Are competitive microfinance services worth regulating? Evidence from microfinance institutions in Sub-Saharan Africa

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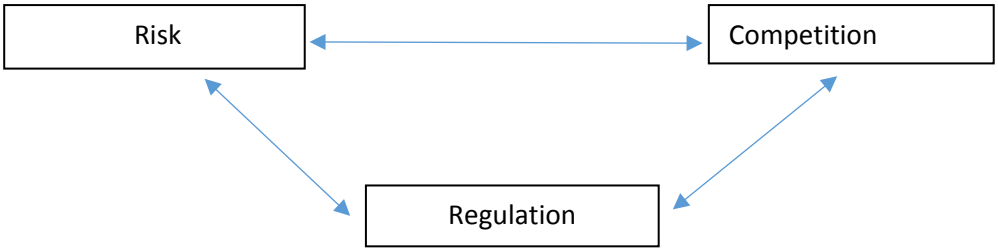

Figure. 1: link between risk, competition and regulation

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1. Introduction

Microfinance institutions play an essential role in most developing countries as they provide financial services, including poverty reduction intervention measures to a significant share of the population that is un-served by the formal financial institutions. About 2.5 million adult population of the World is unbanked in 2014 (World Bank, 2016), which the majority live in Sub-Saharan Africa. The severity of the implication of such a vast size of the unbanked population on poverty alleviation and lack of job creations especially for SSA is that, majority, close to 90% of the unbanked population are in rural areas (Gentil and Servet, 2002), where poverty levels are endemic, with fewer job opportunities. Therefore, the lack of banking services to mobilise funds at lower cost for the impoverished rural population to create a small business, invest into agriculture to provide the needed food requirement and earn some income, further perpetuate the incidence of poverty in such areas.

Over the recent decade, as a consequence of the problems associated with the poor not having access to the formal banking services on their livelihood, poverty outcomes and the associated social menace, coupled with the promising positive effects that MFIs are making, especially in serving the poor unbanked segment of the population, has resulted in a plethora of different MFIs in developing countries, some with goals beyond the social intervention/developmental goals such as pure profit motives. This phenomenon is partly as a result of the success story of the microfinance model (Garrity and Martin, 2018), which leads to an increase in the commercial oriented type of MFIs to enter the microfinance segment of the financial market.

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The increase in MFIs from both types – development oriented MFIs and commercial oriented MFIs in recent years in developing countries, create competition among these firms to provide financial services to the poor (Bateman, 2019). The increase in competition among MFIs due to the increase in the number of MFIs operating in the World financial market from 10 million in 1997 to more than 100 million in 2007 (Assefa et al. 2013), creates some level of competition that may have negative consequences such as taking unnecessary risk in the quest to outcompete competitors for clients and markets.

Economic theory suggests that competition will result in lower prices for products produced due to lower cost of production, more output and generally a welfare improvement for the society relative to the less competitive market environment. However, unhealthy competition may also result in competing firms taking unnecessary pricing, marketing, organisational and overall business strategies that expose them to more risk. On the other hand, having few firms with significant power may also create excessive risk-taking behaviour in the absence of regulation as was the case in the 2008 financial crisis. The question whether competition is good or bad will depend on the strength in these two opposing effects of competition relative to few firms with significant market power, the level of competition and whether the reference is to the firm, consumer/clients or society. If competition is creating more risk-taking behaviour relative to the lower prices and increase in output (outreach in the case of MFIs) effect, it is prudent that authorities regulate the microfinance market to curb competition and reduce the unnecessary risk-taking behaviour of the MFIs. Therefore, whether the government should regulate MFIs will depend on whether competition was high and as a consequence, creating unhealthy competitive behaviours among firms in the microfinance industry. If competition is not creating unhealthy outcomes and regulation is imposed, it will create a less favourable outcome than if regulation is

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not imposed.

The recent financial crisis has increased appetite for more regulation towards the financial sector in general and may also be the case for MFIs for countries that have experienced some Ponzi scheme-types of operations of some MFIs such as in Ghana, DKM Diamond Microfinance Company Limited that went bust in mid-2015, due to its Ponzi type of scheme it offered clients. However, the policymaker will have to assess the two opposing effects to determine if regulation is necessary, especially in the case of MFIs given their core mandate to pool resources to provide microloans to the segment of the society, who cannot access the main financial institutions such as banks for such micro loans. Therefore whether it is optimal for the government to regulate MFIs is conditional on the level of competition and the consequences thereof relative to less competition.

Whether the policymaker should regulate MFIs or not is an empirical question, which has not received much attention, especially about risk-taking behaviour. To the best of our knowledge, there is no study in the MFIs literature that empirically examined the joint effect of regulation and competition on risk-taking the behavior of these firms, especially in the SSA context. The closest studies we have found in the literature are; Assefa et al. (2013), who looked at the effect of competition on performance; Hartarska and Nadolnyk (2011), Purkayastha et al. (2014), Triki et al. (2017) and De Quidt et al. (2018) they focused on market structure, the effect of regulation on performance or growth of the MFIs.

This paper aims to provide some answers in that regard by providing an understanding of the relationships between risk (portfolio risk and operational risk) and both regulation and competition in the case of SSA. We achieved this by adopting a sample of 1574 MFIs in SSA for

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the period 1995 to 2015. Evidence from the study suggests that low competition increases credit risk among MFIs in SSA, which regulation helps reduce such behaviour. In particular, we find that the effect of regulation on credit risk is conditional on the level of competition, at the first percentile of competition (imply more competition); regulation does not reduce credit risk behaviours of MFIs but does at competition level above the 25th percentile (imply less competition). Another hand, we find regulation not to affect operational risk at any level of competition.

This paper aims to contribute to the literature through assessing the sequencing impact of market concentration and regulation on the risk of MFI's in Sub-Sahara Africa. Contribution of this article is in three folds, first to provide an understanding of the nature of relationships between credit risk, competition and regulation of MFIs, second to assess whether regulation and competition reinforces each other or substitute in terms of their effect on credit risk and thirdly the role of both competition and regulation on operational risk of MFIs and whether their effects are different in comparison to their effect on credit risk. Literature review and the general narrative on Sub-Saharan Africa shows that the factors examined by previous studies (Kablan, 2014; Cull et al., 2015; Ayele, 2015) focused merely on measurement effect of portfolio risk on profitability, outreach and repayment rates. The impact of regulation and market concentration jointly on credit (portfolio) risk of MFIs are omitted and therefore policy questions such as whether having a competitive MFI requires strong regulation to reduce for example portfolio risk (credit risk) or they operate in the opposite direction, which each tends to dampen the effect of the other cannot be comprehensively answered based on the existing literature.

