool for sustainable development and evolved rapidly to become a global industry. Since its inception, donations and subsidies have been the main source of funding for microfinance institutions (MFIs). Lately, however, the concern to maintain their development objectives and financial sustainability has motivated many MFIs to turn to international capital markets where most of the foreign debt is denominated in foreign currency. Many MFIs are not familiar with foreign currency risk as they belong to a relatively new industry that witnesses an enormous growth and is still exploring the best practices in doing business. Additionally, MFIs are particularly vulnerable to foreign currency risk since they mostly operate in developing countries where the risks of devaluation, convertibility, and transfer of currencies are high. Unless it is well managed, the foreign currency risk is expected to be priced into microcredit interest rates; the most controversial aspect of microfinance.

The issue of the microcredit interest rates has been the most debated in the modern move of microfinance. Advocates of microfinance regularly assert that operating costs of providing microcredit are inherently high. These high microcredit interest rates are inevitable if MFIs look for covering high costs, seek independence from donors, and aim to achieve financial sustainability.² Opponents argue that the microfinance move exploits poor borrowers through excessive microcredit interest rates. The little bargaining power of the poor and the increasing commercialization movement could mean higher microcredit interest rates which raises fundamental concerns on the social and development missions of microfinance. The debate and research on what “high is high” and what “fair is fair” does not seem to end soon; Hudon and Ashta (2013). When asking “how high is high?” it becomes imperative to reserve judgment long enough to examine the factors that determine microcredit interest rates.

Several empirical studies have identified many contributing components in the determination of interest rates charged by MFIs. The most important component is the cost structure (Rosenberg et al., 2009;

² MFIs face high administrative and personnel costs. Lending a given amount in many small loans costs more than lending it in few large loans and because microfinance involves labor-intensive operation, personnel costs are notably high as well. Interest charged on loans is the main source of income for MFIs and, because MFIs incur considerable costs, the interest rates are similarly high. In addition, many MFIs are socially oriented and operate in remote areas where it costs more to serve. Microcredit interest rates need to be high if MFIs were to continue and operate independently from donors.

Gonzalez, 2010; Mersland and Strøm, 2012; D'espallier et al., 2012; Robert, 2013). Other major components include the gender of borrowers (D'espallier et al., 2012), the profit status of the MFI (Roberts, 2013), the competition (McIntosh and Wydick, 2005; Cull et al., 2009; Cull et al., 2015), and the country specific macroeconomic and macro-institutional elements (Hartarska, 2005; Ahlin et al., 2011). The empirical literature has overlooked the impact of foreign currency risk on microcredit interest rates. While there exists many discussion papers on the nature and management of foreign exchange risk (Holden and Holden, 2004; Crabb, 2004; Cavazos, 2004; Fernando, 2005; Featherston et al., 2006; Littlefield and Kneiding, 2009; Apgar and Reille, 2010; Abrams and Prieur, 2011), there is no empirical work that examine the impact of foreign exchange risk on the MFIs' financial indicators such as microcredit interest rates. An exception is Al-Azzam and Mimouni (2016) who use data on 481 MFIs from 73 countries for the years 2003–2010 and find that microcredit borrowers pay higher interest rates in countries with floating exchange rate regimes. The current paper is different in that it attempts to investigate several unanswered research questions. First, do MFIs that operate in countries with floating exchange rate regimes charge higher microcredit interest rates? Second, do MFIs that rely heavily on foreign currency debt charge higher microcredit interest rates? Third, do MFIs that rely on foreign currency debt but operate in countries with different exchange rate regimes charge different microcredit interest rates? Fourth, does the profit orientation of an MFI have any consequences on foreign currency risk? This paper is the first to empirically tackle these questions.

Using data from the MIX Market, International Monetary Fund, and the World Bank for the years 2003–2014, this paper documents new interesting results. First, MFIs operating in countries with floating exchange rate regimes tend to charge higher microcredit interest rates. Second, MFIs with more reliance on foreign currency debt charge higher microcredit interest rates only in countries with floating exchange rate regimes. Third, profit MFIs seem to be less susceptible to foreign currency risk. These results stress the need for local monetary authorities and policymakers to assist MFIs overcoming foreign exchange risk if the goal is to provide the poor with microcredit at lower interest rates.

The rest of the paper is organized as the following. Section 2 states the hypotheses of this study. Section 3 describes the data and the variables used in the paper. Section 4 discusses the estimation techniques and Section 5 discusses the empirical results. Section 6 reports the robustness tests

implemented and clarifies the caveats of the study. Finally, section 7 concludes and offers some policy implications

2. Hypotheses

We would like to emphasize that there is no well-developed theoretical or empirical works that address the questions of this paper directly. Nevertheless, there are many empirical papers that model microcredit interest rates. Among many others, well known empirical models that use similar data to ours include Ahlin et. al (2011), Mersland and Strøm (2009), Roberts (2013), and D'Espallier et al. (2011). We extend these empirical models by introducing the impact of foreign exchange risk on microcredit interest rates.

Foreign currency debt has been a key driver in the expansion of the microfinance industry. It brings numerous advantages to MFIs by providing capital that might not be available domestically. The growth of the microfinance industry and the donors' pressure to achieve financial sustainability have caused many MFIs to fund their growth through different channels including the international capital markets. According to El-Zogbi, Gähwiler and Lauer (2011) and as of December 2009, the cross-border funds to MFIs surpassed 21 billion US dollars. The foreign currency debt helps mobilize domestic funds and attracts future equity investors. In addition, the terms on foreign currency debt may be more favorable and flexible. According to the data used in this paper, the average term on foreign currency debt is approximately 61 months compare to 51 months on local currency debt. In addition, the average interest rate on foreign currency debt is 5.7 percent compared to 7.2 percent on the local currency debt. According to a survey on the MFIs' funding needs in 2004 performed by the Consultative Group to Assist the Poor (CGAP) and the Microfinance Information Exchange (MIX), MFIs consider foreign debt to be more accessible, less expensive than local debt, and available in better terms.

Broadly speaking, MFIs have access to international capital markets through three main channels: public investors known as international development finance institutions, individual investors, and institutional investors. The development financial institutions aim at supporting a sustainable private sector in developing countries through quasi-commercial loans, equity, and guarantees to MFIs. Individual investors are socially motivated and invest as venture philanthropists. Institutional investors are usually attracted by potential gains and include international banks, pension funds, and insurance companies. Between the years 2007 and 2012, the MIX Market was collecting data from individual

MFIs on the lender type and origin of each of their non-deposit liabilities with external parties. These lenders range from small local NGOs to large international funds and from development finance institutions to government programs and local banks. Sapundzhieva (2011) summarizes the types of lenders, subtypes, and their definitions as shown in Table 1.

Table1
Types of foreign currency borrowings

<i>Name</i>	<i>Subtype</i>	<i>Definition</i>
<i>Development Finance Institution</i>	<i>None</i>	<i>Financial institutions owned by a government or governments and that raise private capital to finance projects with development objectives</i>
<i>Government</i>	<i>Multi- and Bilateral</i>	<i>Bilateral or multilateral aid agencies, owned by governments</i>
<i>Government</i>	<i>Development Programs</i>	<i>Government or other public program with development objectives.</i>
<i>Government</i>	<i>Government Agency/Program</i>	<i>The administration, departments, or agencies of any sovereign entity</i>
<i>Government</i>	<i>Regulator</i>	<i>A domestic central bank</i>
<i>Financial Institution</i>	<i>Commercial Bank</i>	<i>Bank or other regulated financial institution where private entities are majority shareholders</i>
<i>Financial Institutions</i>	<i>Cooperative Society</i>	<i>Financial institution owned by its members, not external shareholders</i>
<i>Financial Institutions</i>	<i>Public Bank</i>	<i>Bank or other regulated financial institution where the government is a majority stakeholder</i>
<i>Fund</i>	<i>None</i>	<i>Professionally managed type of collective investment scheme that pools money from many investors</i>
<i>Other</i>	<i>Private Cooperation</i>	<i>Registered legal entities. The category does not include governments, non-profits, funds or financial institutions.</i>
<i>Other</i>	<i>Individuals</i>	<i>A person or persons</i>
<i>Other</i>	<i>NGO</i>	<i>Non-government organization</i>
<i>Other</i>	<i>Foundation</i>	<i>A non-profit corporation or other non-profit entity</i>

Table 2 shows the percentage of foreign currency debt from local and cross border sources obtained using the sample of MFIs considered in this paper for the years 2007-2012. It is clear from the table that cross-border private funds play a crucial role in providing foreign currency funds. Overall, 49.62%

of foreign debt is provided by cross-border private funds. Cross-border NGOs rank second with 8.42% of the total foreign currency debt followed by multi and bilateral development agencies who provide only 6.53% of foreign currency debt. Commercial banks play an important role as well. However, local commercial banks are more active and provide more foreign currency funds.

