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The impact of COVID-19 on the efficiency of microfinance institutions

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ABSTRACT

This study investigates the effect of the COVID-19-induced decline in economic activities on the financial and social efficiency of microfinance institutions (MFIs). We find that the pandemic-induced impact decreases the financial efficiency of MFIs; however, the social efficiency of MFIs is increased under the impact of COVID-19. To explore potential channels through which efficiency is influenced by the COVID-19 outbreak, we examine the supply and demand side of MFIs' funding. We find that the lending rate mediates the relationship between the impact of COVID-19 and MFI efficiency, whereas the mediating role of the funding rate is negligible.

1. Introduction

> "The global economy could suffer between $5.8 trillion and $8.8 trillion in losses – equivalent to 6.4%–9.7% of global gross domestic product (GDP) – as a result of the novel coronavirus disease (COVID-19) pandemic" estimated by the Asian Development Bank (ADB), May 2020.

The COVID-19 was first identified in China in December 2019, but the virus has spread rapidly across the globe. As of May 20, 2020, the number of confirmed coronavirus infections worldwide approached 5 million across more than 200 countries and territories, with over 90% of reported cases currently located outside China. The ongoing COVID-19 pandemic not only represents a worldwide public health emergency, but also has imposed massive and far-reaching economic cost globally. The spread of the virus itself and the containment measures attempting to mitigate it can bring production and consumption to a standstill (Boone et al., 2020). For example, high mortality and morbidity rates of COVID-19 reduce the labour supply which, in turn, hinders production. In a similar vein, social distancing policies and lockdown measures (e.g., store and factory closures, quarantine, and mobility limitations) aiming to reduce the transmission rate and curb the spread of the disease, may also result in a sharp and immediate decline of production in the economy. Moreover, when workers lose their income due to the mass layoffs, they tend to cut back on spending or reduce their 'postpone-able' social consumption (e.g., restaurants, movie theatres, pubs and clubs, travel and tourism). Firms may also delay their investments owing to heightened uncertainty associated with COVID-19.

While the spread in the US and Europe is attracting considerable media coverage, the COVID-19 pandemic could have more devastating effects on the world's most vulnerable populations in low- and middle-income countries, since emerging economies tend to lack the resources and capacity to cope with a precipitous increase in infections as well as the socioeconomic consequences of containment measures (Loayza & Pennings, 2020). For example, they have poor health infrastructure to deal with the influx of patients;

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they rely heavily on commodity exports and tourism which are severely hit by border lockdowns; and they have less effective policy measures with which to fight the COVID-19-driven recession (Hevia & Neumeyer, 2020). A high degree of informality is a key feature in developing countries: a large share of the labour force is either self-employed or employed in small and medium-sized businesses. These low-income, self-employed or informally employed individuals have limited access to unemployment insurance, health insurance and paid leave, and, thus, are particularly vulnerable to COVID-19 disruptions. In developing and highly informal economies, microfinance institutions (henceforth MFIs) play an important role in providing financial support to poor and low-income households and micro-enterprises who have been excluded from mainstream financial services traditionally. For example, as of November 2019, Grameen Bank has provided collateral-free loans of more than $20 billion to around 9 million the poorest of the poor in rural Bangladesh, including 97% of women borrowers, and covering 93% of the total villages in Bangladesh.[1]

Although a rapidly growing body of research investigates the impact of the COVID-19 crisis on the macroeconomy and stock market (see e.g., Baker et al., 2020; Eichenbaum et al., 2020; Gormsen & Koijen, 2020; Guerrieri et al., 2020; Lewis et al., 2020), almost no research to date has attempted to analyse empirically how COVID-induced economic damage influences the performance of MFIs. The minimal attention to the impact of the COVID-19 epidemic on MFIs is unfortunate though, because MFIs serve hundreds of millions of poor and vulnerable people in developing countries. The goal of this article is to fill this gap in the literature.

To test the effects of the COVID-induced decline in economic activity on the financial and social efficiency of MFIs empirically, we use a dataset from the MIX Market, which covers 73 unique MFIs operating in 11 developing Asian countries and contains individual MFI's financial and outreach data. Additionally, we collect COVID-19 economic impact data from the Asian Development Bank (ADB), which proposes four scenarios: best case, moderate case, worse case, and hypothetical worst case; and estimates drops in 2018 nominal GDP and employment under each scenario. By way of preview, our main findings are summarized as follows. The GDP and employment impact from COVID-19 reduces MFI financial efficiency but increases MFI social efficiency, indicating that, while the economic slowdown lowers MFI financial performance, the role of creating a social impact is seemingly prioritized during COVID-19. Furthermore, we examine the specific channels through which efficiency is influenced using both the lending rate and the funding rate. We find that the lending rate plays a mediating role between the impact of COVID-19 and MFI efficiency. In particular, the potential GDP and employment impact from COVID-19 on financial efficiency is completely mediated by the lending rate, whereas a partial mediation of the lending rate is found between the impact of COVID-19 and social efficiency. This suggests that the influence from the impact of COVID-19 on MFI efficiency is transmitted indirectly through the lending rate; however, we find that a mediating effect through the funding rate is not pronounced, suggesting that the channel between the GDP and employment impact from COVID-19 and MFI efficiency is rather direct.

Our study offers two important contributions to the literature. First, this is the first study examining how MFI financial efficiency and social efficiency are affected by COVID-19. While the extant literature generally investigates the effects of the macroeconomic environment on MFI performance or efficiency (e.g., Hartarska & Nadolnyak, 2007; Ahlin et al., 2011; Bogan, 2012), limited research focuses on how the pandemic-induced economic slowdown may affect MFI performance, particularly with respect to financial and social efficiency, differently. Second, to the best of our knowledge, this is the first study to provide empirical evidence that enhances the understanding of the mechanisms underlying the association between the impact from COVID-19 and MFI efficiency by testing the mediation effect of the supply and demand side of funding, through the channels proposed by Baron and Kenny (1986)'s method and the Sobel test (Sobel, 1982). Accordingly, we explore the relationship between the impact of COVID-19 and MFI efficiency successfully by considering proxies for MFI funding supply and demand using lending rate, funding rate, deposits, and donations as potential mediators.

The structure of the paper is as follows: Section 2 reviews the existing literature and develops the hypotheses. Section 3 describes the data and defines our variables. Section 4 reports the results of the regression analyses. Section 5 concludes the paper.

2. Literature and hypotheses development

MFIs are special financial institutions and differ fundamentally from commercial banks, mainly in that they pursue the double bottom-line objectives of financial sustainability and social outreach. MFIs are socially oriented organizations that provide non-collateralized microcredit to low-income families and microentrepreneurs, who are otherwise unable to access to formal financial services (Zamore et al., 2019). Since MFIs serve hundreds of millions of poor and vulnerable borrowers, they play a pivotal role in alleviating poverty in developing countries. Apart from their social mission, MFIs have a profit nature. Financial viability is a major concern for the microfinance industry; thus, MFIs behave like other profit-driven firms, aiming to be profitable or at least break even (Zamore et al., 2019). In line with their dual objectives, MFIs are generally evaluated with respect to social impact considerations and profit implications. While there is a substantial literature that examines the key determinants of MFI success, previous empirical evidence regarding the impact of macroeconomic conditions on MFI performance is mixed and inconclusive. Against this background, we examine the effects of the COVID-induced economic slowdown, as measured by decline in GDP and employment, on MFI social and financial performance in developing Asian countries. Given the conflicting objectives documented in the literature (Galema et al., 2012), that is, there may be a trade-off between serving the poorest segments and remaining financially viable, we formulate two competing hypotheses on the effects of the macroeconomic environment on MFI performance.

The previous literature suggests that a pandemic-induced economic downturn will put pressure on banks' loan portfolios and can lead to a large withdrawal of deposits, particularly in poor and developing countries (Beck, 2020; Lagoarde-Segot & Leoni, 2013). In line with this view, we expect that the socioeconomic damage caused by COVID-19 should deliver a negative effect on MFI financial

[1] See Grameen Bank website http://www.grameen.com for detailed information.

performance. First, MFI may experience a deterioration in performance as small and medium-sized businesses (SMEs) and vulnerable households, which are among the most exposed to the COVID-19, have been struggling to meet their debt obligations. Businesses are likely to generate insufficient cash flow to service their debt owing to factory shutdowns, supply chain disruption, and a sudden fall in demand for goods and services during the pandemic. Also, a strong decline in economic activity usually translates to an increase in the unemployment rate (Skoufias, 2003). Mass layoffs and closures undermine MFI performance because the laid-off workers are financially fragile, and they may not be able to make mortgage payments on time owing to income shortfalls, thus, increasing the likelihood of non-performing loans. Second, the excessive build-up of non-performing loans arising from the COVID-19 shock will affect sentiment negatively, so a wider decline in confidence in banks by depositors may result in large-scale withdrawals of deposits (Beck, 2020).