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The rest of the paper is structured as follows: section 2 presents the literature review for the study followed by the study's conceptual framework in section 3. Section 4 discusses the methodology; section 5 presents the empirical evidence and sensitivity analysis. The conclusion and summary are presented in section 6.

2. Related Literature

Both in its institutional range and in its penetration of financial markets, microfinance institutions (MFIs) have played a significant role in most developing economies (Mosley, 2009; Postelnicu and Hermes, 2017) in the area of mobilising funds for the weak and small business and as a consequence, contribute to growth and development of developing countries. The financial services provided by MFI enhance the ability of the poor to become bankable (Ledgerwood et al., 2013), leading to a positive impact on income and asset accumulation level which potentially increase the standard of living of microfinance customers through the establishment and expansion of business activities among these customers Beisland (2017).

Microfinance has the potential to empower a significant portion of the workforce in developing countries and contribute towards financial sector deepening. In the case of Sub-Saharan Africa (SSA), about 90% of the population in rural areas are unbanked (Gentil and Servet, 2002), forcing a broad swath of the population to operate without financial services resulting in lack of capital and a considerable share of the population, which is persistently impoverished. Underdevelopment of the financial sector is attributable to three specific factors. Firstly, information asymmetry, which has been reported to be a constraint to access finance for entrepreneurial activities within, developed economies (Hussain et al. 2010).

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Information asymmetry is the dominant factor for the underdevelopment of the financial sector in Sub-Saharan Africa (Marcelin and Mathur, 2014; Smith, 2015; Domeher et al., 2017). In the absence of information on clients' creditworthy, lack of collateral and financial history, lending managers are not equipped to evaluate risk, and this adversely affects the loan decision process. Therefore, information asymmetry gives rise to type 1 error, where a viable loan application is rejected, and type two error, where a non-viable loan application is approved (Deakins and Hussain, 1994). This has the potential to give rise to defective loans that could lead to portfolio underperformance and a barrier to the development of financial services.

Secondly, the extant literature (Kuku and Jakpal, 2015; Mujeri, 2015; Tumwine et al., 2015; Gohar and Batool, 2015) indicate more impoverished populations do not have the capacity to contract large loans but are slightly attracted to a large number of smaller size loans that have higher administrative cost, which serves as a barrier to the development of MFIs portfolio. This has a negative influence on the operation cost of MFIs and by extension, the overall portfolio profitability. Thirdly, the poor operate at the margins of economic systems, carry higher default risk, lack entrepreneurial capacity coupled with lack of financial track record and collateral (Fafchamps, 2014; Fletschner and Kenney, 2014; Singh and Huang, 2016; Wellalage and Locke, 2016; Matamanda and Chidoko, 2017; Otchere et al, 2017) adversely impacts on their chances of accessing finance. Limited earnings by the poor are broadly following the economic interest of traditional banks to avoid profound portfolio risk. According to (Blazy and Will, 2013; Duarte et al., 2017) banks primarily rely on collateral for reduction of loan loss in the event of default. The existence of institutional and regulatory rigidities suggests that the existence of banks alone does not benefit all section of the population equally.

The above narrative highlights market failures, financial exclusion and limited access to

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finance for the weak segment of the population in developing countries. To fill this gap, microfinance institutions reach out to financially excluded populations, who have no collateral for loans to engage in entrepreneurial activities (Islam, 2009). MFI shares a common objective of financial inclusion of the informal sector within an economy to promote enterprise development. Microfinance institutions not only provide a loan, savings and money services, they also support them with social support, training and opportunity to network (Sengupta and Aubuchon, 2008; Jain and Moore, 2003). The growth and presence of MFIs have increased over time. There are currently around 3,700 MFIs, which provide collateral-free loans to 230 million customers in more than 100 countries (Gul et al., 2017). Given the scope, impact and outreach of MFIs, many efforts have been spent on understanding how MFIs overcome challenges where traditional banks have failed to do so (Morduch, 2013; Weaver, 2016; Gan et al., 2017).

Microfinance institutions role and function have evolved over the years (Helms, 2006) and policymakers have accepted it as a tool to alleviate poverty (Sengupta and Aubuchon, 2008; Kanak and Liguni, 2007). The significant innovation that gained traction over the last decade is the peer lending that substitutes asset collateral with non-tangible assets such as reputation, group standing and community cohesion. According to Wenner, et al. (2007) group members undertake to enforce loan contracts; thus, anytime a group member defaults in repayments the group is obliged to pay the loan with their resources. If they do not, the group risk losing access to future loans (Al Mamun, 2012). These groups guarantee that practice is similar to the concept of group insurance. In this case, the MFI uses a compilation of people to reduce portfolio risk; it is in every member's interest to ensure that the other members pay for their loans. The recipient interest deepens assurance and makes MFI`s more secured to issue non-collateralised loans.

Through group collateral mechanism MFI's have emerged as an essential source of

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entrepreneurial finance for the unbanked in Sub-Saharan Africa (Boateng et al., 2015). In the past three decades, however, microfinance practice has evolved. On the one hand, crowding in the microfinance industry highlights a more comprehensive and competitive market mechanism. On the contrary, the financial inclusion of the unbanked in low-income countries have caught the attention of regulatory agencies that seek to protect the financial sector. This is consistent with the theory that competitive forces in finance increase scale and homogeneity. Thus, there is the need to create a regulatory structure that can counteract this and maintain a precarious ecosystem of financial institutions (Mwega, 2014; D'Espallier et al., 2017).

The theory of competitive force has been tested and, with few exceptions, found consistent with data in a wide variety of markets. For example, Anginer and Demirgüç-Kunt (2014) found systematic fragility to be less pronounced in countries with institutions that allow for better public and private monitoring of financial institutions in competitive conditions. The opposite is observed in Appiah-Konadu et al. (2016) analysis; they found that MFI's crowding coupled with limited regulatory supervision generates high portfolio risk in Ghana and constitutes a significant threat to the overall survival of the microfinance sector. Similarly, Assefa et al. (2013) found that for the periods; 1995-2008, the competition was negatively associated with the portfolio performance of 362 MFI's in 73 developing countries. Hartarska and Nadolnyk (2011) suggest the jury is out on whether regulation improves the poor's access to finance but indirectly also enhances the sustainability of MFIs; however, regulation benefits organisations obtaining and promoting savings amongst its members.