No doubt that foreign currency debt has various advantages to MFIs. However, financing with cross border debt exposes MFIs to foreign exchange risk. Featherston et al. (2006) identify three types of foreign exchange risk including devaluation, convertibility and transfer risk. Risk of devaluation arises when MFIs acquire debt in foreign currencies, usually in USD and EUR, and lend these funds in local currencies creating a mismatch between the currencies in which the assets and liabilities are denominated. Risk of convertibility refers to a situation where MFIs with obligations denominated in foreign currencies are not able to repay in these currencies due to government regulations. Transfer risk occurs when a government has restrictions on transfers of foreign currency outside the country. The MFI may have, in both convertibility and transfer risks, the ability to repay in foreign currency, but cannot do so because of governmental restrictions on sales or transfer of foreign currency.

As defined in a later section, countries use three basic types of exchange rate regimes which include floating exchange rate; a soft peg exchange rate; and a hard peg exchange rate. These exchange rate regimes can affect MFIs' risk in a variety of ways. If the country has a floating currency, the value of that currency relative to foreign currencies can be volatile on a day-to-day basis implying higher risk for MFIs. On the contrary, if the country has a soft peg exchange rate regime, the value of its currency relative to foreign currencies is likely to be stable and even more stable if the country adopts hard peg exchange rate regime implying lower devaluation risk for MFIs.

Table 2

Percentage of foreign currency borrowing from local and cross border sources for the years 2007 – 2012.

	2007	2008	2009	2010	2011	2012	Total
Commercial Bank	7.84%	5.56%	7.39%	8.92%	6.41%	6.11%	7.04%
Cross Border	1.49%	2.24%	2.95%	3.13%	3.40%	2.90%	2.78%
Local	6.35%	2.83%	4.22%	5.67%	3.01%	3.21%	4.08%
Unknown	0.00%	0.48%	0.23%	0.12%	0.00%	0.00%	0.18%
Cooperative Society	3.11%	3.04%	2.08%	1.83%	2.31%	1.83%	2.36%
Cross Border	2.57%	2.40%	1.91%	1.65%	1.99%	1.37%	2.00%
Local	0.54%	0.64%	0.17%	0.18%	0.19%	0.46%	0.34%
Unknown	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.02%
Development Program	1.49%	1.34%	1.33%	1.00%	0.58%	0.31%	1.05%
Cross Border	0.14%	0.16%	0.17%	0.47%	0.13%	0.00%	0.21%
Local	1.35%	1.18%	1.16%	0.53%	0.45%	0.31%	0.85%
Foundation	2.03%	2.14%	1.50%	1.83%	1.86%	2.29%	1.89%
Cross Border	0.81%	1.82%	1.33%	1.65%	1.79%	2.29%	1.62%

Local	1.22%	0.32%	0.17%	0.18%	0.06%	0.00%	0.27%
Fund	50.27%	51.39%	55.46%	53.81%	55.09%	33.59%	51.93%
Cross Border	47.43%	46.90%	53.09%	52.10%	54.32%	33.13%	49.62%
Local	0.27%	0.21%	0.29%	0.41%	0.64%	0.31%	0.36%
Unknown	2.57%	4.27%	2.08%	1.30%	0.13%	0.15%	1.94%
Government Agency/Program	8.92%	3.63%	4.10%	2.54%	3.33%	2.14%	3.81%
Cross Border	1.49%	0.11%	0.17%	0.18%	0.32%	0.00%	0.29%
Local	7.43%	3.47%	3.93%	2.30%	2.95%	2.14%	3.48%
Unknown	0.00%	0.05%	0.00%	0.06%	0.06%	0.00%	0.04%
Individuals	0.68%	0.48%	0.87%	0.77%	0.06%	0.15%	0.53%
Unknown	0.68%	0.48%	0.87%	0.77%	0.06%	0.15%	0.53%
MFI	2.43%	1.55%	0.87%	0.59%	1.41%	0.76%	1.20%
Cross Border	0.68%	0.69%	0.35%	0.41%	0.83%	0.00%	0.53%
Local	1.76%	0.85%	0.52%	0.18%	0.58%	0.76%	0.67%
Multi- and Bilateral Development	3.11%	5.77%	6.76%	7.80%	6.92%	8.09%	6.56%
Cross Border	3.11%	5.72%	6.76%	7.74%	6.92%	8.09%	6.53%
Local	0.00%	0.05%	0.00%	0.06%	0.00%	0.00%	0.02%
NGO	12.43%	13.57%	11.90%	11.16%	11.72%	17.25%	12.57%
Cross Border	7.84%	9.08%	8.09%	8.03%	8.26%	9.47%	8.42%
Local	4.59%	3.90%	3.76%	3.13%	3.40%	7.63%	3.97%
Unknown	0.00%	0.59%	0.06%	0.00%	0.06%	0.15%	0.17%
Peer-to-peer Lender	0.95%	2.08%	2.31%	2.95%	2.63%	2.90%	2.38%
Cross Border	0.95%	2.08%	2.31%	2.95%	2.63%	2.90%	2.38%
Private Corporation	0.14%	1.23%	0.92%	0.77%	0.51%	0.46%	0.78%
Cross Border	0.14%	0.43%	0.40%	0.41%	0.06%	0.46%	0.33%
Local	0.00%	0.00%	0.00%	0.00%	0.38%	0.00%	0.07%
Unknown	0.00%	0.80%	0.52%	0.35%	0.06%	0.00%	0.38%
Public Bank	3.65%	3.63%	3.00%	3.43%	2.95%	5.95%	3.51%
Cross Border	0.95%	0.16%	0.58%	0.24%	0.38%	0.61%	0.41%
Local	2.70%	3.47%	2.43%	3.19%	2.56%	5.34%	3.10%
Regulator	0.54%	0.91%	0.17%	0.12%	0.06%	0.00%	0.33%
Local	0.54%	0.91%	0.17%	0.12%	0.06%	0.00%	0.33%
Unknown	2.43%	3.69%	1.33%	2.48%	4.16%	18.17%	4.07%
Cross Border	0.41%	0.05%	0.06%	0.18%	0.13%	0.15%	0.13%
Local	0.14%	0.00%	0.00%	0.00%	0.06%	0.00%	0.02%
Unknown	1.89%	3.63%	1.27%	2.30%	3.97%	18.02%	3.91%
Grand Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

MFIs in countries with floating exchange rate regimes can deal with currency risk using various hedging instruments. These instruments, however, are not easy to master or do not exist in developing countries with shallow financial markets. Since hedging against foreign exchange risk in countries with floating exchange rate regimes is challenging, such risk is expected to be factored into higher microcredit interest rates.

Hypothesis 1: *MFIs operating in countries with floating exchange rate regimes charge higher microcredit interest rates than MFIs operating in countries with pegged exchange rate regimes.*

MFIs may suffer considerable losses when the value of the local currency falls against the foreign currency reducing the value of the MFI's assets relative to its liabilities. Nearly all currencies of

developing economies devalue over time. For example, currencies of countries with major microfinance portfolios such as Bangladesh, Pakistan, Mexico, South Africa, Democratic Republic of the Congo and Tajikistan have witnessed considerable losses in their value over time. These losses may have serious consequences if the MFIs hold significant foreign currency liabilities. Most notably, the devaluation of the local currency implies that more local currencies are needed to buy a given amount of foreign currency. Consequently, this leads to higher cost of foreign debt and MFIs are likely to transfer this higher cost to their client borrowers in the form of higher microcredit interest rates. On the other hand, foreign currency debt is usually obtained with favorable terms, longer maturity, and lower interest rates. Cheaper foreign debt should therefore allow MFIs to charge lower microcredit interest rates to their client borrowers. Therefore, the net effect of foreign currency debt on microcredit interest rates charged by MFIs is uncertain.

Hypothesis 2: *MFIs that acquire more foreign currency debt charge different microcredit interest rates from MFIs that acquire more local currency debt.*

The first two hypotheses have different testable implications. As mentioned above, higher devaluation risk implies higher risks and higher microcredit interest rates but cheaper foreign debt implies lower cost of funds and lower microcredit interest rates. Therefore the impact of foreign currency debt on microcredit interest rates is ambiguous. If the effect of devaluation risk dominates, then the first two hypotheses imply that MFIs operating in countries with pegged exchange rate regimes would face less risk of currency devaluation than MFIs operating in countries with floating exchange rate regimes. Therefore, the impact of foreign currency debt on microcredit interest rates is likely to be negligible for MFIs operating in countries with pegged exchange rate regimes while the impact is likely to be significant for MFIs operating in countries with floating exchange rate regimes.

Hypothesis 3: *The impact of foreign currency debt on microcredit interest rate is negligible for MFIs operating in countries with pegged exchange rate regimes while the impact is significant for MFIs operating in countries with floating exchange rate regimes.*

Another testable implication is whether all MFIs, profit and non-profit, deal with foreign currency risks similarly. Some MFIs' objective is to maximize profits and others strive to maximize social goals such as reaching the poorest population. Since the objectives are different, these MFIs would deal with foreign currency risk differently. Profit MFIs are expected to neutralize the risk of foreign currency debt in various ways such as using different hedging strategies and focusing on local currency funding.

Non-profit MFIs, on the other hand, would incur more foreign currency risk in case it serves the objective of extending more credit and other financial services to the poor. Accumulating more foreign debt may help non-profit MFIs achieve better financial inclusion and consequently foreign currency risk may not be a primary concern. Hence, profit and non-profit MFIs would deal with foreign currency risk differently.