Yet another strand of related research has highlighted that MFI performance is expected to improve under poor economic conditions (Ahlin et al., 2011). Consistent with this line of argument, we predict that COVID-19-induced economic slowdown could affect MFI social performance positively for two possible reasons. First, MFIs with a strong internalized social mission can be incentivized by reaching out to the poor and low-income households and microenterprises active in the informal economy. Ahlin et al. (2011) suggest that a decline in economic growth may increase demand for products produced by microenterprises, as consumers substitute away from imports or higher quality goods. Hence, these microenterprises will be in desperate need of credit to expand their production capacity. Commercial banks are reluctant to lend to SMEs that are already indebted in times of economic downturn, since small and informal entrepreneurs may not be able to cope with any additional loans during the pandemic. By contrast, MFIs share a commitment to make financial services available to fragile and vulnerable clients. Therefore, MFIs may prioritize their social mission during recessions, allowing loans to become delinquent and taking losses (Ahlin et al., 2011). Second, microfinance unique business models, like group lending technology, make MFIs less sensitive to economic shocks, and more cost-efficient, than traditional banks (Schulte & Winkler, 2019; Zamore et al., 2019).[2] It is, thus, expected that MFIs may be able to provide smaller loans to more underserving micro-entrepreneurs during a recession. In other words, the breadth (i.e., the number of active borrowers) and the depth (i.e., the provision of small loans) of MFIs' outreach are likely to be enhanced. Based on the above competing arguments, we posit the following hypotheses:

Hypothesis 1. COVID-19 induced economic slowdown is associated negatively with MFI financial performance

Hypothesis 2. COVID-19 induced economic slowdown is associated positively with MFI social performance

3. Variables and data

In this paper, we assess MFI performance with respect to financial and social efficiency by utilizing a Data Envelopment Analysis (DEA) framework. DEA is a non-parametric linear programming method that calculates the quantity of output produced, given certain levels of input, and allows for multiple comparisons between a set of homogeneous units (Gutiérrez-Nieto et al., 2007). Previous literature suggests that DEA is an appropriate technique for the assessment of MFI performance (e.g., Gutiérrez-Nieto et al., 2009). The advantage of using DEA to calculate MFI efficiency is that it can incorporate the outputs of both social impact and financial viability along with other inputs into a single framework without any assumption on data distribution (Basharat et al., 2015). The input and output data for the DEA framework are obtained from the global database of MFIs collected by the MIX Market information platform. This database contains the best publicly available cross-country data for MFI-specific social and financial indicators. It has been widely used in the microfinance literature (see Assefa et al., 2013; Ahlin et al., 2011; and among many others). Following Basharat et al. (2015), in our main empirical estimation, we use *ace_lr* as a general specification for financial efficiency, where assets (a), operating expense (c), and personnel (e) are taken as inputs; gross loan portfolio (l) and financial revenue (r) as outputs. Similarly, we use *ace_wp* as a general specification for social efficiency, where inputs (*ace*) are the same as those in financial efficiency; number of active female borrowers (w) and an indicator of benefit to the poorest (p) are taken as outputs. To address the concerns that our results may be sensitive to the selection of inputs and outputs, we calculate alternative measures of social and financial efficiency based on a different input and output selection using a robustness check.

We obtain the economic impact of COVID-19 data from the Asian Development Bank (ADB). The COVID-19 induced economic slowdown is measured based on the percentage of decline in both 2018 GDP and employment in all sectors. ADB estimates four scenarios based on tourism and travel bans affected by the COVID-19 situation in China – "best case", "moderate case", "worse case", and "hypothetical worst case", and it assesses the impact conditional on the realization of these scenarios. Appendix B lists the full set of scenario assumptions. The estimated GDP and employment impact of COVID-19 is based on the expected duration of travel bans, and the magnitude of the drop in domestic demand, in China. For instance, under the "best case", the duration of travel bans in China is expected to be two months, which would subsequently lead Chinese outbound tourism to drop by 50% within the two months, and no economies that impose travel bans would have tourism receipts from China. The estimated impact also includes the fall in inbound Chinese tourism and receipts, as well as tourism from outside Asia to non-China East and Southeast Asia by analogy with the pandemic period of SARS. As such, ADB expects a 0.7% decline in consumption from China relative to a no-outbreak scenario for the "best case" scenario. In comparison, the "hypothetical worst case" would see the expected duration of travel bans and decline in domestic demand in China of six months plus an extra three months for economies with COVID-19 outbreaks. Consequently, the Chinese outbound tourism would be

[2] In group lending, MFIs rely on joint liability, where liability for loan repayment is shared among group members, to facilitate lending to the poor. Because of the peer pressure, group lending techniques can promote better screening, monitoring and enforcement of repayment, and mitigate informational asymmetries between lender and borrower.

expected to drop by 50% during the travel ban period, and inbound Chinese tourism would be expected to fall by an additional 30% relative to the best case. Tourism from outside Asia to non-China East and Southeast Asian economies would also be expected to fall by an additional four months relative to the best case. Due to these impacts, ADB expects a 2% drop in consumption and investment in China, as well as a 2% decline in domestic consumption in selected economies. In our study, *gdp_chg_1*, *gdp_chg_2*, *gdp_chg_3*, and *gdp_chg_4* denote the magnitudes of the effects on GDP due to the potential economic impact of the COVID-19 outbreak under the "best case", "moderate case", "worse case", and "hypothetical worst case" scenarios respectively, measured as percentage drop in total 2018 nominal GDP. *emp_chg_1*, *emp_chg_2*, *emp_chg_3*, and *emp_chg_4* denote the magnitudes of the effects on employment due to the potential economic impact of the COVID-19 outbreak under the "best case", "moderate case", "worse case", and "hypothetical worst case" scenarios respectively, measured as percentage drop in employment among all sectors as of 2018.

In addition, we include MFI-specific and macro-economic control variables that prior literature suggests as affecting MFI performance. Data on MFI-specific controls are sourced from the MIX Market database, including the ratio of capital to total assets (*ca*); the impairment loss allowance to total assets ratio (*allow*); the ratio of cash and cash equivalents to total assets (*liq*); the ratio of deposits to gross loan portfolio (*dp*); the lending rate, measured by financial revenue over average loan portfolio (*lendingrate*); and the funding rate, measured as total finance expense over total debt. (*fundingrate*). Country-level macroeconomic data, GDP growth rate and population density, are taken from the World Bank's World Development Indicators database. GDP growth rate (*gdpgr*) is defined as annual percentage growth rate of GDP at market prices based on constant local currency (aggregates are based on constant 2010 U.S. dollars). Population density is measured as midyear population divided by land area in square kilometres. We use the natural logarithm of population density in this paper (*lnpopden*). The variable definition is shown in Appendix A.

After merging all data sources together, we obtain 73 MFIs in 11 Asian developing countries for which complete information is available. All the data correspond to the year 2018. As seen from Table 1, we note that the MFIs included in our samples are higher for Philippines and Cambodia than the other economies, whereas Mongolia and Fiji have the least observations.

4. Results

4.1. Descriptive statistics

Table 2 reports the descriptive statistics for the variables used in our analysis. The mean (median) value of financial efficiency and social efficiency measures, *ace_lr* and *ace_wp*, are 0.258 (0.086) and 0.602 (0.726), respectively. For the impact of COVID-19, the impact based on both nominal GDP and employment increases as the travel restrictions become more intense from the "best case" to "hypothetical worst case". The mean (median) value for *gdp_chg_1*, *gdp_chg_2*, *gdp_chg_3*, and *gdp_chg_4* are −0.341 (−0.169), −0.491 (−0.257), −0.926 (−0.514) and −1.870 (−1.573), respectively. Similarly, the mean (median) values for *emp_chg_1*, *emp_chg_2*, *emp_chg_3*, *emp_chg_4* are −0.211 (−0.199), −0.317 (−0.295), −0.604 (−0.560) and −1.707 (−1.616), respectively. This shows a general trend that the longer the travel bans from China, the greater the impacts for the ADB participants. Furthermore, the average MFIs in our samples has a capital ratio (*cap*) of 0.225, an impairment loss ratio (*allow*) of 0.021, a liquidity ratio (*liq*) of 0.118, and a deposit ratio (*dep*) of 0.458. The average for annual percentage growth rate of GDP (*gdpgr*) is 6.028, and the average the population density (*lnpopden*) is 4.720.

Table 3 reports the Pearson correlations among our variables. It shows that the univariate correlations are generally below 0.7 between our dependent variables and other variables. Furthermore, we do not observe extremely high correlations among variables that might raise concerns over multicollinearity issues. According, we confirm that there is no multicollinearity threat to these variables.

4.2. The impact from COVID-19 on MFI efficiency

To examine our H1, we develop the following model to investigate the association between the impact from COVID-19 on MFI financial efficiency:

Table 1
Sample distribution.

Country	Observations
Cambodia	15
People's Republic of China	3
Fiji	1
Indonesia	5
Kazakhstan	4
Kyrgyzstan	6
Laos	3
Mongolia	2
Nepal	8
Pakistan	8
Philippines	14
Total	**73**

Table 2
Summary statistics.