Empirical evidence is sparse on MFIs regulations, but the study by Hartarska and Nadolnyk (2011) suggest regulating MFIs does not directly affect performance either regarding operational self-sustainability or outreach. Furthermore, Purkayastha et al. (2014) reported that complying

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with prudential regulations and the associated supervision stifled the growth of MFIs and intermediation efficiency in places such as India. This explanation has found support among views that oppose excessive regulation of MFIs in Sub-Saharan Africa (Madestam, 2014; Triki et al., 2017).

Literature review on regulation of MFIs strand of research in emerging markets have either shown discussions that assess the effect of portfolio risk on MFI's performance (Magali, 2013; Castellani and Cincinelli, 2015; Kusi, et al., 2017) or the impact of regulation on performance of MFIs (Barry and Tacneng, 2014; Yu et al., 2014; John, 2015; Spratt, 2016; Adams, 2017; Siwale and Okoye, 2017). Studies by (Pashkova et al., 2016 and Chikalipah, 2017) have used similar data from Africa to analyze the environment of MFI's in Sub-Saharan Africa, but they too have focused on business models and institutional environments respectively; regulation and market competition and its impact on portfolio risk has not been explored to the best our knowledge. Furthermore, the extant literature has hardly explored operational risk notably, in conjunction with regulation and competition.

The above review indicates that studies on the effect of regulation and market competition jointly on portfolio and operational risk of MFIs are rare in general and non-existence in the case of SSA, which makes it difficult to answer policy questions such as whether having a competitive MFI requires strong regulation to reduce, for example credit risk (portfolio risk) or they operate in the opposite direction, which tends to dampen the effect of the other.

3. Conceptual Framework

Microfinance Institutions (MFIs) operate at the margin of society, and borrowers operate at the fringes, often are not bankable, lack collateral and suffer from financial asymmetry (Boateng et

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al., 2015). Whereas microfinance institutions have financial constraints and their goals are to mitigate adverse effects of poverty, impact positively on the welfare of society as a whole. In achieving these objectives, MFIs aim to develop lending strategies to ensure risk is managed and capital pilferage is minimised. This section of the paper examines a) effect of regulation, b) the role of competition amongst MFIs, and c) portfolio approach employed by MFIs to manage risk through adopting lending portfolio methods and better operational procedures.

For the efficient functioning of MFIs, competition plays a central role, and regulation is pre-requisite for this purpose; as it aids the structural development of the market at large and the institution in particular. Efficient and fair regulation brings transparency in its conduct and enables performance to be measured. Within this context, competition fosters the efficient allocation of resources and negates imperfections. Pragmatisms dictates lenders make lending decisions to alleviate poverty through the entrepreneurial financing of individual and groups which are not bankable, yet at the same time preserve MFIs assets, earn a return to ensure continuity of funding provision. To achieve this objective, MFIs adopt a portfolio approach that manages its lending portfolio. Figure 1 illustrates the relationship between regulation, competition and risk. This connectivity between the three pillars serves as a continuous loop to enhance one another's performance.

[Insert Figure 1 Here]

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Regulation is integral to issues related to corporate governance of MFIs; it ensures processes and procedures applied to sanction loans are consistent across institutions. The consistency in lending methodology promotes operational and allocational efficiency. Competition serves to lower the price of a loan, improve services and provides choice to the borrower. At the same time, effectiveness and transparency enable MFIs to adopt a sectoral portfolio approach to reduce un-systematic risk and also use advanced due diligence and screening methods to lend to viable borrowers and implement better operational procedures. However, this method risks alienating or further disadvantaging the impoverished section of the population.

The central proposition of this empirical study is that MFIs portfolio risk is not independent of market competition and the regulatory environment. Efficient and optimum regulation assists to manage competition amongst MFIs that supports them to develop optimum portfolios, operational procedures and reduce risk. The study builds lessons and the inferences of mainstream banks (Dewatripont, 2014; Berger et al., 2016) and lends support to the argument that portfolio adequacy, efficient and appropriate regulation and the market discipline affects the performance of MFI's. Therefore, there is a case to measure the joint effect of regulations and market competition on portfolio risk of MFI's in Sub-Saharan Africa.

4. Methodology

4.1 Sample and data

The source of data for the study is from the Microfinance Information Exchange (MIX) Market dataset that covers the period 1995 to 2015 for 3856 microfinance firms for SSA countries. The period was chosen based on data availability for many microfinance firms in SSA countries. The dataset is a panel, but due to differences in the year of operations across different MFIs within

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and between countries in the dataset, we have an unbalanced panel. Also due to missing observations for some of the variables, our final sampled reduced to 1574 firms. The summary statistics for each of the variables for the analysis is presented in table A1 in the appendix, which reflects the average values and variability within a country and across countries for each of the variables that are defined in section 4.2.

4.2 Variables definitions

MFI credit risk is measured as impaired loans to gross loans and advances and used as the dependent variable in this study. Chaibi and Ftiti (2015) argue that credit risk measured as impaired loans divided by gross loans is a better representation of credit risk as it reflects actual credit risk or loss that pertains to a specific time The portfolio at risk is used as a proxy and is estimated as the proportion of the loan portfolio of an MFI that is overdue for 30 days and is at risk of not being settled. Differently phrased, the portfolio at risk >30 variable reflects the actual risk of a delinquency problem because it takes into account the full amount of the loan at risk predominantly when the loan payments are small (Ledgerwood, 2000). Portfolio in itself specifies the aggregate incomes accessible for the MFI to disburse it as credits to its customers. Portfolio quality is a way of determining how best the organisation can safeguard its portfolio. It is a crucial aspect of performance evaluation, as it is the most significant source of risk for most business organisations that exists in their assets portfolio. Hence, to their best effort, MFIs need to sustain the value of their investments. For our study, we consider portfolio at risk over 30 days (PAR >30 days) as used in Assefa et al. (2013). We include this variable to determine how well an MFI is managing its risks as it provides services to its clients.