Hypothesis 4: *The impact of foreign currency debt on microcredit interest rates depends on the profit orientation of the MFI.*

3. Data and variable description

3.1. Data

We use annual dataset collected from the MIX Market, the International Monetary Fund (IMF) and the World Bank for the years 2003–2014. The data on exchange rate regimes are available from the International Monetary Fund (IMF) and the data for the macroeconomic variables are obtained from the World Bank. The data for MFIs are obtained from the MIX Market which aims at promoting investment and information flows to MFIs, donors, and at large to the public. The MIX Market data combines two data sources: the MIX MFI dataset and their archive of MFI Funding Currency.³ The Funding Currency archive includes information on MFIs’ sources of funding, total amount of borrowing in local currency, and total amount of borrowing in foreign currency. In total, we use data for 670 MFIs operating in 77 countries. The breakdown by region is as follows: 103 MFIs from Africa, 72 from East Asia and the Pacific, 108 from Eastern Europe and Central Asia, 23 from Middle East and North Africa, 242 from Latin America and the Caribbean, and 122 from South Asia. We include all types of MFIs; non-government organizations, non-bank financial institutions, credit unions, banks, rural banks, and one type under the category “others.” The breakdown by MFI’s type is as follows: 258 MFIs are non-government organizations, 229 are non-bank financial institutions, 85 are credit unions, 54 are banks, 37 are rural banks, and 7 are classified as “others”. In total, 1569 observations are used.

³ While the MIX MFI data set is available for free for the public (www.mixmarket.org), data on foreign currency debt by MFIs are available for a charge.

The 670 MFIs in our data have IDs that range from 100000 to 111777. The maximum number of individual year over which we observe any MFI is 12. Fifty percent of the MFIs are observed in 2 years or less. Only 5 percent of the MFIs are observed in 5 years or more. The data we use have large N and small T. In addition, there are many missing observations implying that the panel time-series comes with many gaps. For example, each MFI has approximately two observations only for the key variable on foreign currency risk over the period 2003 – 2014 causing the panels to be very unbalanced. In fact, the sample size would rise from 1,569 to 7,574 if the key variable on foreign currency risk is dropped.

In addition to the use of unbalanced panels, the data used in this paper has some other limitations. First, the data at the MFI level are self-reported and therefore some MFIs may choose not to respond or respond with incomplete information. Second, MFIs reporting to the MIX Market might be the better performers. Bauchet and Morduch (2010) identify several patterns of MFIs reporting to the MIX Market. They show systematic biases in MFIs' choices on which survey to respond and which specific indicators to report and that patterns of reporting correlate with the institutions' region, mission, and size. While we make no claim that the sample is the finest representative, the data itself is rich, indicative, and varies in different aspects.

3.2. Variable description

There are two basic measures of microcredit interest rates: portfolio yield and annual percentage rate (APR). The APR takes into account the amount and timing of all cash flows associated with the client's particular loan product. This includes the interest, the fees as well as all other charges and conditional compulsory deposits to obtain the loan. The portfolio yield, however, is the ratio of the total income from all loans (interest, fees, and other charges) divided by the average annual gross loan portfolio of an MFI. Therefore, the APR can be considered as a better representation of the cost of loans paid by the micro-borrowers. First, compulsory savings by some MFIs reduce the net loan disbursement that a borrower receives while paying interest on the full loan amount which increases the effective interest rate paid by the borrower. This effect is captured by the APR but not by the portfolio yield. Second, the portfolio may contain products that are better characterized as small business loans rather than microloans. Third, the denominator of the portfolio yield is gross loan portfolio which includes all outstanding loans. Since some of these loans are delinquent, the true interest rates may be underestimated.

Even though the portfolio yield can be considered an inferior measure to the APR, this paper uses the portfolio yield for various reasons. First, the MIX database provides data on portfolio yield only and the current database available cannot be used to generate APRs. Second, the MIX database offers a much broader coverage, a better sample of the worldwide microcredit market, and more years of data relative to other competing databases.⁴ Third, according to a report by Rosenberg et al. (2013), it is highly likely that portfolio yields and APRs' trends would approximately move together. The microcredit interest rate in all our regressions is the portfolio yield; interest and fees revenues divided by the average gross loan portfolio.⁵

Let the microcredit interest rate ($InterestRate_{ij,t}$) be the interest rate charged by MFI_i operating in country j for year t ; MFI_{it} be a set of variables that characterize MFI_i at time t ; $Macro_{j,t}$ be a set of Macroeconomic variables for country j at time t , $Foreigncurrency_{i,t}$ be the amount of foreign currency debt by MFI_i at time t and $Exchangeregime_{j,t}$ be the foreign exchange rate regime of country j at time t . The estimated baseline model is:

The description of the dependent and independent variables are provided in Table 3. The independent variables are classified into three groups; MFIs' characteristics, macroeconomic and foreign exchange risk variables. The table also shows the expected sign for each independent variable. The descriptive statistics of the dependent and independent variables as well as the correlation matrix among the independent variables are shown in Tables 4 and 5 respectively. Subsections 3.2.1, 3.2.2, and 3.2.3 below discuss these variables.

⁴ Starting from 2009 to 2014, MF Transparency collected, analyzed and disclosed microloan pricing data reported voluntarily by selected worldwide MFIs. The MF Transparency started with a small number of MFIs and as of 2014, MF Transparency collected data from approximately 500 institutions that operate in 29 countries. MF Transparency ceased collecting new pricing data in 2015.

⁵ We have also used real microcredit interest rate in the analysis and the overall results are similar.

Table 3

Description of dependent variable, independent variables and their predicted signs

Variable	Description	Expected Sign
Dependent Variable		
Interest Rate	interest and fees revenue divided by the average gross loan portfolio	
MFI Characteristics		
Age	Categorical variable, the difference between the year the MFI started its operation and the year the data was submitted to the MIX Market	-
Assets	Value of assets in millions of US dollars	-
Profit status	A dummy equal to 1 if the MFI is a profit institution	±
Regulated	A dummy equal to 1 if the MFI is regulated	±
Total Cost	Financial cost, operating cost and the impairment loss relative to total assets	+
Female	Fraction of female borrowers	±
Productivity	Thousands of loans processed by staff member	-
Macroeconomic Variables		
GDP Growth	GDP growth	±
Inflation	Percentage change in the Consumer Price Index	+
Lending Rate	Bank lending rate	+
Rule of Law	Rule of law (Index: -2.5 to 2.5)	+
Foreign Exchange Risk		
Exchange Regime	Categorical variable, exchange rate regime	+
Foreign Currency	Ratio of foreign currency debt to total borrowing	±

Table 4

Descriptive statistics of dependent and independent variables

Variable	Mean	Std. Dev.	25 th percent	Median	75 th percent
Interest Rate	0.338	0.176	0.223	0.297	0.408
MFI Characteristics					
Age	2.716	0.559	3	3	3
Assets	54.78	176.08	3.059	9.486	35.65
Profit Status	0.412	0.492	0	0	1
Regulated	0.604	0.489	0	1	1
Total Cost	0.257	0.159	0.164	0.227	0.307
Female	0.657	0.247	0.457	0.638	0.900
Productivity	0.153	0.118	0.084	0.125	0.185
Macroeconomic					
GDP Growth	0.054	0.040	0.038	0.061	0.091
Inflation	0.071	0.049	0.050	0.082	0.116
Lending Rate	0.123	0.094	0.073	0.119	0.171
Rule of Law	-0.591	0.421	-0.903	-0.659	-0.345
Foreign Exchange Risk					
Exchange Regime	5.460	2.174	3	7	7
Foreign Currency	0.348	0.433	0	0.052	1

Table 5

Correlation matrix

	Age	Asset	Profit Status	Regulated	Total Cost	Female	Productivity	GDP Growth	Inflation	Lending Rate	Rule of Law	Exchange Regime	Foreign Currency
Age	1												
Asset	0.1027	1											
Profit Status	-0.1552	0.1688	1										
Regulated	-0.056	0.1736	0.3987	1									
Total Cost	-0.181	-0.1112	0.264	-0.1581	1								
Female	0.0187	-0.0735	0.55	-0.1024	0.1414	1							
Productivity	0.0313	0.0556	0.398	-0.0006	-0.1375	0.348	1						

			0										
			.										
			0										
			0										
GDP			9				0.05						
Growth	-0.1895	0.0329	6	0.1117	-0.0707	8	0.1018	1					
			0										
			.										
			0										
			4										
Inflation	-0.0869	-0.052	5	0.0909	0.095	14	0.02	0.0125	0.1336	1			
			4										
			-										
			0										
			.										
			0										
			8				-						
Lending			0				0.19						
Rate	0.0016	0.0222	7	-0.0497	0.1585	79	-0.1221	0.0108	0.088	1			
			-										
			0										
			.										
			0										
			2										
Rule of			6				0.14						
Law	-0.0137	0.0111	6	-0.1334	0.0356	67	0.2155	0.0571	-0.0719	0.0959	1		
			0										
			.										
			1										
			4										
Exchange			4				0.12						
Regime	-0.0948	0.047	8	-0.0636	0.2586	9	0.1069	0.0659	0.1364	0.3205	0.2775	1	
			-										
			0										
			.										
			1										
			0				-						
Foreign			1				0.01						
Currency	-0.0783	-0.1522	7	-0.0431	0.1005	44	-0.0839	0.0761	0.1151	-0.0337	-0.1281	0.0175	1

3.2.1. MFIs' characteristics

The MFIs' characteristics include the age of the MFI, its total assets, profit orientation, regulations status, fraction of female borrowers, total cost of loans, and productivity of loan officers.