	Mean	SD	P25	Median	P75	N	Min	Max
ace_lr	0.258	0.312	0.017	0.086	0.380	72	0	1
ace_wp	0.602	0.362	0.236	0.726	0.950	73	0.013	1
gdp_chg_1	−0.341	0.431	−0.322	−0.169	−0.041	73	−1.154	−0.005
gdp_chg_2	−0.491	0.593	−0.739	−0.257	−0.063	73	−1.592	−0.010
gdp_chg_3	−0.926	1.086	−1.510	−0.514	−0.126	73	−2.898	−0.019
gdp_chg_4	−1.870	1.045	−1.741	−1.573	−1.107	73	−3.810	−0.617
emp_chg_1	−0.211	0.198	−0.446	−0.199	−0.027	73	−0.647	−0.005
emp_chg_2	−0.317	0.304	−0.703	−0.295	−0.041	73	−0.991	−0.011
emp_chg_3	−0.604	0.576	−1.337	−0.560	−0.083	73	−1.952	−0.020
emp_chg_4	−1.707	0.504	−1.953	−1.616	−1.256	73	−2.547	−0.892
cap	0.225	0.195	0.127	0.205	0.299	73	−0.389	0.915
allow	0.021	0.019	0.010	0.016	0.026	73	0	0.139
liq	0.118	0.074	0.069	0.107	0.160	73	0.002	0.478
dep	0.458	0.422	0	0.477	0.649	73	0	1.737
gdpgr	6.028	1.299	5.83	6.244	7.076	73	3.209	7.498
lnpopden	4.720	1.247	4.522	4.999	5.617	73	0.713	5.879

$$ace\_lr_i = \beta_0 + \beta_1 COVID_i + \sum Controls_i + \varepsilon_i \quad (1)$$

where ace_lr_i is our financial efficiency measure for firm *i*; $COVID_i$ is a vector, which contains eight measures of the impact of COVID-19 for firm *i*, including $gdp\_chg\_1_i$, $gdp\_chg\_2_i$, $gdp\_chg\_3_i$, $gdp\_chg\_4_i$, $emp\_chg\_1_i$, $emp\_chg\_2_i$, $emp\_chg\_3_i$, and $emp\_chg\_4_i$. Our control variables include *cap*, *allow*, *liq*, *dep*, *gdpgr*, and *lnpopden*. Table 4 shows the results for Equation (1). As seen from Column (1), the impact from COVID-19 by nominal GDP decreases MFI financial efficiency under the "best case" measured by *gdp_chg_1* ($\beta_1 = -0.397, p < 0.01$). The results are consistent across Columns (2), (3) and (4) for *gdp_chg_2* ($\beta_1 = -0.319, p < 0.01$), *gdp_chg_3* ($\beta_1 = -0.185, p < 0.01$), and *gdp_chg_4* ($\beta_1 = -0.164, p < 0.01$), respectively, suggesting that the potential GDP impact of COVID-19 generally lowers MFI financial efficiency in all scenarios. Likewise, for the impact from COVID-19 by employment, Column (5) shows that under the "best case", *emp_chg_1* significantly lowers *ace_lr* ($\beta_1 = -0.886, p < 0.01$). The results remain consistent across Columns (6), (7) and (8), where they show that financial efficiency is decreased by *emp_chg_2* ($\beta_1 = -0.587, p < 0.01$), *emp_chg_3* ($\beta_1 = -0.318, p < 0.01$) and *emp_chg_4* ($\beta_1 = -0.374, p < 0.01$). Interestingly, the marginal effect of the potential GDP and employment impact from COVID-19 on financial efficiency tends to be descending as the scenario evolves from the best to hypothetically the worst. For instance, under the "best case", the marginal effect of *gdp_chg_1* on *ace_lr* is −0.397, which is lowered gradually as the scenario worsens. A similar effect is also noted among the impacts on employment. For control variables, MFIs that are high in deposits to loan ratio but low in capital ratio and growth rate of GDP are more likely to exhibit high financial efficiency. The results in Table 4 show that COVID-19 induced economic slowdown is associated with MFI financial performance negatively; hence, we accept H1.

We then develop the following model to examine H2 on the impact from COVID-19 on MFI social efficiency:

$$ace\_wp_i = \beta_0 + \beta_1 COVID_i + \sum Controls_i + \varepsilon_i \quad (2)$$

where ace_wp_i is our social efficiency measure for firm *i*; $COVID_i$ is a vector, which contains eight measures of the impact of COVID-19 for firm *i*. Our control variables are *cap*, *allow*, *liq*, *dep*, *gdpgr*, and *lnpopden*. The results for Equation (2) are presented in Table 5. The impact from COVID-19 generally shows a positive influence on MFI social efficiency. More specifically, under the "best case" in Column (1), *gdp_chg_1* ($\beta_1 = 0.793, p < 0.01$) is strongly and positively associated with *ace_wp*. The results are consistent across Columns (2), (3) and (4), where *gdp_chg_2* ($\beta_1 = 0.572, p < 0.01$), *gdp_chg_3* ($\beta_1 = 0.308, p < 0.01$), and *gdp_chg_4* ($\beta_1 = 0.280, p < 0.01$) are positively related to *ace_wp*. The results suggest the potential GDP impact of COVID-19 is related to MFI social efficiency positively. The results for the impact of COVID-19 on employment are similar, where *emp_chg_1* ($\beta_1 = 0.908, p < 0.01$), *emp_chg_2* ($\beta_1 = 0.406$, p < 0.1), *emp_chg_3* ($\beta_1 = 0.222$, p < 0.1), and *emp_chg_4* ($\beta_1 = 0.438, p < 0.01$) also increase *ace_wp*. Similarly, we also note that the marginal effect of the potential GDP and employment impact of COVID-19 seem not to increase as the scenario worsens. That is, the coefficient estimates of our COVID-19 impact variables generally decrease from "best case" to "hypothetically worst case". For the control variables, we find that MFIs with higher liquidity, GDP growth rate, population density and lower deposits ratio exhibit high levels of social efficiency. The results in Table 5 show that COVID-19 induced economic slowdown is associated with MFI social efficiency negatively. Thus, we accept H2.

4.3. Effect of lending rate on MFI efficiency

Having established that COVID-19 induced economic downturn affects MFI financial and social efficiency, we now turn our attention to the potential channels through which this effect operates. From the perspective of uses of funding (demand for microfinance) and sources of funding (supply of microfinance), in Sections 4.3 and 4.4, we examine whether and how the lending and funding rates might mediate the relationship between COVID-19 impact and the financial and social efficiency of MFIs.

Literature generally shows that the most important financial service provided by MFIs to poor household and microenterprises is

Table 3
Multicollinearity diagnostics[a,b].

	ace_{lr}	ace_{wp}	$gdp_{c}hg_{1}$	$gdp_{c}hg_{2}$	$gdp_{c}hg_{3}$	$gdp_{c}hg_{4}$	$emp_{c}hg_{1}$	$emp_{c}hg_{2}$	$emp_{c}hg_{3}$	$emp_{c}hg_{4}$	*cap*	*allow*	*liq*	*dep*	*gdpgr*	*lnpopden*
ace_lr	–															
ace_wp	−0.21*	–														
gdp_chg_1	−0.27**	0.57***	–													
gdp_chg_2	−0.26**	0.55***	0.99***	–												
gdp_chg_3	−0.26**	0.52***	0.98***	0.95***	–											
gdp_chg_4	−0.32***	0.54***	0.97***	0.96***	0.92***	–										
emp_chg_1	−0.24**	0.33***	0.86***	0.88***	0.9***	0.81***	–									
emp_chg_2	−0.21*	0.26***	0.8***	0.85***	0.87***	0.75***	0.97***	–								
emp_chg_3	−0.2*	0.26***	0.8***	0.85***	0.88***	0.75***	0.96***	0.98***	–							
emp_chg_4	−0.33***	0.41***	0.91***	0.92***	0.92***	0.95***	0.88***	0.84***	0.84***	–						
cap	−0.39***	0	−0.22	−0.26**	−0.29**	−0.19	−0.28***	−0.36***	−0.38***	−0.24**	–					
allow	0.03	0.15	0.06	0.06	0.05	0.04	0.02	0.03	0.02	0.01	−0.12	–				
liq	0.33***	−0.12	−0.17	−0.16	−0.17	−0.18	−0.32***	−0.26**	−0.24**	−0.28**	−0.03	0.02	–			
dep	0.35***	−0.18	0.15	0.17	0.18	0.07	0.16	0.2*	0.21*	0.09	−0.37***	−0.3**	0.47***	–		
gdpgr	0.11	−0.25**	−0.65***	−0.66***	−0.66***	−0.65***	−0.66***	−0.64***	−0.64***	−0.63***	0.17***	−0.2	0.24**	0.2*	–	
lnpopden	−0.04	0.14	0.1	0.09	0.1	−0.05	0.15	0.1	0.09	0.02	−0.11	−0.03	−0.27**	0.28**	0.24**	–

Note.
[a] Pearson correlation coefficients are shown on the bottom-left of the table.
[b] *if $p < 0.10$; **if $p < 0.05$; ***if $p < 0.01$.

Table 4
Financial efficiency and change on macroeconomic conditions due to COVID-19[a,b,c].