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Operational risk is defined as the loss resulting from inadequate or failed internal processes, people and systems or external events (Chavez-Demoulin et al., 2006). This is proxied by computing the coefficient of variation (CV) of write-off ratio of loans by MFIs. The CV is then used as a proxy for operational risk.

The dataset also contains information on whether the MFI is regulated or not. Regulation is measured as a dummy variable that takes a value of 1 if the MFI is regulated and 0 if it is not regulated. This is to determine whether regulated MFIs are exposed to more risk than their counterparts. Gietzen (2017) found no association between regulation (regulatory quality from the World Bank governance indicators) and risk exposure and thus conclude that regulators might see no need intervening in the sector due to seemingly lower liquidity risk. Their regulatory index is generic at the country level, not MFIs specific regulation and therefore considering MFIs related regulation will likely provide a better understanding of the role of regulation on risk-taking by MFI. To the best of our knowledge, the only available MFI regulatory variable is the dummy variable in the MIX Market dataset that indicates whether the MFI is regulated or not. We, therefore, rely on this variable as our regulation variable.

Competition is one of the critical variables for our study. However this variable is not readily available, we preferably have to compute it by considering existing literature on the best measure for competition. There is no unanimity in the literature of the optimal way to measure competition. The Lerner index is our primary choice to proxy competition due to its relatively good properties as presented in the next paragraph. The inclusion of competition for the analysis is to assess whether the risk-taking behaviour of MFIs increases with competition or otherwise. It

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is crucial to include competition because the risk faced by MFIs might be influenced dramatically due to the competitive nature of the market in which they operate.

The Lerner index is our measure of MFI-level of competition (see Aghion et al., 2005). The index ranges between 0 and 1, where a value close to zero is an indication of strong competition, while close to 1 suggests less competition. The index is of form $\mathrm{LI}=\frac{P\ -MC}{P}$, where p is the output price proxy by yield on gross loan portfolio and MC, is the marginal cost of the firms. High (low) index imply low (high) competition. In estimating the Lerner index, we follow an approach by Assefa et al. (2013), by constructing a translog cost function as follows;

$$\ln TC_{it} = \beta_0 + \beta_1 \ln y_{it} + \tfrac{1}{2}\beta_2 \ln y_{it}^2 + \sum_{k=1}^{2} \gamma_k \ln w_{k,it} + \tfrac{1}{2}\sum_{j=1}^{2} \phi_j \ln y_{it} \cdot \ln w_{j,it} + \sum_{k=1}^{2}\sum_{j=1}^{2} \theta_{kj} \ln w_{k,it} \cdot \ln w_{j,it} + \sum_{j=1}^{2} \tfrac{1}{2}\varphi_j \ln w_{j,it}^2 + \rho trend + \tfrac{1}{2}\tau trend^2 + \sum_{j<k}\sum \xi_{jk} \ln w_{j,it} + \delta trend + \varepsilon_{it} \quad (1)$$

where TC is the total cost of firm i for time t, y_{it} denote outthe put of the firms, w_{it} is a vector of firms' input, which in this study constitute labour and capital, trend the is a time trend to capture technological progress, while ε_{it} is random error term.

In order to get the marginal cost (MC) we take the first derivatives with respect output to obtain the marginal cost function as shown below

$$MC_{it} = \frac{TC_{it}}{y_{it}}\left[\beta_1 + \beta_2 \ln y_{it} + \sum_{j=1}^{2} \phi_j \ln w_{j,it} + \delta trend_{it}\right]. \quad (2)$$

We then estimate the marginal cost function because it cannot be inferred directly from the data.

The advantages of the Lerner index relative to other measures of competition are: (i) Lerner index enables us to investigate competition at the firm-level; (ii) It varies over time which again gives us the opportunity to measure competition over some years (Assefa et al., 2013).

In estimating the marginal cost in equation above, the following variables were used. First the total cost for each firm (*TC)*, which is the aggregate of all expenses incurred by an MFI in a given financial year. It consists of both operating and financial expenses that the firm incurred in running the affairs of the business. The sum of operating and financial expenses incurred by the firm is used to proxy for this.

The output variable (y) for each MFI is the gross Loan Portfolio, which consists of all outstanding principal for all outstanding client loans, including current, delinquent and restructured loans, but not loans that have been written off. It does not include interest receivable and employee loans. In constructing the cost function, we considered only two inputs, which are very crucial to the operations of microfinance institutions. These include the cost of labour and capital. The cost of capital refers to the cost of equity and debt used in financing the microfinance business. It is the opportunity cost of taking a specific investment. It is measured as the ratio of financial expenditure to total liabilities of the firm within the financial accounting year.

The cost of labour, on the other hand, consists of both direct and indirect cost incurred by employees for rendering services to the firm. In estimating the labour cost, the study took the ratio of personnel expenses to total assets as a proxy, with the assumption that the primary component of operating costs is the personnel salaries. To control for important unobservable such as technology, we included a time trend to take care of technological change or capture movement of the cost function over time and MFI-specific fixed effects. This is to cater for related variances in the cost structures among MFIs and unobserved MFI heterogeneity.

4.3 Econometric specifications and method

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4.3.1 Empirical Model

Based on the previous literature as discussed in the literature review section and coupled with the conceptual framework, the following reduced-form model is formulated for the empirical analysis to answer the research questions raised in the introduction section of the paper. The extant literature on determinants of a portfolio (credit) risk suggests that it is influenced by firm-specific factors such as the size of the business, the financial cost of the MFI, operational efficiency of the MFI, financial strength and financial revenue of the MFI. Also, both theory and policy discussions suggest that both competition and regulation are key market and policy variables that influence the risk-taking behaviour of firms in general including MFIs. Based on this, the reduced-form model is specified as;

$$\ln Risk_{it} = \beta_0 + \beta_1 Regulation_{it} + \beta_2 \ln Competion_{it} + \beta_3 Regulation_{it} * \ln Competition_{it} + \lambda' \mathbf{X}_{it} + \mu_t + \eta_i + \varepsilon_{it} \quad (3)$$

Where risk in this study will focus on two different aspects of risk, credit risk and operational risk, regulation is measured as a dummy variable that takes a value of 1 if the MFI is regulated and 0 for unregulated MFI, competition is measured using two different competition index (Lerner index and Herfindahl-Hirschman Index (HHI)), ***X*** is a vector of controls that include business size, financial cost of the microfinance firm, operational efficiency of each microfinance firm, financial strength of microfinance firms, financial revenue, both firm (η_i) and time fixed effects (μ_i) to account for unobserved heterogeneity, ε_{it} is a random error term.