Economies of scale and experience effects imply that larger and older MFIs should be more efficient and therefore able to charge lower microcredit interest rates (Roberts, 2013). We use the MIX Market classification for age (*Age*) as a proxy for the experience effect and total assets (*Assets*) as a proxy for the size and economies of scale. The variable *Age* takes a value of 1 (new) if the difference between the year the MFI started its operation and the year it reported to the MIX market is between 1 – 4 years, a value of 2 (young) if the difference is between 5 – 8 years, and a value of 3 (mature) if the difference is greater than 8 years. The variable *Assets* is the value of assets managed by an MFI measured in millions of US dollars. As can be seen in Table 4, the standard deviation of the variable *Assets* is large. We therefore proceed by using the natural logarithm of this variable. Taking logarithms reduces the extrema in the data and curtails the effects of outliers.

The profit orientation of an MFI may impact its microcredit interest rates. While Robert (2013) shows that MFIs with stronger profit orientation charge higher microcredit interest rates, Mersland and Strøm (2008) find that the impact profit orientation of an MFI on its performance is negligible . We use a dummy variable (*Profit Status*) equal to 1 if the MFI is a profit institution. These MFIs usually take the legal status as non-bank financial institutions, banks, and rural banks. In our sample, 41.2 percent of the MFIs are for profit.

In the current sample, the average microcredit interest rate charged by regulated MFIs is 32 percent while this average is 36 percent for unregulated MFIs. We include a dummy equal to one if the MFI is regulated and zero otherwise (*Regulated*). Regulated MFIs are subject to regulations and guidelines that ensure stability, soundness, transparency, disclosure of interest rates, and interest rate ceiling which all may lead to lower microcredit interest rates. However,

regulation may increase the cost of operation and lead to higher microcredit interest rates. In our sample, 60.4 percent of the MFIs are regulated.

It has been frequently asserted that female borrowers have better repayment behavior and low credit risk (Armendariz and Morduch, 2005; D'Espallier et al., 2011). If this assertion holds true, then MFIs that focus on female borrowers are able to charge lower microcredit interest rates. On the other hand, females may have less access to credit markets or receive smaller loans both of which increase microcredit interest rates (Al-Azzam and Mimouni, 2016; Roberts, 2013; and Hudon and Nawaz, 2011). To account for the fraction of female borrowers we use (*Female*) defined as the number of active female borrowers divided by the total number of active borrowers. In our sample, 65.7 percent of microfinance borrowers are females.

Studies that examine cross-country differences in microcredit interest rates have established a strong link between microcredit interest rates and cost structure and emphasized that cost is the single most important determinant of microcredit interest rates (Al-Azzam and Mimouni, 2016; Roberts, 2013; Cotler and Almazan, 2013; and Rozenberg et al., 2009). To account for the impact on microcredit interest rate, we use (*Total Cost*); the sum of operating and financial costs and impairment losses relative to total assets. On average, the total cost represents 25.7 percent of total assets.

Finally, the literature has documented an inverse relationship between employees' productivity in MFIs and microcredit interest rates (Gonzalez, 2010; Cotler and Almazan, 2013). The impact of productivity (*Productivity*) in the paper is estimated by using the number of loans processed by a staff member. In our sample, a staff member, on average, processes 153 loans a year.

3.2.2. Macroeconomics variables

Ahlin et al. (2010), Hermes et al. (2009), Gonzalez (2007), Honahan (2004), and Al-Azzam and Mimouni (2016) find that the performance of MFIs depends on the country-level macroeconomic and macro-institutional features. Hence, we employ some country-level variables including GDP

growth (*GDP Growth*), inflation rate (*Inflation*), lending interest rates (*Lending Rate*), and rule of law (*Rule of Law*) obtained from the World Bank. The GDP growth is defined as the annual percentage growth of GDP and reflects the overall developmental, institutional and technological progress of a country. Higher growth may increase micro-enterprise returns and the demand for microcredit allowing MFIs to charge higher interest rates. On the other hand, higher growth may increase households' incomes reducing the demand for microcredit and interest rates. Hence, the impact of GDP growth on microcredit interest rates is uncertain. The average GDP growth of the selected countries in the sample is 5.4 percent.

In this paper, we use nominal interest rates where MFIs are likely to factor the cost of inflation into their interest rates. Inflation is defined as the annual percentage change of the consumer price index. The average inflation rate in our sample is approximately 7 percent.

Commercial lending interest rates may also affect microcredit interest rates. Higher commercial lending rates increase the cost of borrowing by MFIs. It also increases the demand for micro-lending since the latter can be a substitute for commercial loans. Both effects combined would potentially lead to an increase in microcredit interest rates. The lending rate is defined as the bank rate that usually meets the short and medium-term financing needs of the private sector. On average, the lending interest rate in our sample is 12.3 percent.

We also control for the impact of institutional factors on microcredit interest rates. The World Bank provides a number of variables intended to capture some aspects of the institutional environment. These variables include: control of corruption, rule of law, regulatory quality, government effectiveness, political stability/lack of violence, and voice/accountability. A preliminary work with the data shows that the impact of these variables on microcredit interest rates is similar. Accordingly, we choose to include one indicator only in our regressions; rule of law. This variable captures the extent to which agents have confidence in and abide by the rules of the society. This includes for instance the quality of contract enforcement, the property rights, the police, the courts, and the likelihood of crime and violence. The rule of law variable ranges from - 2.5 (weak rule of law) to 2.5 (strong rule of law). In our sample the average value of this

variable is -0.59 indicating a relatively weak rule of law which may distort the allocation of financial resources and increase microcredit interest rates.

3.2.3. Foreign exchange risk variables

This paper captures the impact of foreign exchange risk by employing two variables. The first is the exchange rate regime of the country where the MFI is located. The second is the amount of foreign currency debt acquired by an MFI. While an MFI may have no control in deciding the exchange rate regime, it can control the amount of foreign currency debt.

A currency exchange rate can be determined freely by the foreign exchange market or by the government authority that pegs the currency to one or more foreign currencies with various degrees of flexibility. The member countries report their exchange rate regimes to the International Monetary Fund (IMF) annually. The IMF classifies exchange rate regimes based on members' actual, de facto, arrangements, on the degree of flexibility and on the existence of formal and informal commitments to exchange rate paths. The IMF classifies exchange rate regimes into eight categories ranging from adoption a foreign currency as a legal tender to free floats. Table 6 shows an overview of the IMF's classification. A gradual increase in the classification of the exchange rate from hard peg to floating implies a higher risk exposure to those MFIs that raise funds denominated in foreign currencies. Our empirical analysis uses the IMF classification that takes values ranging from 1 to 8. We denote this variable (*Exchange Regime*). A value of 1 reflects hard peg, 2 reflects slightly soft peg, 3 reflects soft peg and so on until 8 which reflects market determined exchange rate.

Table 6
Exchange rate regimes: the IMF's classification system in 2008

Exchange Rate Regime	Description
1 Dollarization, Euroization	No separate legal tender
2 Currency Board	Currency fully backed by foreign exchange reserves
3 Conventional Fixed Pegs	Peg to another currency or currency basket within a band of at most +/- 1percent

4	Horizontal Bands	Pegs with bands larger than +/- 1percent
5	Crawling Pegs	Pegs with central parity periodically adjusted in fixed amounts at a pre-announced rate or in response to changes in selected quantitative indicators
6	Crawling Bands	Crawling pegs combined with bands larger than +/- 1percent
7	Managed Float with No Preannounced Path for the Exchange Rate	Active intervention without pre-commitment to a preannounced target or path for the exchange rate
8	Independent Float	Market-determined exchange rate with monetary policy independent of exchange rate policy

The second variable of foreign exchange risk is the value of the foreign currency debt of an MFI relative to its total borrowings (*Foreign Currency*). On average, foreign currency debt represents 35 percent of the MFIs' total borrowings. The origin of funds, whether in local currency or in foreign currency, may influence microcredit interest rates. Local currency debt is the main source of funding for MFIs in countries such as India where restrictions exist on foreign investment. For other MFIs, foreign funding represents the major source of funds where, for example, banks are competing with MFIs and thus banks are reluctant to finance MFIs such as NBFIs in Azerbaijan or where the cost of local funding is high for MFIs such as in Eastern Europe and Central Asia (Sapundzhieva, 2011).

4. Estimation methodology

We use unbalanced panel data. The panel data suggests that individual MFIs are heterogeneous and hence the models that do not control for heterogeneity may lead to biased estimates. We first estimate ordinary least squares (OLS) regressions using the Huber-White sandwich estimators clustered at the institution level. The OLS, however, does not control for the likely correlation of the errors over time for a given MFI. Standard errors in pooled OLS are usually underestimated leading to inflated t-statistics.