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ace_lr	*ace_lr*	*ace_lr*	*ace_lr*	*ace_lr*	*ace_lr*	*ace_lr*	*ace_lr*
gdp_chg_1	−0.397***							
	(-2.21)							
gdp_chg_2		−0.319***						
		(-4.14)						
gdp_chg_3			−0.185***					
			(-4.36)					
gdp_chg_4				−0.164***				
				(-4.11)				
emp_chg_1					−0.886***			
					(-3.42)			
emp_chg_2						−0.587***		
						(-3.69)		
emp_chg_3							−0.318***	
							(-3.81)	
emp_chg_4								−0.374***
								(-4.50)
cap	−0.552***	−0.586***	−0.610***	−0.565***	−0.587***	−0.668***	−0.690***	−0.593***
	(-3.07)	(-3.33)	(-3.50)	(-3.21)	(-3.22)	(-3.68)	(-3.81)	(-3.43)
allow	0.774	0.789	0.727	0.588	0.801	0.824	0.660	0.533
	(0.44)	(0.45)	(0.42)	(0.34)	(0.45)	(0.46)	(0.37)	(0.31)
liq	0.628	0.599	0.565	0.530	0.098	0.156	0.199	0.132
	(1.06)	(1.03)	(0.98)	(0.90)	(0.15)	(0.25)	(0.32)	(0.22)
dep	0.220*	0.240*	0.251*	0.206*	0.270**	0.274**	0.272**	0.248**
	(1.87)	(2.06)	(2.17)	(1.80)	(2.15)	(2.22)	(2.23)	(2.17)
gdpgr	−0.064**	−0.074***	−0.081***	−0.057**	−0.062*	−0.057*	−0.060**	−0.059**
	(-1.74)	(-2.03)	(-2.21)	(-1.68)	(-1.61)	(-1.59)	(-1.67)	(-1.83)
lnpopden	0.000	−0.000	0.001	−0.022	−0.007	−0.015	−0.015	−0.022
	(0.01)	(-0.01)	(0.04)	(-0.72)	(-0.23)	(-0.49)	(-0.48)	(-0.75)
Constant	0.442**	0.487**	0.510***	0.358**	0.459**	0.477**	0.490***	0.079
	(2.49)	(2.46)	(2.60)	(1.91)	(2.21)	(2.33)	(2.40)	(0.45)
Observations	72	72	72	72	72	72	72	72
R-squared	0.405	0.428	0.441	0.427	0.387	0.402	0.409	0.449

Note.
[a] The first row (number) represents the estimated coefficient, the second row (number in parentheses) represents the *t*-value of significance.
[b] We winsorized all continuous variables at the 1st and 99th percentiles to moderate the possible effects of extreme outliers.
[c] *if $p < 0.10$; **if $p < 0.05$; *** if $p < 0.01$. All tests are two-tailed.

lending (Postelnicu & Hermes, 2018). Since MFIs are subjected to relatively higher administrative costs than other types of financial institutions owing to the small and short-term loans that are not secured by collateral (Cull et al., 2009), they usually charge a high interest rate to cover the cost of lending (Hartarska & Nadolnyak, 2007). The outbreak of COVID-19 may expose MFI clients like SMEs, to bankruptcy risk owing to the pandemic-induced economic slow-down, so many businesses are not able to meet their debt obligations. Under these circumstances, the higher the interest rate MFIs charge, the more likely that vulnerable borrowers will default on their loan repayments. Given that non-performing loans are the direct source of financial fragility (Beck, 2020), we expect that the higher lending rate charged by MFIs during the pandemic will undermine their financial efficiency. Therefore, we argue that the impact from COVID-19 on MFI financial efficiency is mediated by their lending rates. Related, the relationship between the COVID-19 economic impact and MFI social efficiency is also mediated by lending rates. The demand for credit from MFIs during crises tends to increase for microenterprises, because commercial banks are reluctant to lend to SMEs (Ahlin et al., 2011). The extant literature also shows firms in poor countries have limited access to financial markets (Hevia & Neumeyer, 2020; Loayza & Pennings, 2020). As such, we predict that micro-entrepreneurs and low-income borrowers will rely heavily on MFIs and are willing to pay the high interest rate charged by MFIs, as this may be their only obtainable source of funding during the pandemic. We, therefore, posit that during the COVID-19 outbreak, high lending rates enhance the MFIs' ability to expand their outreach and serve poor clients.

To examine the role of lending rate on MFI efficiency, we undertake a mediation test based on the basic four-step Baron and Kenny (1986) approach, using the following equations:

$$Efficiency_i = \beta_0 + \beta_1 COVID_i + \sum Controls_i + \varepsilon_i \quad (3\text{–}1)$$

$$lendingrate_{i,t} = a_0 + a_1 COVID_i + \sum Controls_i + \varepsilon_i \quad (3\text{–}2)$$

$$Efficiency_i = \beta_0^{'} + \beta_1^{'} COVID_i + \beta_2 lendingrate_i + \sum Controls_i + \varepsilon_i \quad (3\text{-}3)$$

Table 5
Social efficiency and change on macroeconomic conditions due to COVID-19[a,b,c].

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ace_wp	ace_wp	ace_wp	ace_wp	ace_wp	ace_wp	ace_wp	ace_wp
gdp_chg_1	0.793***							
	(7.34)							
gdp_chg_2		0.572***						
		(6.98)						
gdp_chg_3			0.308***					
			(6.57)					
gdp_chg_4				0.280***				
				(6.39)				
emp_chg_1					0.908***			
					(2.71)			
emp_chg_2						0.406*		
						(1.90)		
emp_chg_3							0.222*	
							(1.97)	
emp_chg_4								0.438***
								(4.13)
cap	−0.078	−0.011	0.031	−0.047	0.012	0.065	0.080	0.007
	(-0.43)	(-0.06)	(0.16)	(-0.25)	(0.05)	(0.27)	(0.33)	(0.03)
allow	−0.031	−0.036	0.089	0.311	0.188	0.205	0.313	0.406
	(-0.02)	(-0.02)	(0.05)	(0.16)	(0.08)	(0.09)	(0.13)	(0.19)
liq	1.365***	1.371***	1.390***	1.469***	1.618**	1.332*	1.309*	1.728**
	(2.27)	(2.23)	(2.21)	(2.30)	(1.99)	(1.62)	(1.64)	(2.31)
dep	−0.502***	−0.512***	−0.510***	−0.442***	−0.411***	−0.357**	−0.358**	−0.422***
	(-4.26)	(-4.23)	(-4.09)	(-3.60)	(-2.61)	(-2.22)	(-2.24)	(-2.97)
gdpgr	0.101***	0.100***	0.097***	0.062	0.004	−0.030	−0.028	0.016
	(2.69)	(2.57)	(2.40)	(1.65)	(0.08)	(-0.63)	(-0.59)	(0.39)
lnpopden	0.054*	0.060**	0.060*	0.098***	0.082**	0.093**	0.093**	0.098**
	(1.69)	(1.83)	(1.79)	(2.96)	(2.01)	(2.24)	(2.24)	(2.60)
Constant	0.095	0.076	0.082	0.323	0.374	0.465*	0.453	0.768***
	(0.47)	(0.36)	(0.38)	(1.56)	(1.40)	(1.69)	(1.65)	(3.39)
Observations	73	73	73	73	73	73	73	73
R-squared	0.539	0.519	0.494	0.483	0.243	0.202	0.205	0.333

Note.
[a] The first row (number) represents the estimated coefficient, the second row (number in parentheses) represents the *t*-value of significance.
[b] We winsorized all continuous variables at the 1st and 99th percentiles to moderate the possible effects of extreme outliers.
[c] *if $p < 0.10$; **if $p < 0.05$; *** if $p < 0.01$. All tests are two-tailed.

where $Efficiency_i$ is a vector containing the financial efficiency and social efficiency measures, which are *ace_lr* and *ace_wp* for firm *i*. *COVID* is a vector containing the potential GDP and employment impact of COVID-19 and *lendingrate* is MFI lending rate, which is measured as financial revenue divided by average loan portfolio. The control variables include *cap*, *allow*, *liq*, *dep*, *gdpgr*, and *lnpopden*. To test the mediation effect through lending rate, we adopt the classic mediation test from Baron and Kenny (1986), jointly with the Sobel test (Sobel, 1982). Based on the definition of a mediator by Baron and Kenny (1986), we test the following conditions to show lending rate can be considered as a mediator. First, the potential impact of COVID-19 is correlated with MFI financial and social efficiency ($\beta_1 \neq 0$). This is shown in Equation (3-1), and the results from our baseline models show that COVID-19 decreases financial efficiency but increases social efficiency. Second, the potential impact of COVID-19 is correlated with lending rate, which shows the mediator as through it were an outcome variable ($a_1 \neq 0$). This is tested in Equation (3-2). Last, in Equation (3-3), lending rate is shown to affect MFI financial and social efficiency while controlling for COVID-19 ($\beta_2 \neq 0$). The equation must control for COVID-19, given the relationship between COVID-19 and MFI are direct. A complete mediation would be confirmed if the effect from COVID-19 to MFI efficiency reduces to minimal ($\beta_1^{'} = 0$). To confirm the mediation effect, we further examine our results through Sobel tests. The null hypothesis for the Sobel test indicates the indirect effect of lending rate on the potential impact of COVID-19 and MFI efficiency ($a_1 \times \beta_2$) is zero (or equivalent, $\beta_1 - \beta_1^{'} = 0$). A critical ratio Z[3] is yielded using ($a_1 \times \beta_2$) divided by the standard error of the indirect effect ($S_{a_1\beta_2}$).[2] Hence, it is used to compare with the critical value, which is 0.97, under the Sobel test derived from a standard normal distribution. The rejection of a null hypothesis in the Sobel test would confirm the existence of a mediation effect based on Baron and Kenny (1986)'s approach.