The Firm size is measured as the natural log of gross loan portfolio (Barry and Tacneng 2014). Following the economies of scale and diseconomies of scale theories, the study expects a positive or negative effect of MFIs size on credit risk. That is following economies of scale; larger

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MFIs have the needed resources, both financial and human and the capacity to monitor and supervise their customers or borrowers; thus, reduction in credit risk. However, following diseconomies of scale larger MFIs are overwhelmed by their size causing replication of functions and idle resources to monitor clients, which could result in increased credit risk. For instance, Williamson (1967) and Himmelberg et al. (1999) prove that as the size of a financial institution become too large, it results in inefficiencies in monitoring and evaluation of clients due to the massive cost of operation; therefore, leading to increased credit risk.

In addition to the size of the firm, we also control for the financial cost of MFI. This is the cost of the firm incurs in disbursing loans to their clients (Ceb and Traca, 2009). Once, loans are the primary product for microfinance activity; we proxy financial cost with the cost per loan. It is measured as the ratio of financial expenses to gross loan portfolio to determine per unit cost of distributing loans to customers. The essence of this is to indicate the efficiency of MFIs in its loans disbursement.

Operational Efficiency of MFIs is also controlled for in our estimations. This is a performance measure that shows how well MFIs is rationalising its operations and takes into consideration the cost of the input and the price of output (Barry and Tacneng 2014; Kinde, 2012). Efficiency in expense management should ensure more efficient use of MFIs loanable resources. It is proxy with the write off ratio. It is the ratio of the total amount of loans written off to gross loan portfolio (Kinde, 2012). High (low) ratio indicates a low (high) efficiency of management.

The last controlled variables in the model are financial strength and financial revenue. Financial strength measures the soundness or profitability of a company (Chavez-Demoulin et al. 2006; Ceb and Traca 2009). It measures the firm's ability to generate positive net incomes for a

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given level of investment. This variable also determines how well management is running the affairs of the business in the interest of shareholders. We proxy financial strength with the yield on gross loans portfolio obtain from the MIX market database (Serrano-Cinca and Gutiérrez-Nieto, 2014). The yield is the net incomes from gross loans of an MFI. Financial revenue, on the other hand, is some incomes that a firm generates through its activities within a specific period. Includes revenue generated from both the gross loan portfolio and investments (Gutiérrez-Nieto et al. 2009). It measures the total amount of money that accrues to an MFI in a given financial year. It determines how well management will be able to meet their financial obligation. The variable is proxy with interest and fee income on transactions. The descriptive statistics for the entire critical variables described above is presented in the appendix (Table A3).

From equation (3), the total impact of regulation on risk is given by taking the partial derivative of risk concerning regulation, which is express as:

$$\frac{\partial \ln Risk_{it}}{\partial Regulation_{it}} = \beta_1 + \beta_3 \times \ln Competition_{it}$$

On the other hand, the total effect of competition on risk is given by taking the partial derivative of risk concerning competition based on (3), which is specified as:

$$\frac{\partial \ln Risk_{it}}{\partial \ln Competion_{it}} = \beta_2 + \beta_3 \times Regulation_{it} .$$

We adopt a fixed effect approach that controlled for potential endogeneity problem associated with risk and regulation. The potential endogeneity problem due to possible reverse causation between risk and regulation is resolved by estimating a second-reduced form equation for regulation as specified in equation (4), where the residuals for this equation is generated and added into equation (3) as an additional covariate (two-stage residual inclusion approach). The

purpose is to control for the endogeneity problem caused by the reverse causation between risk and regulation. This approach has been suggested and used by prior studies such as Hausman (1978), Das et al. (2003), Blundell and Powel (2004), Terza et al. (2008) to deal with issues of endogeneity when there are no suitable available instruments. We assumed that risk, competition and firm characteristics are vital factors that influence the level of regulation of MFIs and therefore specify the reduced-form model as:

$$Reglation_{it} = \alpha_0 + \alpha_1 \ln Risk_{it} + \alpha_2 \ln Competion_{it} + \theta' \mathbf{X}_{it} + \mu_t + \eta_i + e_{it} \quad (4)$$

where all the variables are the same as defined for equation (1), e_{it} is a random error term.

4.3.2 Empirical strategy

Our estimation strategy follows three steps. In the first step, we estimate equation (4) using fully parametric econometric methods (panel probit model since regulation is a dummy variable) appropriate for panel analysis to generate the residuals for the main equation (3) of interest to control potential endogeneity problem. We then estimate equation (3) to assess our fundamental questions.

The models presented in both equation (3) and (4) are estimated using the fixed effect estimation approach. The estimation strategy is in two steps. In the first step, we estimate the regulation model and save the residuals to be included in the risk model. The purpose of this is to reduce potential endogeneity problems due to the interdependence between risk and regulation. In the second step, we estimate the risk model, both for credit risk and operational risk. In the final stage, we perform sensitivity analysis on our main results by relaxing the static structure imposed in estimating equations (3) and (4) to a dynamic structure. In the case of the dynamic model, the usually fixed effect model will not be appropriate because of the included lag dependent variable as a regressor will be correlated with the fixed effect, creating a dynamic panel bias (Nickel bias),

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which is severe in small panels. Since our panel time dimension is less than 30 years, the threshold level where Nickel bias is not critical (Judson and Owen, 1999), we need to apply the appropriate methods to reduce the effects of Nickel bias.

In the literature both the corrected least squares dummy variable (LSDVC) and the GMM estimators were designed purposely to handle dynamic panels to correct for Nickel bias, especially in panels with short periods, where the bias is severe. In panels with period above 30 years, the bias created by the correlation between the lagged dependent variable and fixed effects is small (Judson and Owen, 1999). In such instances, the FE estimator performs well relative to both the GMM and LSDVC. In this study, we opted for the LSDVC to correct for the bias created by the lagged depended on variable in the dynamic model estimation due to its superior performance over the GMM showed by Judson and Owen, 1999, especially in panels with 20 years' time period.