Fixed effects models allow for unobserved individual heterogeneity that might be correlated with the independent variables. The omitted variables in fixed effects models are assumed to have time invariant values and therefore time invariant impact. However, fixed effects models may not work well or even at all if within cluster variation of the independent variable is minimal, e.g. *Exchange Regime*. According to Beck (2011), independent variables with little within cluster

variation will have little explanatory power and the fixed effects models yield imprecise coefficient estimates with large standard errors. The fixed effects models assume that each MFI has a non-stochastic group specific component to microcredit interest rates. Because these unobservable effects might be stochastic (i.e. random), we use random effects models (RE) where the unobservable component is treated as a component of the random error term that varies between MFIs. While pooled OLS is consistent and estimate the effects of slowly changing and time invariant variables, random effects models do the same but with smaller standard errors.

Another potential disadvantage of the fixed effects models is that it only estimates relationships among high frequency variables. As an alternative we use between models (BE) which captures low relationships among variables with low frequency. Between models perform OLS where data are converted into panel averages.

Serial correlation may be a potential problem in the data where an unobserved shock in one period affects behavioral relationships in the next periods. Ignoring serial correlation results in consistent but biased standard errors and inefficient estimates of the regression coefficients. We use Baltagi and Wu (1999) estimation of unequally spaced panel data regression with an AR(1) remainder disturbances (BW1999). Using Baltagi and Wu (1999) Locally Best Invariant (LBI) test for zero first-order serial correlation against positive or negative serial correlation in the case of unequally spaced paned data, we reject the null hypothesis of no first order serial correlation.

The estimates from the regression techniques mentioned above can be sensitive to outliers. For example, the use of data points for MFIs that receive substantial subsidies, have massive microcredit portfolios, or blend microcredit with significant portfolio of commercial lending may bias the estimation. To address the outlier problem, we report the results for robust regressions (RR). Robust regressions compromise between excluding the outlier points entirely from the analysis and including all data points with equal treatment of each point in the OLS regression. It assigns different weights for each data point through a process called iteratively reweighted least squares or (IRLS). In this procedure, each point is assigned equal weight in the first iteration and the coefficients are estimated using ordinary least squares. At subsequent iterations, the points

obtained from previous iterations that are far from the model's predictions are given less weight and coefficients are recomputed using weighted least squares. This process reiterates until the weights and coefficient estimates converge within a specified tolerance level.⁶

In total five regression techniques are used: OLS, random effects (RE), between MFIs (BE), Baltagi and Wu (1999) random effects with AR(1) remainder disturbance (BW1999) and robust regressions (RR). When dealing with MFIs' microcredit interest rates, one would expect to find heteroskedasticity in the disturbance terms as MFIs are of varying sizes. For example, preliminary work with the data showed that the variation of microcredit interest rates tend to increase with the increase in total cost. While the estimates are still consistent and unbiased, they are inefficient. Hence, we report the robust standard errors clustered at the institution level. We bootstrap standard errors and confidence intervals for the robust regressions, clustering by institution and applying 1000 iterations.

5. Empirical results

Table 7 reports the results for the baseline models of the OLS, random effects, between MFIs, BW1999 and robust regression. Before discussing the impact of foreign exchange risk, we first briefly discuss the impact of the MFIs' characteristics and macroeconomic variables on microcredit interest rates.

5.1. *MFIs' characteristics and macroeconomic variables*

Overall, the results for the MFIs' characteristics reported in Table 7 are consistent with the vast literature. The impact of *Age* and *Assets* on microcredit interest rates seem to be negligible.⁷ The overall results suggest that profit MFIs charge higher microcredit interest rates and the regulation status of the MFIs has no effect on microcredit interest rates. The impact of cost on microcredit

⁶ For robustness, two other estimation techniques are used. The first includes the use of the median regressions. In median regressions, the conditional median functions are estimated instead of the conditional mean functions. The second includes the lowest and the highest percentiles of the dependent variables (1st to 5th percentiles). The results of the median and percentile regressions are very similar to robust regressions. Hence, we report the results for the robust regressions only.

interest rates is as expected. MFIs that incur higher cost charge higher microcredit interest rates. This is consistent with many previous works such as Cotler and Almazan (2013) and Rosenber et al. (2009). On average, MFIs that target women charge higher microcredit interest rates. This is in line with other studies including Hudon and Nawaz (2011) and Roberts (2013). The results also suggest that processing more loans per a staff member lowers microcredit interest rates. Cotler and Almazan (2013) and Gonzalez (2010) find similar results as well. The impacts of the macroeconomic variables in general are also consistent with the literature. The results show that higher inflation and higher commercial lending rates are associated with higher microcredit interest rates while better governance measured by rule of law is associated with lower rates. The impact of GDP growth seems to be negligible.⁸ The overall results for the MFIs' characteristics and macroeconomic variables in the subsequent analysis are similar and thus the following discussion will focus on the variables of foreign exchange risk.

Table 7

Baseline (pooled) results

	OLS	RE	BE	BW1999	RR
<i>Constant</i>	0.0754 (0.0708)	0.152** (0.0614)	0.0863 (0.0679)	0.118*** (0.0434)	0.0276 (0.0327)
MFI Characteristics					
<i>Age</i>	-0.00272 (0.0099)	0.0031 (0.0074)	-0.0022 (0.0107)	0.0031 (0.0055)	0.0041 (0.0058)
<i>Assets</i>	-0.0021 (0.0033)	-0.0054* (0.0031)	-0.0033 (0.0038)	-0.0033 (0.0025)	-0.0011 (0.0016)
<i>Profit Status</i>	0.0219** (0.0106)	0.0469*** (0.0139)	0.0376*** (0.0133)	0.0423*** (0.0117)	0.0066 (0.0059)
<i>Regulated</i>	-0.0071 (0.0117)	-0.0136 (0.0145)	-0.0131 (0.0132)	-0.0151 (0.0118)	-0.0041 (0.0061)

7 We cannot claim that the results for *Age* and *Assets* are representatives. We believe that the impact of *Age* and *Assets* can be significant if a more representative sample is used. As described in the data section, our sample is constrained by the availability of observations for the foreign currency debt. If the regression models are estimated without the variables of foreign exchange risk, the sample size will rise to 7,574 observations and the impact of *Age* and *Assets* appear with the expected negative signs and with conventional statistical significance.

8 Similarly, we cannot claim that the results for *GDP growth* is representative. If the regression models are estimated without the variables of foreign exchange risk, the sample size will rise to 7,574 observations and the impact of *GDP growth* appears to be negative and statistically significant in all models.

<i>Total Cost</i>	0.664*** (0.134)	0.461*** (0.082)	0.516*** (0.033)	0.501*** (0.021)	1.016*** (0.054)
<i>Female</i>	0.0774*** (0.0223)	0.0971*** (0.0208)	0.0840*** (0.0258)	0.0813*** (0.0168)	0.0144 (0.0105)
<i>Productivity</i>	-0.124*** (0.033)	-0.087*** (0.025)	-0.132*** (0.046)	-0.084*** (0.025)	-0.039** (0.017)
Macroeconomic Variables					
<i>GDP Growth</i>	-0.0558 (0.101)	-0.0101 (0.0555)	-0.193 (0.178)	0.0485 (0.0510)	0.0778 (0.069)
<i>Inflation</i>	0.183** (0.0723)	0.120*** (0.0393)	0.420*** (0.119)	0.126*** (0.0334)	0.105** (0.0449)
<i>Lending Rate</i>	0.0886 (0.0714)	0.220*** (0.0555)	0.144** (0.0639)	0.178*** (0.0476)	-0.0164 (0.0434)
<i>Rule of Law</i>	-0.0278* (0.0154)	-0.0272* (0.0141)	-0.0481*** (0.0145)	-0.0335*** (0.0108)	-0.0024 (0.0088)
Foreign Exchange Risk					
<i>Exchange Regime</i>	0.0088*** (0.0025)	0.0047*** (0.0016)	0.0092*** (0.0031)	0.0044*** (0.0015)	0.0047*** (0.0012)
<i>Foreign Currency</i>	0.0196** (0.0096)	0.0141** (0.0067)	0.0304** (0.0150)	0.0159*** (0.0057)	0.0113** (0.0055)
N	1569	1569	1569	1569	1569
MFIs	670	670	670	670	670
R ²	0.51	0.48	0.48	0.50	0.50

Notes: Baseline models of the OLS, random effects, between MFIs, BW1999 and robust regression using the whole sample. The independent variable is *Interest Rate*. Standard errors are in parentheses. *, **, and *** indicate statistical significance at 10 percent, 5 percent, and 1 percent levels respectively. All standard errors are cluster-adjusted at the institution level.

5.2. Foreign exchange risk

We now discuss the impact of foreign exchange risk on microcredit interest rates. Hypotheses 1 and 2 are tested in Tables 7 and 8; Hypothesis 3 is tested in Tables 9 and 10; and Hypothesis 4 is tested in Tables 11 and 12. While Tables 7 and 8 utilize the full data sample, the rest of the tables use sub-samples obtained according to the type of foreign exchange rate regime and profit status of the MFIs. The analysis includes both bivariate and multivariate regressions for robustness.