Table 6 presents the results of the mediation effect of lending rate on the relationship between MFI financial efficiency and the

[3] We also employed the deposits ratio (total deposits/average assets) and the donation ratio (donations/average assets) as alternative measures of funding rate. Our untabulated results on the mediation test remain qualitatively unchanged. To assess the reliability of our findings, we also conduct several robustness checks with alternative measures of financial and social efficiency for both the baseline and the mediation models. The results corroborate broadly our main findings (not shown for brevity). Note that the specification of alternative measures and the results are available from a supplementary (online) appendix.

Table 6
Mediation effect of lending rate on financial efficiency[a,b,c].

Panel A: COVID-19 impact on GDP

Dep. Var.	*gdp_chg_1*			*gdp_chg_2*			*gdp_chg_3*			*gdp_chg_4*		
	ace_lr (1)	Lendingrate (2)	ace_lr (3)	ace_lr (4)	Lendingrate (5)	ace_lr (6)	ace_lr (7)	Lendingrate (8)	ace_lr (9)	ace_lr (10)	Lendingrate (11)	ace_lr (12)
COVID	−0.397**	0.119***	−0.038	−0.319***	0.090***	−0.027	−0.185***	0.050***	−0.015	−0.164***	0.044***	−0.011
	(-2.21)	(3.08)	(-0.92)	(-4.14)	(3.25)	(-0.91)	(-4.36)	(3.32)	(-0.88)	(-4.11)	(2.75)	(-0.66)
lendingrate			−0.645***			−0.644***			−0.644***			−0.659***
			(-5.38)			(-5.33)			(-5.32)			(-5.55)
Sobel test	$\beta_1 = -0.397^{***}$			$\beta_1 = -0.319^{***}$			$\beta_1 = -0.185^{***}$			$\beta_1 = -0.164^{***}$		
	$\alpha_1 = 0.119^{***}, \beta_2 = -0.645^{***}$			$\alpha_1 = 0.090^{***}, \beta_2 = -0.644^{***}$			$\alpha_1 = 0.050^{***}, \beta_2 = -0.644^{***}$			$\alpha_1 = 0.044^{***}, \beta_2 = -0.659^{***}$		
	$\beta_1^{'} = -0.038$			$\beta_1^{'} = -0.027$			$\beta_1^{'} = -0.015$			$\beta_1^{'} = -0.011$		
	Sobel test z-stat = |–2.677| > |0.97|			Sobel test z-stat = |–2.776| > |0.97|			Sobel test z-stat = |-2.819| > |0.97|			Sobel test z-stat = |-2.471| > |0.97|	
Mediation effect	Complete mediation			Complete mediation			Complete mediation			Complete mediation		
N	72			72			72			72		

Panel B: COVID-19 impact on employment

Dep. Var.	*emp_chg_1*			*emp_chg_2*			*emp_chg_3*			*emp_chg_4*		
	ace_lr (1)	Lendingrate (2)	ace_lr (3)	ace_lr (4)	Lendingrate (5)	ace_lr (6)	ace_lr (7)	Lendingrate (8)	ace_lr (9)	ace_lr (10)	Lendingrate (11)	ace_lr (12)
COVID	−0.886***	0.143*	−0.078	−0.587***	0.111*	−0.046	−0.318***	0.062**	−0.023	−0.374***	0.056*	−0.022
	(-3.42)	(1.63)	(-0.92)	(-3.69)	(1.95)	(-0.81)	(-3.81)	(2.07)	(-0.76)	(-4.50)	(1.69)	(-0.64)
lendingrate			−0.663***			−0.662***			−0.662***			−0.668***
			(-5.78)			(-5.72)			(-5.70)			(-5.27)
Sobel test	$\beta_1 = -0.886^{*}$			$\beta_1 = -0.587^{***}$			$\beta_1 = -0.318^{***}$			$\beta_1 = -0.374^{***}$		
	$\alpha_1 = 0.143^{*}, \beta_2 = -0.663^{***}$			$\alpha_1 = 0.111^{*}, \beta_2 = -0.662^{***}$			$\alpha_1 = 0.062^{**}, \beta_2 = -0.662^{***}$			$\alpha_1 = 0.056^{*}, \beta_2 = -0.668^{***}$		
	$\beta_1^{'} = -0.078$			$\beta_1^{'} = -0.046$			$\beta_1^{'} = -0.023$			$\beta_1^{'} = -0.022$		
	Sobel test z-stat = |–1.571| > |0.97|			Sobel test z-stat = |-1.852| > |0.97|			Sobel test z-stat = |-1.952| > |0.97|			Sobel test z-stat = |-1.580| > |0.97|	
Mediation effect	Complete mediation			Complete mediation			Complete mediation			Complete mediation		
N	72			72			72			72		

Note.
[a] The first row (number) represents the estimated coefficient, the second row (number in parentheses) represents the *t*-value of significance.
[b] We winsorized all continuous variables at the 1st and 99th percentiles to moderate the possible effects of extreme outliers.
[c] *if $p < 0.10$; **if $p < 0.05$; *** if $p < 0.01$. All tests are two-tailed.

Table 7
Mediation effect of lending rate on social efficiency[a,b,c].

Panel A: COVID-19 impact on GDP												
Dep. Var.	*gdp_chg_1*			*gdp_chg_2*			*gdp_chg_3*			*gdp_chg_4*		
	ace_wp (1)	Lendingrate (2)	ace_wp (3)	ace_wp (4)	Lendingrate (5)	ace_wp (6)	ace_wp (7)	Lendingrate (8)	ace_wp (9)	ace_wp (10)	Lendingrate (11)	ace_wp (12)
COVID	0.488***	0.119***	0.427***	0.339***	0.090***	0.292***	0.178***	0.050***	0.151***	0.191***	0.045***	0.165***
	(5.99)	(3.08)	(5.04)	(5.62)	(3.25)	(4.62)	(5.32)	(3.32)	(4.30)	(5.53)	(2.759)	(4.69)
lendingrate			0.511**			0.516**			0.529**			0.575**
			(2.08)			(2.05)			(2.06)			(2.33)
Sobel test	$\beta_1 = 0.488^{***}$ $\alpha_1 = 0.119^{***}, \beta_2 = 0.511^{**}$ $\beta_1^{'} = 0.427^{***}$ Sobel test z-stat = $\lvert 1.729 \rvert > \lvert 0.97 \rvert$			$\beta_1 = 0.339^{***}$ $\alpha_1 = 0.090^{***}, \beta_2 = 0.516^{**}$ $\beta_1^{'} = 0.292^{***}$ Sobel test z-stat = $\lvert 1.734 \rvert > \lvert 0.97 \rvert$			$\beta_1 = 0.178^{***}$ $\alpha_1 = 0.050^{***}, \beta_2 = 0.529^{**}$ $\beta_1^{'} = 0.151^{***}$ Sobel test z-stat = $\lvert 1.755 \rvert > \lvert 0.97 \rvert$			$\beta_1 = 0.191^{***}$ $\alpha_1 = 0.045^{***}, \beta_2 = 0.575^{**}$ $\beta_1^{'} = 0.165^{***}$ Sobel test z-stat = $\lvert 1.783 \rvert > \lvert 0.97 \rvert$		
Mediation effect	Partial mediation			Partial mediation			Partial mediation			Partial mediation		
N	73			73			73			73		
Panel B: COVID-19 impact on employment												
Dep. Var.	*emp_chg_1*			*emp_chg_2*			*emp_chg_3*			*emp_chg_4*		
	ace_wp (1)	Lendingrate (2)	ace_wp (3)	ace_wp (4)	Lendingrate (5)	ace_wp (6)	ace_wp (7)	Lendingrate (8)	ace_wp (9)	ace_wp (10)	Lendingrate (11)	ace_wp (12)
COVID	0.619***	0.143* (1.63)	0.504**	0.325**	0.111* (1.95)	0.233*	0.172**	0.062**	0.122*	0.307***	0.056* (1.69)	0.264***
	(3.03)		(2.56)	(2.38)		(1.76)	(2.40)	(2.07)	(1.73)	(3.97)		(3.54)
lendingrate			0.807***			0.827***			0.822***			0.764***
			(3.09)			(3.07)			(3.03)			(3.03)
Sobel test	$\beta_1 = 0.619^{***}$ $\alpha_1 = 0.143^{*}, \beta_2 = 0.807^{***}$ $\beta_1^{'} = 0.504^{**}$ Sobel test z-stat = $\lvert 1.443 \rvert > \lvert 0.97 \rvert$			$\beta_1 = 0.325^{**}$ $\alpha_1 = 0.111^{*}, \beta_2 = 0.233^{*}$ $\beta_1^{'} = 0.827^{***}$ Sobel test z-stat = $\lvert 1.650 \rvert > \lvert 0.97 \rvert$			$\beta_1 = 0.172^{**}$ $\alpha_1 = 0.062^{**}, \beta_2 = 0.122^{*}$ $\beta_1^{'} = 0.822^{***}$ Sobel test z-stat = $\lvert 1.715 \rvert > \lvert 0.97 \rvert$			$\beta_1 = 0.307^{***}$ $\alpha_1 = 0.056^{*}, \beta_2 = 0.264^{***}$ $\beta_1^{'} = 0.764^{***}$ Sobel test z-stat = $\lvert 1.444 \rvert > \lvert 0.97 \rvert$		
Mediation effect	Partial mediation			Partial mediation			Partial mediation			Partial mediation		
N	73			73			73			73		