5. Empirical Evidence

5.1 Results of the empirical estimation

We first present the results based on a fixed effect model both for credit risk and operational risk in that sequence and provide some discussion on the results and later present sensitivity analysis by relaxing the static model imposed to obtained our main findings and also using a different index to measure competition and the implication of the sensitivity analysis on our primary results.

5.1.1 Credit risk results

In Table 1, we present the credit risk results based on a fixed effect model. Table 1 contains three columns, each represent a unique version of the fixed effect model, first column (1) is a model without both the interaction between regulation and competition, and time dummies, the second

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column (2) is based on a model without time dummies, and the third column (3) is based on our specified model presented in equation (3).

In all cases, we find a significant positive direct effect of regulation on credit risk across the three different specifications, with an increasing magnitude as one moves from column (1) to column (3). This is just the direct effect of regulation since the estimated coefficient of the interaction term in column (3) is negative but significant at any of the conventional levels of significance, it, therefore, implies that the estimated regulation coefficient presented in columns (1) and (2) are tentatively the direct effects of regulation, but the indirect impact via its interaction with competition is not captured by the models estimated and presented in columns (1) and (2), respectively. The negative coefficient of the interaction term between regulation and competition implies that the total effect of regulation on credit risk could be positive or negative depending on the level of competition via taking the partial derivative of credit risk with respect to regulation, which is presented in the model section after equation (3).

[Insert Table 2 Here]

The estimated total effect of regulation evaluated at different percentiles, 1st, 25th, 50th, 75th and 95th respectively are all significant at the 5% significance level except at the 25th percentile, where it is not significant. This result is reported in table 3 and revealed that the total effect of regulation on credit risk is conditional on the level of competition. The impact is positive at 1st percentile level of competition (high competition) and turns negative (significant) on the 50th, 75th and 95th percentiles (low level of competition) of competition proxy by Lerner index. The table further revealed that the magnitude of the negative interaction effect increases as percentile level increases, suggesting among other things that a very low competitive microfinance industry should

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be regulated if the policy target is to reduce credit risk exposure. However, if the level of competition is high as demonstrated by 1% percentile level of competition, regulation is bad for credit risk. This is because regulation of a competitive MFIs may induce some market power for the existing firms, which could result in more risk-taking behaviour for pure profit motives. Also, in a high competitive market, with very many firms, effective regulation may be difficult to achieve and in such an environment, an ineffective regulation may instead induce reckless credit risk-taking behaviour by competing MFIs, where the MFIs in the industry will not adhere to rules and regulation provided by the policymaker or regulator to ensure a smooth and less risk-taking activities among MFIs.

[Insert Table 3 Here]

The estimated direct effect of competition is positive and significant at any of the conventional significance levels. The estimated direct elasticity between credit risk and competition is about 1.8, which is also the total effect of competition on credit risk for non-regulated MFI since the interaction effect evaluated for non-regulated MFI is zero. On the other hand, the total impact of competition for regulated MFI is 0.213, which is calculated by adding the coefficient of the interaction term (-1.589) to the coefficient of competition (1.802) via the partial derivative of credit risk with respect to competition as expressed in the model section.

This implies that non-regulated MFIs tend to take more risk if they operate in a less competitive environment relative to regulated MFIs. The transmission mechanism is as follows, without regulation, MFIs enter the industry for all manner of reasons including serving the poor and for commercial purposes, as a consequence these MFIs tend to take more risk for profit motives due to the relaxed rules governing their operations. Few big MFIs can utilise unfair competitive strategies to dominate the market to gain some market power. Given the power, they

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will be taking excessive risk in the absence of regulation. This means that, given a less competitive environment, regulation will tend to reduce credit risk exposure.

Among the control variables, only the estimated coefficients on financial revenue, financial strength and the residuals from estimating a regulation model (included to control potential endogeneity of regulation in our credit risk model), are statistically significant. The estimated elasticity between credit risk and financial revenue is -0.05, while that between credit risk and financial strength is -0.09. These results imply that MFIs tend to take less credit risk when their financial revenue position is high. MFIs with excellent financial strength also tend to make less credit risk, which is very intuitive. This is because MFI with good financial revenue position and excellent financial power will not take unnecessary credit risk exposures. Besides, MFIs with such good and excellent financial revenues and financial strength are more likely to make strict screening measures to reduce risk exposures relative to those without such financial standing, as they are not under severe revenue and liquidity pressure to venture into taking unnecessary credit risk.

5.1.2 Operational risk results

Next, we assess whether regulation and competition matter regarding the operational risk of MFIs in SSA. Thus, given the finding that both competition and regulations are essential factors to consider when implementing policies to reduce credit risk among MFIs, does this also apply to operational risk? In addressing this objective, we similarly estimated an operational risk model as done in the case of credit risk. We assessed three different versions, which are reported under three different columns in table 4. Column (3) is estimated based on the model presented in eqn (1), while column (2) excluded the interaction between regulation and competition and column (1)

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excluded both the interaction term and time dummies. The reported results indicate that regulation is not essential for operational risk of the MFIs since the estimated coefficient is statistically insignificant across the three different versions at any of the conventional significance levels. A possible explanation for this is may be that most of the regulation of MFIs is directed towards loans activities but less towards how the MFIs operate. As a consequence, in such a case, regulation is likely to be associated with loan and credit activities of these institutions, but less to operational activities.

Competition, on the other hand, increases the operational risk of MFIs, since the estimated coefficient is positive and significant at least at the 5 per cent significance level, meaning that a less competitive MFIs industry is associated with high operational risk. The interaction term between regulation and competition is however insignificant, further supporting the finding from the direct effect of regulation on operational risk. In a nutshell, the regulation does not affect the operational risk of MFIs in our sample, both direct and indirect.

The estimated coefficient of size is negative and significant, implying that the size of the MFI has an impact on operational failures and hence operational risk. The mechanism for this is as follows; large firms can afford better systems and implement relatively better policies and procedures on the average relative to small firms. The implication of this is that large firms on the average can reduce employee errors due to the better screening process and monitoring procedures, reduce system failures and in general reduce events that are likely to create problems for the firm's operations.