Table 8
Basic bivariate and multivariate results

	OLS	RE	BE	BW1999	RR
<i>Constant</i>	0.212*** (0.014)	0.275*** (0.011)	0.210*** (0.019)	0.280*** (0.011)	0.222*** (0.011)

<i>Exchange Regime</i>	0.0230*** (0.003)	0.011*** (0.002)	0.0236*** (0.003)	0.011*** (0.002)	0.016*** (0.002)
N	1569	1569	1569	1569	1568
MFIs	670	670	670	670	670
R2	0.08	0.08	0.08	0.08	0.05
<i>Constant</i>	0.320*** (0.008)	0.328*** (0.007)	0.316*** (0.009)	0.328*** (0.007)	0.295*** (0.007)
<i>Foreign Currency</i>	0.053*** (0.014)	0.03*** (0.009)	0.065*** (0.018)	0.03*** (0.006)	0.042*** (0.011)
N	1569	1569	1569	1569	1569
MFIs	670	670	670	670	670
R2	0.017	0.017	0.017	0.017	0.012
<i>Constant</i>	0.195*** (0.014)	0.270*** (0.011)	0.186*** (0.02)	0.273*** (0.011)	0.209*** (0.011)
<i>Exchange Regime</i>	0.023*** (0.003)	0.011*** (0.002)	0.023*** (0.003)	0.01*** (0.001)	0.016*** (0.002)
<i>Foreign Currency</i>	0.051*** (0.013)	0.026*** (0.009)	0.066*** (0.017)	0.028*** (0.006)	0.041*** (0.01)
N	1569	1569	1569	1569	1569
MFIs	670	670	670	670	670
R ²	0.10	0.10	0.10	0.10	0.09

Notes: Results of the OLS, random effects, between MFIs, BW1999 and robust regressions using the whole sample. The independent variable is *Interest Rate*. Key variables *Exchange Regime* and *Foreign Currency* are included individually and together. Standard errors are in parentheses. *, **, and *** indicate statistical significance at 10 percent, 5 percent, and 1 percent levels respectively. All standard errors are cluster-adjusted at the institution level.

Tables 7 and 8 use the pooled sample and two key variables: *Exchange Regime* and the *Foreign Currency*. The signs on the coefficients of the exchange rate regime are positive as expected and highly significant across all models in both the bivariate and multivariate baseline models. On average, MFIs operating in countries with floating exchange rate regimes charge higher microcredit interest rates. Depending on the model estimated, Table 7 indicates that borrower clients of an MFI operating in a country with one more degree of exchange rate flexibility pay, on average, 0.4 to 0.9 percent higher microcredit interest rates. This result suggests that MFIs in countries with floating exchange rate regimes face higher risks of currency devaluation, convertibility, and transfer which are translated into higher microcredit interest rates. These results confirm Hypothesis 1 that MFIs operating in countries with floating exchange rate regimes charge higher microcredit interest rates than MFIs operating in countries with pegged exchange rate regimes.

The empirical results on *Foreign Currency* are in favor of the previous findings. The signs on the coefficients of this measure of foreign exchange risk are positive and statistically significant in all models. MFIs that rely on foreign currency debt for financing charge their clients higher microcredit interest rates. Depending on the model estimated, Table 7 indicates that a one percent increase in foreign currency debt relative to total borrowings increases microcredit interest rates by an average that ranges from 1.1 to 3 percent. Foreign currency risk is ultimately passed to microcredit borrowers through higher interest rates confirming Hypothesis 2; MFIs that acquire foreign currency debt will charge different microcredit interest rates from MFIs that acquire more local currency debt. The results suggest that the advantages of obtaining foreign currency debt in favorable terms such as longer maturity and lower interest rates might be outweighed by the foreign exchange risk leading to higher microcredit interest rates.

Why MFIs raise funds in foreign currencies and incur foreign exchange risk may be due to several reasons. First, MFIs may have limited local currency options when international lenders are ready to deliver larger loans with favorable terms to MFIs. Second, MFIs may view the cost of borrowing in foreign currency to be cheaper than borrowing in local currency. As such, MFIs may view the differential between the local currency and foreign currency borrowing rates to be larger than the expected rate of devaluation of their local currency. Third, MFIs may offer loans to their borrowing clients in foreign currency in countries where financial transactions take place in foreign currency (e.g. Ecuador) and thus no foreign exchange risk is incurred. The results of this paper suggest that MFIs on average emphasize the apparent interest advantage on foreign currency debt and do not identify the foreign exchange risk associated with this borrowing. The results of this paper suggest that MFIs should either choose local currency funding options or manage the consequences of borrowing in foreign currency and mitigate the foreign exchange risk through the use of various hedging instruments if the goal is to provide microcredit at lower interest rates.

5.2.1. Foreign currency risk under different exchange regimes

The results in Tables 7 and 8 indicate that MFIs operating in countries with more flexible exchange rate regimes and MFIs that rely on foreign currency debt tend to charge higher

microcredit interest rates. If this is true, then MFIs that seek foreign currency debt but operate in countries with pegged exchange rate regimes should not face the consequences of the foreign exchange risk. That is, the impact of foreign currency risk on microcredit interest rates for MFIs operating in countries with pegged exchange rate regimes should be negligible. To test this hypothesis, we divide our sample into two sub-samples based on whether a given MFI is located in a country with pegged exchange rate regime or in a country with floating exchange rate regime. In doing so, we use the IMF classification and assume that a country has a pegged exchange rate regime if the value of the *Exchange Regime* is between 1 – 4 and has a floating exchange rate regime if the value is between 5 – 8. Table 9 shows the impact of foreign currency risk and other independent variables on microcredit interest rates in countries with pegged exchange rate regimes and Table 10 shows this impact in countries with floating exchange rate regimes.

Results in Tables 9 and 10 reveal that MFIs may benefit from foreign currency debt if they are located in countries with pegged exchange rate regimes where the risk of foreign exchange is minimal. While the impact of *Foreign Currency* on microcredit interest rates is statistically insignificant for MFIs located in countries with pegged exchange rate regimes across all models(Table 9), the impact of *Foreign Currency* is positive and statistically significant for MFIs located in countries with floating exchange rate regimes across all models (Table 10). This strongly supports Hypothesis 3. The results in Table 10 suggest that an increase in foreign currency debt by MFIs located in countries with floating exchange rate regimes leads to an increase in microcredit interest rates. This comparative advantage of MFIs operating in countries with pegged currencies should be interpreted with caution. MFIs located in pegged currency countries do not bear exchange rate fluctuations but are still at risk of currency devaluation. Our results indicate that this risk does not seem to be significant and is not charged to microcredit borrowers. Managers of MFIs located in countries with floating exchange rate regimes should be more aware of the risks and costs associated with borrowing in foreign currency if the goal is to provide microcredit at lower interest rates. Similarly, international development finance institutions and individual investors with interest in in providing microcredit at lower interest rates should consider foreign currency risks when providing funds in foreign currency to MFIs, in particular to MFIs operating in countries with floating exchange rate regimes.

Table 9

Interest rates charged by MFIs in pegged exchange rate regimes

	OLS	RE	BE	BW1999	RR
<i>Constant</i>	0.249** (0.117)	0.204** (0.0906)	0.260** (0.117)	0.244*** (0.0778)	0.0971* (0.0517)
MFI Characteristics					
<i>Age</i>	0.0133 (0.0143)	0.0159* (0.0096)	0.0094 (0.0208)	0.0084 (0.0106)	0.0142 (0.0103)
<i>Assets</i>	-0.0118** (0.0054)	-0.0091 (0.0056)	-0.0136* (0.0064)	0.0099** (0.0045)	-0.0051** (0.0023)
<i>Profit Status</i>	0.0177 (0.0145)	0.0163 (0.0194)	0.0156 (0.0218)	0.0158 (0.0195)	0.0149 (0.0094)
<i>Regulated</i>	0.0069 (0.0134)	0.0183 (0.0202)	0.0179 (0.0215)	0.0160 (0.0193)	-0.0061 (0.0091)
<i>Total Cost</i>	0.765*** (0.137)	0.636*** (0.110)	0.649*** (0.116)	0.619*** (0.0619)	1.042*** (0.0912)
<i>Female</i>	0.0143 (0.0227)	0.0303 (0.0309)	0.0108 (0.0421)	0.0127 (0.0294)	0.0049 (0.0181)
<i>Productivity</i>	-0.162** (0.0821)	-0.168** (0.0708)	-0.183* (0.109)	-0.152** (0.0699)	0.0021 (0.0405)
Macroeconomic Variables					
<i>GDP Growth</i>	-0.0716 (0.200)	-0.257 (0.172)	-0.0254 (0.356)	-0.195 (0.128)	0.0877 (0.188)
<i>Inflation</i>	0.313 (0.210)	0.218** (0.101)	0.467** (0.234)	0.208** (0.0840)	0.185** (0.0891)
<i>Lending Rate</i>	0.144 (0.105)	0.318** (0.157)	0.225 (0.147)	0.285*** (0.101)	0.0191 (0.0700)
<i>Rule of Law</i>	0.0150 (0.0183)	-0.0037 (0.0202)	-0.0211 (0.0240)	-0.0119 (0.0185)	0.0243* (0.0133)
Foreign Exchange Risk					
<i>Foreign</i>	0.0195 (0.0154)	-0.0024 (0.0123)	0.0225 (0.0241)	0.0063 (0.0106)	0.0037 (0.0096)
N	495	495	495	495	495
MFIs	265	265	265	265	265
R ²	0.36	0.34	0.34	0.35	0.49

Notes: Results of the OLS, random effects, between MFIs, BW1999 and robust regressions for MFIs operating in pegged exchange rate regimes. The independent variable is *Interest Rate*. Standard errors are in parentheses. *, **, and *** indicate statistical significance at 10 percent, 5 percent, and 1 percent levels respectively. All standard errors are cluster-adjusted at the institution level.