Note.
[a] The first row (number) represents the estimated coefficient, the second row (number in parentheses) represents the *t*-value of significance.
[b] We winsorized all continuous variables at the 1st and 99th percentiles to moderate the possible effects of extreme outliers.
[c] *if $p < 0.10$; **if $p < 0.05$; *** if $p < 0.01$. All tests are two-tailed.

potential impact of COVID-19. The results from Panel A Column (1) are identical to our baseline results, as they capture the total effect of *gdp_chg_1* on lending *ace_lr* ($\beta_1 = -0.397, p < 0.05$), whereas Column (2) shows that the potential GDP impact from COVID-19 increases the lending rate ($\alpha_1 = 0.119, p < 0.01$). As seen from Column (3), the direct effect from *gdp_chg_1* to *ace_lr* diminishes ($\beta_1^{'} = -0.038, p > 0.1$) after introducing the indirect effect from *lendingrate* ($\beta_2 = -0.645$, p < 0.01), where *lendingrate* lowers *ace_lr*. The results show a complete mediation effect of lending rate on the potential GDP impact from COVID-19 on MFI financial efficiency. That is, *gdp_chg_1* decreases *ace_lr* entirely through the indirect effect of *lendingrate*. The results are confirmed by the Sobel test, as the *z*-value is greater than the Sobel critical value. We further test the impact of COVID-19 across various scenarios of COVID-19, and the complete mediation effect from the lending rate remains consistent. Then, we test the potential employment impact from COVID-19. The results are shown in Panel B. As seen from Columns (1) and (2), likewise, we first test the total effect of *emp_chg_1* on *ace_lr* ($\beta_1 = -0.886, p < 0.01$), then, the path between *emp_chg_1* and *lendingrate* ($\alpha_1 = 0.143, p < 0.01$). In the mediation equation, the direct effect from *emp_chg_1* ($\beta_1^{'} = -0.078, p > 0.1$) becomes insignificant, whereas the indirect effect shows a strong coefficient estimate to *ace_lr* ($\beta_2 = -0.663, p < 0.01$), suggesting that the employment impact from COVID-19 on MFI financial efficiency is completely mediated by lending rate. The Sobel test further confirms the existence of the mediation. The results are also consistent across various scenarios of COVID-19.

We then test the mediation effect of lending rate on MFI social efficiency. The total effect between *ace_wp* and *gdp_chg_1* is positive ($\beta_1 = 0.488, p < 0.01$), as seen from Panel A Column (1) from Table 7. This result is consistent with our baseline model as shown in the preceding sections, indicating that, overall, the potential GDP impact from COVID-19 in the "best case" increases MFI social efficiency without controlling for the effect of *lendingrate*. Column (2) shows that owing to COVID-19, MFIs generally increase lending rates ($\alpha_1 = 0.119, p < 0.01$). This result is consistent with those from Column (2) of Table 6, because it reports the direct relationship between the *lendingrate* and *gdp_chg_1*. The results for the mediation equation are shown in Column (3). We note that both the direct effect from COVID-19 on *ace_wp* ($\beta_1^{'} = 0.427, p < 0.01$) and the indirect effect from *lendingrate* on *ace_wp* ($\beta_2 = 0.511, p < 0.05$) are pronounced, and are positive and significant, showing that *lendingrate* has a partial mediation effect. We then conduct the Sobel test, and the results show that the *z*-stat of 1.729 is greater than the 0.97 Sobel critical value. Furthermore, we test the mediation effect using various alternative COVID-19 scenarios, and our results remain consistent under the "moderate case" ($\beta_1 = 0.339, p < 0.01$; $\alpha_1 = 0.090, p < 0.01$; $\beta_1^{'} = 0.292, p < 0.01$; $\beta_2 = 0.516, p < 0.05$), "worse case" ($\beta_1 = 0.178, p < 0.01$; $\alpha_1 = 0.050, p < 0.01$; $\beta_1^{'} = 0.151, p < 0.01$; $\beta_2 = 0.529, p < 0.05$), and "hypothetical worst case" ($\beta_1 = 0.191, p < 0.01$; $\alpha_1 = 0.045, p < 0.01$; $\beta_1^{'} = 0.165, p < 0.01$; $\beta_2 = 0.575, p < 0.01$). To validate our results on the impact from COVID-19, we adopt the employment impact from COVID-19 as an alternative proxy. As seen from Panel B Table 7, we find that the results remain consistent with the GDP impact under all scenarios. Hence, we confirm a partial mediation effect of *lendingrate* exists for the relationship between the potential GDP and employment impact from COVID-19 and MFI social efficiency. Our results suggest that during the pandemic, the demand for small loans increases; and poor household and small businesses are willing to pay the high interest rate charged by MFIs due to their limited access to funding. Therefore, high lending rates may positively affect MFI social performance as MFIs are likely to serve more poor clients by granting smaller loans.

4.4. Effect of funding rate on MFI efficiency

On the supply side of funding, literature has identified various sources of external financing to support MFIs. Initially, MFIs rely primarily on donors, subsidies from charitable or governmental agencies, and concessional funds to keep afloat (Assefa et al., 2013). With the rapid development of commercialization, MFIs are allowed to take deposits from the public and to operate like "traditional bank-like MFIs" (Schulte & Winkler, 2019). In addition to donation and deposits, MFIs have recently obtained private funding from commercial investors, like commercial banks, pension funds, insurance companies, private equity firms, etc., who consider MFIs as a socially responsible investment (Postelnicu & Hermes, 2018).

During the pandemic, we expect funding rates to have ambiguous (i.e., positive or negative) effects on the financial and social efficiency of MFIs for reasons explained below. First, higher funding rates imply higher costs of capital, which may undermine MFI financial performance; but higher funding rates also mean MFIs can attract long-term investment, since long-term capital providers usually require higher rates of return to compensate for their opportunity costs. This stable source of financing may result in improved financial efficiency in the long run. Second, higher funding rates that MFIs offer to depositors and other lenders could encourage more savings and investment with the MFIs. This will, in turn, enable MFIs to reach out to more low-income households and underserved microbusinesses. Hence, MFI social performance (i.e., the breadth and depth of outreach) will be enhanced. However, because of the heightened uncertainty and loss of confidence in banks (Beck, 2020), depositors may withdrawal their deposits, and risk-averse investors may become extremely cautious about investing in MFIs. As such, even a higher funding rate cannot attract funding during a pandemic, and restricted availability of funding will translate into less outreach to the poorest clients.

Following the literature (e.g., Basharat et al., 2015), the funding rate (*fundingrate*) is defined as total finance expense over total debt. We undertake the following equations to examine the mediation effect of funding rate:

$$Efficiency_i = \beta_0 + \beta_1 COVID_i + \sum Controls_i + \varepsilon_i \tag{4–1}$$

$$fundingrate_{i,t} = a_0 + a_1 COVID_i + \sum Controls_i + \varepsilon_i \tag{4–2}$$

$$Efficiency_i = \beta_0^{'} + \beta_1^{'} COVID_i + \beta_2 fundingrate_i + \sum Controls_i + \varepsilon_i \tag{4–3}$$

Table 8
Mediation effect of funding rate on financial efficiency[a,b,c].