[Insert Table 4 Here]

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The results also revealed that operational efficiency has a significant negative effect on operational risk of MFIs, which among other things means that if the firm is operating efficiently, the firm tends to be less prone to failures in procedure, systems and policies and as a consequence reduce employee errors, system failures, reduction in criminal activities and any action that will disrupt the firm's business process. This ultimately reduces the cost associated with operational failures and hence operational risk.

The other controls such as financial revenue, financial strength and financial cost are not statistically significant at any of the conventional significance level, which implies these controls have no impact on MFI's operational risk exposures, contrary to the findings from credit risk.

5.2 Sensitivity analysis

Our primary results reported in table 2 and 4, may be sensitive to the type of structure imposed on the model (a static model for the primary results). To assess the implication of the imposed structure of the model on the results, we relax the static nature of the model by estimating a dynamic model. The results based on a dynamic model are reported in table A2 in the appendix. The results revealed, in general, they are qualitatively similar to our primary results for both the credit risk results and the operational risk results. They were only slightly different regarding the size of the coefficients. Our general conclusion based on this sensitivity analysis is that the results are robust to the model structure (static or dynamic) for both the credit risk and operational risk models.

The general conclusion from the sensitivity analysis is that in general, the type of model structure imposed (static versus dynamic) does not significantly influence the model results. In the case of the choice of proxy for competition, we found estimates on the critical variables of interest

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(regulation and competition) are sensitive to the proxy used for competition (Lerner index versus HHI).

6. Summary and Conclusion

The study highlights the sequencing impact of portfolio risk, market concentration and regulation of MFI's in Sub-Saharan Africa. To establish this, we use both fixed effect and dynamic panel regression models on a sample of 1574 microfinance firms from Sub-Saharan Africa countries for the period 1995 to 2015. Evidence from our extensive panel fixed effect, and dynamic models suggest a significantly positive direct impact of regulation on credit risk. The result implies that regulation substantially affects credit risk positively. In similar evidence, the findings also suggest a significantly negative relationship between the interactive term of regulation and competition on risk. This indicates that a low competitive MFI industry could be efficiently regulated if the policy target is to reduce credit risk exposure. This is because; regulation will control reckless credit risk-taking behaviour by powerful MFIs to ensure that MFI in the industry adheres to rules and regulation provided by the policymaker or regulator to aid smooth and less risk-taking activities among MFIs.

Contrary to the above evidence, we did not find any significant relations between regulation and operational risk. A possible explanation for this is that most of the regulation of MFIs is directed towards loans activities but less towards how the MFIs operate. Consequently, regulation is likely to associate with loan and credit activities of these institutions, but less to operational activities. However, we find the estimated coefficient of competition on operational risk to be positive and significant, which suggests that low competitive MFI's are very much

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exposed to high operational risk. Our general conclusion based on this sensitivity analysis is that the results are robust to the model structure (static or dynamic) for both the credit risk and operational risk models. The results remain consistent after controlling for model structure (static or dynamic).

However, the findings of our study should be interpreted in light of some limitations. For instance, due to data availability, our study is limited to a sample of 1574 microfinance firms from Sub-Saharan African countries. As a result, we caution scholars against generalisation using the findings of this paper. Also, despite the findings that regulation and competition have different effects on credit risk and operational risk, it is possible that there may be other explanatory variables not included in our model. This is especially so particularly in Sub-Saharan African countries, where so many other variables can contribute to credit risk and operational risk-taking the behaviour of firms.

Further and more extensive analyses in multiple contexts and countries will help to establish causal effects between the variables. Finally, it is possible that the impact of regulation and competition on credit risk and operational risk might be best captured at a sectorial level, as this will enable the characteristics of individual sectors to be modelled; due to data availability, our study could not achieve this. This could be an avenue for future research.

Despite these limitations, the study makes a significant contribution to academic literature and policy implication. First, we offer new evidence of the relationship between regulation, competition and risk-taking behaviour of MFI's. While prior studies provide extensive empirical evidence on the impact of regulation on risk-taking behaviour of firms, there is no evidence that demonstrates how regulation and competition are likely to have different effects on credit risk and operational risk among firms. Our model reveals that regulation is likely to associate with loan and

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credit activities of these institutions, but less to operational activities. Against this backdrop, we suggest further studies to control for these conditions to derive reliable conclusions.

In terms of the policy implications, our findings suggest that policymakers should be concerned about the economic consequences of regulation on credit risk-taking the behaviour of MFI. Our findings suggest that the MFI industry could be regulated efficiently if policymakers develop policies targeted at reducing credit risk exposures of MFI's than their exposure to operational risk.

Finally, our findings also offer a guide to business owners on the type of risk exposure they may be exposed to under different market conditions. Our model reveals that low competitive MFI's are very much likely to be exposed to high operational risk.

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[Insert Table A1 Here]

[Insert Table A2 Here

Table A1: Descriptive statistics for the dataset for the analysis for overall, where data is pooled cross firms and time period, within firms and between firms.

Variable		Mean	Std. Dev.	Minimum	Maximum	Observation
Portfolio risk	Overall	0.100	0.200	0.000	6.843	N = 240
	Between		0.197	0.000	2.440	n = 62
	Within		0.140	-2.264	4.504	
Regulated	Overall	0.773	0.419	0.000	1.000	N = 385
	Between		0.324	0.000	1.000	n = 81
	Within		0.327	-0.164	1.607	
Gross loan Portfolio	Overall	16300000.000	107000000.000	0.000	3400000000.000	N = 369
	Between		53100000.000	0.000	1010000000.000	n = 80
	Within		78000000.000	-952000000.00	2410000000.000	
Cost per loan	Overall	261.810	482.417	4.000	6822.000	N = 117
	Between		453.854	5.000	4164.000	n = 52
	Within		305.979	-2542.690	4367.477	
Write of Ratio	Overall	0.048	0.648	-0.023	25.711	N = 189
	Between		0.213	0.000	3.723	n = 52
	Within		0.599	-3.675	22.037	
Financial Strength	Overall	2074.507	91062.650	-1.959	4100000.000	N = 202
	Between		40741.080	-0.799	1025000.000	n = 63
	Within		78886.220	-1022926.000	3077074.000	
Financial Revenue	Overall	52137.630	407119.200	-2057.860	15000000.000	N = 385