Table 10**Interest rates charged by MFIs in floating exchange rate regimes**

	OLS	RE	BE	BW1999	RR
<i>Constant</i>	0.0348 (0.0796)	0.130* (0.0693)	0.0377 (0.0734)	0.0863* (0.0496)	0.0155 (0.0452)
MFI Characteristics					
<i>Age</i>	-0.0072 (0.0115)	-0.0018 (0.0093)	-0.0061 (0.0108)	0.0017 (0.0065)	-0.0008 (0.0069)
<i>Assets</i>	0.0027 (0.0039)	-0.0024 (0.0034)	0.0021 (0.0040)	-0.0003 (0.0028)	0.0014 (0.0022)
<i>Profit Status</i>	0.0270* (0.0156)	0.0524*** (0.0158)	0.0498*** (0.0142)	0.0477*** (0.0131)	0.0028 (0.0080)
<i>Regulated</i>	-0.0119 (0.0153)	-0.0250 (0.0161)	-0.0258* (0.0141)	-0.0239* (0.0131)	0.0041 (0.0091)
<i>Total Cost</i>	0.663*** (0.146)	0.471*** (0.0979)	0.526*** (0.0315)	0.504*** (0.0228)	1.065*** (0.0728)
<i>Female</i>	0.115*** (0.0320)	0.111*** (0.0228)	0.121*** (0.0271)	0.104*** (0.0195)	0.0263 (0.0166)
<i>Productivity</i>	-0.118*** (0.0393)	-0.0755*** (0.0236)	-0.116** (0.0452)	-0.0769*** (0.0276)	-0.0413** (0.0180)
Macroeconomic Variables					
<i>GDP Growth</i>	-0.0670 (0.115)	0.0532 (0.0655)	-0.173 (0.158)	0.0647 (0.0581)	0.0819 (0.0765)
<i>Inflation</i>	0.151** (0.0735)	0.131*** (0.0504)	0.360*** (0.112)	0.143*** (0.0425)	0.0793 (0.0529)
<i>Lending Rate</i>	0.106 (0.0849)	0.187*** (0.0569)	0.178*** (0.0638)	0.153*** (0.0520)	0.0016 (0.0565)
<i>Rule of Law</i>	-0.0418* (0.0180)	-0.0332* (0.0160)	-0.0392*** (0.0150)	-0.0358*** (0.0124)	-0.0109 (0.0089)
Foreign Exchange Risk					
<i>Foreign</i>	0.0219* (0.0124)	0.0245*** (0.0085)	0.0388** (0.0159)	0.0227*** (0.0071)	0.0141* (0.0075)
<i>Currency</i>					
N	1074	1074	1074	1074	1074
MFIs	503	503	503	503	503
R ²	0.53	0.51	0.51	0.52	0.47

Notes: Results of the OLS, random effects, between MFIs, BW1999 and robust regressions for MFIs operating in floating exchange rate regimes. The independent variable is *Interest Rate*. Standard errors are in parentheses. *, **, and *** indicate statistical significance at 10 percent, 5 percent, and 1 percent levels respectively. All standard errors are cluster-adjusted at the institution level.

5.2.2. *Foreign currency risk and profit status of MFIs*

MFIs have two main objectives in serving the poor. While the main goal was social at first, the microfinance move deviated from this objective to become more commercial with a clear profit orientation. MFIs therefore have different incentives to deal with foreign currency risk. In principle, profit MFIs are expected to mitigate foreign exchange risk through the use of different hedging strategies or possibly through the focus on local currency funding. Non-profit MFIs, on the other hand, may raise funds in foreign currency. Since the objective of non-profit MFIs is social in its nature and intends to reach the poorest borrowers, the risk of foreign currency borrowing may remain a minor concern. In our sample dataset, foreign currency debt to total borrowing is 29 percent for profit MFIs while it is 41 percent for non-profit MFIs. To investigate the impact of foreign currency risk on microcredit interest rates for non-profit versus profit MFIs, we divide our sample into two sub-samples based on whether an MFI is profit (276) or non-profit (394). The results are reported in Tables 11 and 12. Table 11 shows the impact of foreign currency and other independent variables on microcredit interest rates charged by profit MFIs and Table 12 shows the impact on microcredit interest rates charged by non-profit MFIs.

While the signs on the coefficients of *Foreign Currency* are positive, none of the coefficients is statistically significant for the profit MFIs presented in Table 11. Not only that profit MFIs are able to reduce their reliance on foreign currency debt, the results suggest that they are also able to mitigate the foreign exchange risk when they raise funds in foreign currency. As shown in Table 11, more foreign currency funds raised by profit MFIs does not significantly increase their microcredit interest rates. On the contrary, as shown in Table 12, the impact of foreign currency debt on microcredit interest rates charged by non-profit MFIs is positive and statistically significant across all models. The goals of the non-profit MFIs, mainly NGOs, are usually social and therefore they may decide not to act earnestly to alleviate the consequences of foreign exchange risk. These findings strongly confirm Hypothesis 4 that the impact of foreign currency debt on microcredit interest rates depends on the profit orientation of the MFI.

Table 11**Interest rates charged by profit MFIs**

	OLS	RE	BE	BW1999	RR
<i>Constant</i>	0.0798 (0.0845)	0.232* (0.0952)	0.0247 (0.0932)	0.183*** (0.0645)	0.0968 (0.0676)
MFI Characteristics					
<i>Age</i>	0.0119 (0.0107)	0.0021 (0.0097)	0.0188 (0.0132)	0.0085 (0.0076)	0.0022 (0.0089)
<i>Assets</i>	-0.00307 (0.00385)	-0.0032 (0.0044)	-0.0015 (0.0049)	-0.0026 (0.0025)	-0.0038 (0.0027)
<i>Regulated</i>	-0.0268 (0.0255)	-0.0708** (0.0310)	-0.0285 (0.0222)	-0.0631*** (0.0195)	0.0015 (0.0146)
<i>Total Cost</i>	0.846*** (0.155)	0.449*** (0.109)	0.791*** (0.0564)	0.530*** (0.0345)	1.164*** (0.104)
<i>Female</i>	0.0656** (0.0305)	0.0961*** (0.0299)	0.0772** (0.0349)	0.0744*** (0.0237)	0.0015 (0.0196)
<i>Productivity</i>	-0.0992** (0.0481)	-0.0592** (0.0248)	-0.133* (0.0704)	-0.0687** (0.0344)	-0.0343 (0.0271)
Macroeconomic Variables					
<i>GDP Growth</i>	-0.0918 (0.158)	-0.0616 (0.0883)	0.0130 (0.261)	0.0058 (0.0854)	0.0490 (0.116)
<i>Inflation</i>	0.0673 (0.0749)	0.0899 (0.0555)	0.136 (0.158)	0.112** (0.0535)	0.0639 (0.0709)
<i>Lending Rate</i>	-0.112 (0.0781)	0.0029 (0.071)	-0.107 (0.0912)	-0.0307 (0.0738)	-0.172** (0.0752)
<i>Rule of Law</i>	-0.0270 (0.0225)	-0.0296 (0.0191)	-0.0337 (0.0207)	-0.0325** (0.0158)	0.0070 (0.0152)
Foreign Exchange Risk					
<i>Exchange</i>	0.0107*** (0.0032)	0.0064*** (0.0021)	0.0108** (0.0043)	0.0071*** (0.0025)	0.0050** (0.0022)
<i>Foreign</i>	0.0150 (0.0145)	0.0084 (0.0109)	0.0266 (0.0211)	0.0089 (0.0100)	0.0095 (0.0094)
N	672	672	672	672	672
MFIs	276	276	276	276	276
R ²	0.61	0.57	0.60	0.59	0.44

Notes: Results of the OLS, random effects, between MFIs, BW1999 and robust regressions for profit MFIs. The independent variable is *Interest Rate*. Standard errors are in parentheses. *, **, and *** indicate statistical significance at 10 percent, 5 percent, and 1 percent levels respectively. All standard errors are cluster-adjusted at the institution level.