Panel A: COVID-19 impact on GDP

Dep. Var.	*gdp_chg_1*			*gdp_chg_2*			*gdp_chg_3*			*gdp_chg_4*		
	ace_lr (1)	fundingrate (2)	ace_lr (3)	ace_lr (4)	fundingrate (5)	ace_lr (6)	ace_lr (7)	fundingrate (8)	ace_lr (9)	ace_lr (10)	fundingrate (11)	ace_lr (12)
COVID	−0.397**	−0.002	−0.122**	−0.319***	0.000	−0.091***	−0.185***	0.001	−0.049***	−0.164***	0.002	−0.043**
	(-2.21)	(-0.13)	(-2.65)	(-4.14)	(0.060)	(-2.73)	(-4.36)	(0.11)	(-2.75)	(-4.11)	(0.39)	(-2.26)
fundingrate			−0.039			−0.016			−0.009			0.018
			(-0.10)			(-0.04)			(-0.02)			(0.46)
Sobel test	$\beta_1 = -0.397^{**}$			$\beta_1 = -0.319^{***}$			$\beta_1 = -0.185^{***}$			$\beta_1 = -0.164^{***}$		
	$\alpha_1 = -0.002, \beta_2 = -0.039$			$\alpha_1 = 0.000, \beta_2 = -0.016$			$\alpha_1 = 0.001, \beta_2 = -0.009$			$\alpha_1 = 0.002, \beta_2 = 0.018$		
	$\beta_1^{'} = -0.122^{**}$			$\beta_1^{'} = -0.091^{**}$			$\beta_1^{'} = -0.049^{***}$			$\beta_1^{'} = -0.043^{**}$		
	Sobel test z-stat = |0.079 | < |0.97|			Sobel test z-stat = |-0.034| < |0.97|			Sobel test z-stat = |-0.024| < |0.97|				
										Sobel test z-stat = |0.046| < |0.97|		
Mediation effect	No mediation			No mediation			No mediation			Complete mediation		
N	72			72			72			72		

Panel B: COVID-19 impact on employment

Dep. Var.	*emp_chg_1*			*emp_chg_2*			*emp_chg_3*			*emp_chg_4*		
	ace_lr (1)	fundingrate (2)	ace_lr (3)	ace_lr (4)	fundingrate (5)	ace_lr (6)	ace_lr (7)	fundingrate (8)	ace_lr (9)	ace_lr (10)	fundingrate (11)	ace_lr (12)
COVID	−0.886***	0.003	−0.193*	−0.587***	0.011	−0.132*	−0.318***	0.007	−0.070**	−0.374***	0.005	−0.068*
	(-3.42)	(0.09)	(-1.89)	(-3.69)	(0.54)	(-1.97)	(-3.81)	(0.66)	(-2.00)	(-4.50)	(0.41)	(-1.69)
fundingrate			−0.015			0.027			0.039			0.009
			(-0.04)			(0.69)			(0.09)			(0.25)
Sobel test	$\beta_1 = -0.886^{***}$			$\beta_1 = -0.587^{***}$			$\beta_1 = -0.318^{***}$			$\beta_1 = -0.374^{***}$		
	$\alpha_1 = 0.003, \beta_2 = -0.015$			$\alpha_1 = 0.011, \beta_2 = 0.027$			$\alpha_1 = 0.007, \beta_2 = 0.039$			$\alpha_1 = 0.005, \beta_2 = 0.009$		
	$\beta_1^{'} = -0.193^{*}$			$\beta_1^{'} = -0.132^{*}$			$\beta_1^{'} = -0.070^{**}$			$\beta_1^{'} = -0.068^{*}$		
	Sobel test z-stat = |-0.036| < |0.97|			Sobel test z-stat = |0.069| < |0.97|			Sobel test z-stat = |0.098| < |0.97|			Sobel test z-stat = |0.024| < |0.97|	
Mediation effect	No mediation			No mediation			No mediation			No mediation		
N	72			72			72			72		

Note.

[a] The first row (number) represents the estimated coefficient, the second row (number in parentheses) represents the *t*-value of significance.

[b] We winsorized all continuous variables at the 1st and 99th percentiles to moderate the possible effects of extreme outliers.

[c] *if $p < 0.10$; **if $p < 0.05$; *** if $p < 0.01$. All tests are two-tailed.

Table 9
Mediation effect of funding rate on social efficiency[a,b,c].

Panel A: COVID-19 impact on GDP

Dep. Var.	*gdp_chg_1*			*gdp_chg_2*			*gdp_chg_3*			*gdp_chg_4*		
	ace_wp (1)	fundingrate (2)	ace_wp (3)	ace_wp (4)	fundingrate (5)	ace_wp (6)	ace_wp (7)	fundingrate (8)	ace_wp (9)	ace_wp (10)	fundingrate (11)	ace_wp (12)
COVID	0.488***	−0.002	0.484**	0.339***	0.000	0.337***	0.178***	0.001	0.178***	0.191***	0.002	0.181***
	(5.99)	(-0.12)	(5.87)	(5.62)	(0.060)	(5.52)	(5.32)	(0.11)	(5.24)	(5.53)	(0.39)	(5.494)
fundingrate			−0.508			−0.597			−0.619			−0.752
			(−0.73)			(−0.85)			(−0.87)			(−1.06)
Sobel test	$\beta_1 = 0.488^{***}\ \alpha_1 = -0.002, \beta_2 = -0.508\ \beta_1^{'} = 0.484^{***}$ Sobel test z-stat = |0.126 | < |0.97|			$\beta_1 = 0.339^{***}$ $\alpha_1 = 0.000, \beta_2 = -0.597$ $\beta_1^{'} = 0.292^{***}$ Sobel test z-stat = |-0.061| < |0.97|			$\beta_1 = 0.178^{***}$ $\alpha_1 = 0.001, \beta_2 = -0.619$ $\beta_1^{'} = 0.178^{***}$ Sobel test z-stat = |-0.111| < |0.97|			$\beta_1 = 0.191^{***}$ $\alpha_1 = 0.002, \beta_2 = -0.752$ $\beta_1^{'} = 0.181^{***}$ Sobel test z-stat = |-0.370| < |0.97|		
Mediation effect	No mediation			No mediation			No mediation			No mediation		
N	73			73			73			73		

Panel B: COVID-19 impact on employment

Dep. Var.	*emp_chg_1*			*emp_chg_2*			*emp_chg_3*			*emp_chg_4*		
	ace_wp (1)	fundingrate (2)	ace_wp (3)	ace_wp (4)	fundingrate (5)	ace_wp (6)	ace_wp (7)	fundingrate (8)	ace_wp (9)	ace_wp (10)	fundingrate (11)	ace_wp (12)
COVID	0.619***	0.003	0.611***	0.325**	0.011	0.325**	0.172**	0.007	0.174**	0.307***	0.005	0.307***
	(3.03)	(0.09)	(2.95)	(2.38)	(0.54)	(2.35)	(2.40)	(0.66)	(2.38)	(3.97)	(0.41)	(3.92)
fundingrate			−0.595			−0.694			−0.723			−0.719
			(−0.75)			(−0.85)			(−0.88)			(−0.94)
Sobel test	$\beta_1 = 0.619^{***}\ \alpha_1 = 0.003, \beta_2 = -0.595\ \beta_1^{'} = 0.611^{***}$ Sobel test z-stat = |-0.089| < |0.97|			$\beta_1 = 0.325^{**}$ $\alpha_1 = 0.011, \beta_2 = -0.694$ $\beta_1^{'} = 0.325^{***}$ Sobel test z-stat = |-0.460| < |0.97|			$\beta_1 = 0.172^{**}$ $\alpha_1 = 0.007, \beta_2 = -0.723$ $\beta_1^{'} = 0.174^{**}$ Sobel test z-stat = |-0.531| < |0.97|			$\beta_1 = 0.307^{***}$ $\alpha_1 = 0.005, \beta_2 = -0.719$ $\beta_1^{'} = 0.307^{***}$ Sobel test z-stat = |-0.381| < |0.97|		
Mediation effect	No mediation			No mediation			No mediation			No mediation		
N	73			73			73			73		

Note.
[a] The first row (number) represents the estimated coefficient, the second row (number in parentheses) represents the *t*-value of significance.
[b] We winsorized all continuous variables at the 1st and 99th percentiles to moderate the possible effects of extreme outliers.
[c] *if $p < 0.10$; **if $p < 0.05$; *** if $p < 0.01$. All tests are two-tailed.

where *Efficiency*$_i$ is a vector containing the financial and social efficiency measures, which are *ace_lr* and *ace_wp* for firm *i*. *COVID* is a vector containing the potential GDP and employment impacts of COVID-19. The control variables include *cap*, *allow*, *liq*, *dep*, *gdpgr*, and *lnpopden*. We first examine the mediation effect of funding rate on financial efficiency affected by COVID-19. The results are presented in Table 8. As seen from Panel A, the potential GDP impact of COVID-19 does not relate to the funding rate ($\alpha_1 = -0.002, p > 0.1$; $\alpha_1 = 0.000, p > 0.1$; $\alpha_1 = 0.001, p > 0.1$; $\alpha_1 = 0.002, p > 0.1$), indicating that the path between the mediator and the independent variable has a trivial effect in influencing the dependent variable. Additionally, in the mediation equation (Columns (3), (6), (9), and (12)), the indirect effect from *fundingrate* to *ace_lr* is insignificant ($\beta_2 = -0.039, p > 0.1$; $\beta_2 = -0.016, p > 0.1$; $\beta_2 = -0.009, p > 0.1$; $\beta_2 = -0.018, p > 0.1$), while the direct effect from *gdp_chg_1* ($\beta_1^{'} = -0.122, p < 0.05$), *gdp_chg_2* ($\beta_1^{'} = -0.091, p < 0.01$), *gdp_chg_3* ($\beta_1^{'} = -0.049, p < 0.01$), and *gdp_chg_4* ($\beta_1^{'} = -0.043, p < 0.05$) is highly negatively significant. The Sobel test confirms the results from our mediation models. In Panel B, we test the potential employment impact of COVID-19 on MFI financial efficiency, and our results remain the same. Our results suggest that the funding rate does not mediate the potential employment impact of COVID-19 on MFI financial efficiency ($\beta_2 = -0.015, p > 0.1$; $\beta_2 = 0.027, p > 0.1$; $\beta_2 = 0.039, p > 0.1$; $\beta_2 = 0.009, p > 0.1$). Rather, the direct effect is much more pronounced through the impact of COVID-19 ($\beta_1^{'} = -0.193, p < 0.1$; $\beta_1^{'} = -0.132, p < 0.1$; $\beta_1^{'} = -0.070, p < 0.05$; $\beta_1^{'} = -0.068, p < 0.1$).