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	Between		274067.700	0.000	5000507.000	n = 81
	Within		339063.100	-4948369.000	10100000.000	
Lerner Index	Overall	0.702	0.156	0.041	0.974	N = 235
	Between		0.148	0.091	0.974	n = 59
	Within		0.084	0.139	1.026	
HHI	Overall	0.002	0.009	0.000	0.115	N = 385
	Between		0.007	0.000	0.115	n = 81
	Within		0.007	-0.044	0.107	
Total cost	Overall	5581175.000	30800000.000	4.885	820000000.000	N = 238
	Between		18400000.000	97.214	385000000.000	n = 60
	Within		18500000.000	-281000000.00	441000000.000	
Labour Cost	Overall	12937.260	11423.950	0.851	244348.800	N = 215
	Between		10401.210	1.136	90979.570	n = 54
	Within		6782.434	-22465.180	221594.000	
Capital Cost	Overall	0.063	0.207	0.000	6.644	N = 219
	Between		0.319	0.001	6.644	n = 56
	Within		0.088	-1.654	2.139	
Market share	Overall	0.010	0.032	0.000	0.628	N = 369
	Between		0.022	0.000	0.240	n = 80
	Within		0.028	-0.151	0.546	

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Table A2: Regression results from estimating a Least Squares Corrected Dummy Variable dynamic model for operational risk and portfolio risk

Variables	(1) Operational Risk (log)	(3) Credit risk (log)
Lag Credit risk (log)		0.460***
		(0.033)
Lag Operational risk (log)	0.080***	
	(0.016)	
Regulation	-0.009	0.853*
	(0.121)	(0.493)
Competition (Lerner index (log))	0.254**	1.879***
	(0.112)	(0.491)
Size (log)	-0.096***	-0.087
	(0.020)	(0.107)
Regulation*competition	-0.051	-1.491***
	(0.174)	(0.539)
Financial Cost (log)	0.004	-0.022
	(0.007)	(0.052)
Operational Efficiency	-0.059*	-0.130
	(0.034)	(0.254)
Financial Revenue (log)	0.006	-0.044*
	(0.004)	(0.024)
Financial strength (log)	0.011	-0.053**
	(0.007)	(0.022)
Residual (regulation residual)	0.009	-0.509**
	(0.037)	(0.224)
Time dummies	yes	yes
Observations	2,017	1,174
Number of firms	521	324

Robust standard errors that correct for heteroskedasticity are in parentheses, *** p<0.01, ** p<0.05, * p<0.1. "Yes" on Time dummies row indicate that time dummies are included in the regression and are significant statistically, while "No" indicate they are not included in the estimation

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Table 2: Regression results from estimating a fixed effect static model for portfolio risk

Variables	(1) Credit risk (log)	(2) Credit risk (log)	(3) Credit risk (log)
Regulation	0.742***	1.354***	1.395***
	(0.245)	(0.347)	(0.337)
Competition (log Lerner Index)	0.125	0.251	1.802***
	(0.214)	(0.206)	(0.433)
Regulation* competition (log Lerner Index)			-1.589***
			(0.393)
Size (log)	0.157***	-0.079	-0.088
	(0.056)	(0.076)	(0.075)
Financial Cost (log)	-0.031	-0.033	-0.033
	(0.027)	(0.027)	(0.026)
Operational Efficiency	0.041	0.027	0.029
	(0.144)	(0.141)	(0.145)
Financial Revenue (log)	-0.065***	-0.054**	-0.049**
	(0.025)	(0.024)	(0.024)
Financial strength (log)	-0.100**	-0.097*	-0.086*
	(0.051)	(0.051)	(0.050)
Residual (regulation residual)	-0.296***	-0.533***	-0.742***
	(0.107)	(0.147)	(0.156)
Constant	-5.154***	-2.766***	-2.659***
	(0.881)	(0.997)	(0.989)
Time dummies	No	yes	yes
Observations	1,574	1,574	1,574
Number of firms	444	444	444
CVS	1.155	1.122	1.105

Robust standard errors that correct for heteroskedasticity are in parentheses, *** p<0.01, ** p<0.05, * p<0.1, cvs denotes cross validation score. Note competition have inverse interpretation as higher values implies lower competition, while lower values denote high competition. "Yes" on Time dummies row indicate that time dummies are included in the regression and are significant statistically, while "No" indicate they are not included in the estimation.

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Table 3: Total effect of regulation evaluated at different percentiles of competition.

Percentile of competition (Lerner index)	1%	25%	50%	75%	95%
Total regulation effect (FE model)	1.330***	-0.344	-1.811**	-2.760**	-2.792**
	(0.30)	(0.54)	(0.89)	(1.12)	(1.13)

Robust standard errors that correct for heteroskedasticity are in parentheses, *** p<0.01, ** p<0.05, * p<0.1

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Table 4: Regression results from estimating a fixed effect static model for Operational risk

Variables	(1) Operational Risk (log)	(2) Operational Risk (log)	(3) Operational Risk (log)
Regulation	-0.012	0.010	0.021
	(0.066)	(0.095)	(0.094)
Competition (log Lerner Index)	0.215***	0.205***	0.283**
	(0.060)	(0.063)	(0.111)
Regulation*competition			-0.081
			(0.095)
Size (log)	-0.102***	-0.092***	-0.092***
	(0.013)	(0.017)	(0.017)
Financial Cost (log)	0.005	0.003	0.003
	(0.008)	(0.008)	(0.008)
Operational Efficiency	-0.057*	-0.064*	-0.062*
	(0.033)	(0.033)	(0.033)
Financial Revenue (log)	0.008	0.007	0.007
	(0.008)	(0.008)	(0.008)
Financial strength (log)	0.016	0.013	0.013
	(0.012)	(0.012)	(0.012)
Residual (regulation residual)	0.017	0.011	-0.005
	(0.027)	(0.039)	(0.041)
Constant	-0.076	0.076	0.081
	(0.215)	(0.258)	(0.258)
Time Dummies	No	yes	yes
Observations	2,144	2,144	2,144
R-squared	560	560	560
CVS	0.147	0.147	0.147

Robust standard errors that correct for heteroskedasticity are in parentheses, *** p<0.01, ** p<0.05, * p<0.1, cvs denotes cross validation score. “Yes” on Time dummies row indicate that time dummies are included in the regression and are significant statistically, while “No” indicate they are not included in the estimation.

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