Table 12

Interest rates charged by non-profit MFIs

	OLS	RE	BE	BW1999	RR
<i>Constant</i>	0.0529 (0.0874)	0.143* (0.0763)	0.0439 (0.0963)	0.103* (0.0607)	-0.0652 (0.0433)
MFI Characteristics					
<i>Age</i>	0.0026 (0.0112)	0.0034 (0.0107)	0.0066 (0.0169)	-0.0008 (0.0083)	0.0091 (0.0090)
<i>Assets</i>	-0.0021 (0.0045)	-0.0071* (0.0039)	-0.0032 (0.0053)	-0.0036 (0.0035)	0.0029 (0.0024)
<i>Regulated</i>	0.0090 (0.0118)	0.0171 (0.0157)	0.0055 (0.0166)	0.0113 (0.0147)	0.0014 (0.0083)
<i>Total Cost</i>	0.536*** (0.156)	0.501*** (0.113)	0.405*** (0.0417)	0.524*** (0.0279)	1.027*** (0.0743)
<i>Female</i>	0.0950*** (0.0285)	0.0980*** (0.0298)	0.0881** (0.0354)	0.0832*** (0.0232)	0.0251 (0.0186)
<i>Productivity</i>	-0.116*** (0.0399)	-0.142*** (0.0523)	-0.102* (0.0592)	-0.113*** (0.0414)	-0.0357 (0.0261)
Macroeconomic Variables					
<i>GDP Growth</i>	0.0125 (0.100)	0.0231 (0.0689)	-0.0881 (0.234)	0.0822 (0.0654)	0.0905 (0.0912)
<i>Inflation</i>	0.288** (0.110)	0.147*** (0.0484)	0.587*** (0.168)	0.141*** (0.0438)	0.151*** (0.0477)
<i>Lending Rate</i>	0.283*** (0.0994)	0.348*** (0.0776)	0.375*** (0.0872)	0.308*** (0.0616)	0.0906 (0.0584)
<i>Rule of Law</i>	-0.0252 (0.0161)	-0.0276 (0.0199)	-0.0478** (0.0192)	-0.0376*** (0.0143)	-0.0030 (0.0103)
Foreign Exchange Risk					
<i>Exchange</i>	0.0051 (0.0031)	0.0035 (0.0022)	0.0043 (0.0042)	0.0029 (0.0042)	0.0032* (0.0019)
<i>Foreign</i>	0.0288**	0.0180**	0.0423**	0.0202***	0.0156*
<i>Currency</i>	(0.0126)	(0.0082)	(0.0199)	(0.0071)	(0.0085)
N	897	897	897	897	897
MFIs	394	394	394	394	394
R ²	0.46	0.45	0.43	0.45	0.54

Notes: Results of the OLS, random effects, between MFIs, BW1999 and robust regressions for non-profit MFIs. The independent variable is *Interest Rate*. Standard errors are in parentheses. *, **, and *** indicate statistical significance at 10 percent, 5 percent, and 1 percent levels respectively. All standard errors are cluster-adjusted at the institution level.

6. Robustness tests and caveats

Overall, the evidence on the relationship between foreign currency debt and microcredit interest rate is strong. The results from various models that correct for both heteroscedasticity, autocorrelation, and outliers are solid and consistent. First, dividing the sample dataset based on different criterion such as the exchange rate regimes under which MFIs are operating and profit statuses of the MFIs yield similar results. Second, should the strong relationship between foreign currency debt and microcredit interest rates be interpreted as a causal effect of foreign currency debt? This is unlikely to be the case. It might be that MFIs borrowing foreign currency face more risk and therefore charge higher microcredit interest rates. In addition, local funding costs may be prohibitively high which force MFIs to find cheaper funds through foreign loans. While reverse causality cannot be ruled out, it is likely to be implausible. Domestic capital markets in most of the developing countries are underdeveloped and tapping alternative domestic sources of capital cannot be easily achieved. Moreover, large banks are increasingly venturing into the microfinance realm, offering small loans and competing with MFIs for clients and thus unwilling to finance local MFIs. Deficiency of local funds limits MFIs' financing options. Given the inefficient banking industries of the developing economies, foreign borrowing may still be an attractive option despite the risk of borrowing in foreign currency. Nevertheless, it is important to emphasize that the results do not indicate causal relationships. In addition, microcredit interest rates persist over time. To address this issue and to mitigate the endogeneity problem, we estimate a dynamic panel data model of Arellano and Bover (1995) and Blundell and Bond (1998) which uses a system of GMM and performs particularly well with large cross section and a small time series. We also estimate the Baltagi random effect estimator where the lag of *Foreign Currency* is used as an instrumental variable. The results of the dynamic model and the Baltagi's random effects estimator support our original findings on the impact of foreign currency debt on microcredit interest rates. The Arellano and Bond test for zero autocorrelation and the Sargan test for over-identifying restrictions do not show an evidence of misspecification and suggest that the instruments used are valid. Third, the access to foreign credit and the cost of borrowing could have been affected by the recent financial crisis. In fact, the value of *Foreign Currency* was 0.44 in the period before the crisis and fell to 0.29 in the period after the crisis. To study the impact of the financial crisis, we include a dummy variable (zero for the period 2003 –

2007 and one for the period 2008 – 2014). The coefficients of the dummy variable are all insignificant suggesting that the impact of the financial crisis is not obvious in the sample data. We also divide the sample period into two sub-samples for the pre-crisis period (2003 – 2007) and crisis period (2008 – 2014) and run the baseline regression models. The impact of the foreign exchange variables on microcredit interest rates does not seem to be different across these sub-samples. Fourth, while coefficient estimates are still unbiased in the presence of multicollinearity, the standard errors tend to be wide and the t-statistics tend to be small. The correlation matrix and the results from the Variance Inflation Factor (VIF) suggest that there are no issues of multicollinearity in our dataset. Fifth, the panels are strongly unbalanced with a large number of MFIs and a short span of time. Almost one third of the MFIs are observed only once and the panel time-series show many gaps due to missing observations for the key variable *Foreign Currency*. Hence, converting the unbalanced panel data into balanced panel data remains a challenge. However, the results obtained from converting the data into more balanced panels by using only MFIs with at least two observations, or MFIs with at least three observations, or MFIs with at least 4 observations and narrowing the sample period do not alter the main findings. Sixth, there might be some other unobserved variables that cause both foreign currency debt and microcredit interest rates. In addition to fixed effects models, we control for a large number of MFIs and macroeconomic variables. The results for the key variables of this study are consistent suggesting that omitted variables bias is not severe in our empirical analysis. Seventh, the data from the MIX Market at the MFI level are self-reported implying that some MFIs may choose not to report or respond with incomplete information causing a selection bias. However, the data itself is rich, indicative and varies in different aspects. Eighth, in principle, using non-stationary panel variables may prove spurious. To test for stationarity, the panel data must be balanced, has no gaps, has a large T and small N. Our data, however, is unbalanced panels, comes with many gaps, has small T and large N. Accordingly, we cannot technically test for stationarity. Given that one third of the MFIs have one year observation and that T is relatively small for the rest of the MFIs and has many gaps, it is highly unlikely that the non-stationary panels would drive the results. Finally, cross-sectional dependence can lead to a bias in test statistics. Since the data is unbalanced and there is no time periods that are common to all panels, we cannot test for correlation across panels. According to Baltagi (2014), cross-sectional dependence can be a serious problem in macro panels with long time series (over 20-30 years).

This is not much of a concern in micro panels with large number of panels and few years for each panel.

7. Conclusion

Microcredit interest rates constitute the basis of the controversial debate on the role of microfinance in the lives of the poor. More competitive microcredit interest rates will positively expand the industry along with its social goals. Understanding the components of microcredit interest rates is therefore an essential element for the viability of the microfinance industry. This paper examines one important element in microcredit interest rate; the impact of foreign exchange risk. This element may have significant consequences for MFIs using cross-border sources of funds.

Using data from the MIX Market, the International Monetary Fund and the World Bank for the years 2003 – 2014, this paper uncovers and documents various important results. First, MFIs operating in countries with floating exchange rate regimes tend to charge higher microcredit interest rates. Second, MFIs raising more foreign currency funds charge higher microcredit interest rates particularly in countries with floating exchange rate regimes. Third, profit MFIs seem to be less susceptible to foreign currency risk. In general, the data suggest that foreign exchange rate regime and foreign currency risk are priced in microcredit interest rates. The results suggest that the rise in the proportion of foreign currency debt may be appropriate in economies that adopt pegged exchange rate regimes or in highly dollarized economies. Higher foreign currency debt in economies that adopt floating exchange rate regimes adds risk due to the increased asset/liability currency mismatch.

What may MFIs do to mitigate foreign exchange risk? In principle an MFI has three main options. First, do nothing and pass the risks to borrower clients through higher microcredit interest rates. Given the philanthropic nature of microfinance, passing the risk to the most vulnerable link in the microfinance value chain will remain a questionable practice. Since borrower clients bear the burden, the “do nothing” option may come at low cost for MFIs in the event of adverse exchange rate risks. Second, use various hedging instruments, portfolio

diversification, maintenance of foreign currency accounts in local banks, etc. This option may not be easily available particularly to newly established MFIs or may come at substantial transaction costs. Third, MFIs may raise funds in local currency. However, funds in local currencies usually come at higher lending interest rates with less attractive terms. No doubt that local monetary authorities and policymakers can play an important role in assisting MFIs overcoming the foreign currency risk. Poor countries that need microfinance lending usually have extremely illiquid currencies that are difficult to hedge for foreign lenders. Local authorities may work with foreign lenders to lessen the illiquidity risks and help local MFIs get foreign loans with better terms.

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