We then examine the mediation effect of the funding rate on social efficiency as affected by COVID-19. The results are shown in Table 9. As seen from Panel A, we note that *fundingrate* shows an insignificant indirect effect to *ace_wp* ($\beta_2 = -0.508, p > 0.1$; $\beta_2 = -0.597, p > 0.1$; $\beta_2 = -0.619, p > 0.1$; $\beta_2 = -0.752, p > 0.1$), while the direct effect from *gdp_chg_1* ($\beta_1^{'} = 0.484, p < 0.01$), *gdp_chg_2* ($\beta_1^{'} = 0.337, p < 0.01$), *gdp_chg_3* ($\beta_1^{'} = 0.178, p < 0.01$), and *gdp_chg_4* ($\beta_1^{'} = 0.181, p < 0.01$) is positive and significant. These results are confirmed when we use the employment impact from COVID-19 on social efficiency, as shown, we do not observe any mediation effect from the funding rate ($\beta_2 = -0.595, p > 0.1$; $\beta_2 = -0.694, p > 0.1$; $\beta_2 = -0.723, p > 0.1$; $\beta_2 = -0.719, p > 0.1$). Hence, we confirm that the funding rate has a negligible effect on the economic impact of COVID-19.[3]

5. Conclusion

This study examines whether and how the potential economic impact of the recent COVID-19 outbreak affects MFI financial and social efficiency. On one hand, if low-income households and microenterprises are less able to meet their debt obligations owing to the pandemic-induced economic slowdown, we would then expect a negative association between the impact of COVID-19 and MFI financial efficiency. On the other hand, if the social impact role of MFI is prioritized during the pandemic, the demand for small loans magnifies and we would, thus, expect a positive association between the impact of COVID-19 and MFI social efficiency.

Our findings support a weakening effect of COVID-19 on MFI financial efficiency, but a strengthening effect on MFI social efficiency. Our results are robust to various scenarios of the potential impact from COVID-19. In addition, we find that the effect of COVID-19 on MFI efficiency is mediated by lending rates. That is, during the pandemic, the higher the interest rate MFIs charge, the more likely that vulnerable borrowers may default on their loan repayments. Therefore, we expect that higher lending rates result in lower financial efficiency. However, as microentrepreneurs and low-income borrowers will rely heavily on MFIs, and are willing to pay the high interest rates charged by MFIs, i.e. the demand for smaller loans is increased during COVID-19, we predict that higher lending rates lead to higher social efficiency. We also examine the effect of the MFI funding rate, but no statistical significance is obtained from our analyses.

Our study adds to the growing literature on the role of the macroeconomic environment on MFI performance. Specifically, we focus on how a pandemic is related to MFI efficiency with new evidence based on a recent and on-going COVID-19 outbreak. Our findings provide important implications for MFIs who want to manage their efficiency during the pandemic period. One point to note is that the results of this study should be viewed in light of their limitations, considering the estimation of the COVID-19 economic impact is based on the GDP and employment data for 2018 only. An avenue for future research could be to explore our hypotheses in a much larger sample as new data is released and to challenge our findings.

Author statement

Chen Zheng: Conceptualization, Methodology, Data curation, Writing – original draft, Wring – review & editing; Junru Zhang: Methodology, Data curation, Writing – original draft, Wring – review & editing.

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Appendix C. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.iref.2020.09.016.

Appendix A. Variable definition

Panel A: Financial efficiency and social efficiency	
ace_lr	Financial efficiency specification where assets (*a*), operating expense (*c*), and personnel (*e*) are taken as inputs; gross loan portfolio (*l*) and financial revenue (*r*) as outputs; see Panel D in this table for the definition of inputs and outputs.
ace_wp	Social efficiency specification where assets (*a*), operating expense (*c*), and personnel (*e*) are taken as inputs; number of active female borrowers (*w*) and indicator of benefit to the poorest (*p*) as outputs. See Panel D in this table for the definition of inputs and outputs.
Panel B: Impact from COVID-19	
gdp_chg_1	The magnitudes of the effects on GDP due to the potential economic impact of the COVID-19 outbreak under the "best case" scenario, measured as percentage decline in total 2018 nominal GDP.
gdp_chg_2	The magnitudes of the effects on GDP due to the potential economic impact of the COVID-19 outbreak under the "moderate case" scenario, measured as percentage decline in total 2018 nominal GDP.
gdp_chg_3	The magnitudes of the effects on GDP due to the potential economic impact of the COVID-19 outbreak under the "worst case" scenario, measured as percentage decline in total 2018 nominal GDP.
gdp_chg_4	The magnitudes of the effects on GDP due to the potential economic impact of the COVID-19 outbreak under the "hypothetical worst case" scenario, measured as percentage decline in total 2018 nominal GDP.
emp_chg_1	The magnitudes of the effects on employment due to the potential economic impact of the COVID-19 outbreak under the "best case" scenario, measured as percentage decline in employment among all sectors as of 2018.
emp_chg_2	The magnitudes of the effects on employment due to the potential economic impact of the COVID-19 outbreak under the "moderate case" scenario, measured as percentage decline in employment among all sectors as of 2018
emp_chg_3	The magnitudes of the effects on employment due to the potential economic impact of the COVID-19 outbreak under the "worst case" scenario, measured as percentage decline in employment among all sectors as of 2018.
emp_chg_4	The magnitudes of the effects on employment due to the potential economic impact of the COVID-19 outbreak under the "hypothetical worst case" scenario, measured as percentage decline in employment among all sectors as of 2018.
Panel C: Other variables	
lendingrate	Lending rate, calculated as the ratio of financial revenue to average loan portfolio.
fundingrate	Funding rate, calculated as the ratio of finance expense to average assets.
cap	The ratio of capital to total assets.
allow	The ratio of impairment loss allowance to total assets.
liq	The ratio of cash and cash equivalents to total assets.
dep	The ratio of deposits to gross loan portfolio.
gdpgr	Annual percentage growth rate of GDP at market prices based on constant local currency (aggregates are based on constant 2010 U.S. dollars).
lnpopden	Natural logarithm of population density (population density is measured as midyear population divided by land area in square kilometres).
Panel D: Variables for efficiency calculation	
input a	Total assets: total value of resources controlled by the financial institution as a result of past events and from which future economic benefits are expected to flow to the financial institution.
input c	Operating expense: includes expenses not related to financial and credit loss impairment, such as personnel expenses, depreciation, amortization and administrative expenses.
input e	Personnel: the number of individuals who are actively employed by an entity. This number includes contract employees or advisors who dedicate a substantial portion of their time to the entity, even if they are not on the entity's employees roster.
output w	Number of active women borrowers; the number of female individuals who currently have an outstanding loan balance with the financial institution or are primarily responsible for repaying any portion of the gross loan portfolio.
output p	Indicator of benefit to the poorest: this output is measured as $(1-(K_i-\min(K))/\text{range}(K)) \times$ number of active borrowers, where K is the average loan balance per borrower divided by Gross National Income (GNI) per capita; *i* is an indicator associated with a particular MFI; min(K) is the minimum value of K over all *i*; range(K) is the maximum value of K over all *i* minus the minimum value of K over all *i*.
output l	Gross loan portfolio: all outstanding principals due for all outstanding client loans. This includes current, delinquent, and renegotiated loans, but not loans that have been written off.
output r	Financial revenue: includes all financial income and other operating revenue which is generated from non-financial services.

Appendix B. Impact from COVID-19 scenario definition (Source: Asian Development Bank)

Source	Duration of travel bans and sharp decline in domestic demand	Tourism and travel bans	Decline in PRC Consumption relative to no-outbreak scenario	Decline in PRC Investment relative to no-outbreak scenario	Decline in Domestic Consumption in selected economy
Best case	2 months	-Chinese outbound tourism drops by 50% for two months -For economies imposing travel bans, no tourism receipts from PRC for two months -Inbound PRC tourism and receipts fall by as much as during the SARS outbreak -Tourism from outside Asia to non-PRC East and Southeast Asian economies falls by as much as during the SARS outbreak (assume peak decline lasts two months)	0.7% (based on 2.75pp decline in retail sales growth in 2003Q3 vs. prior nine quarters)	none	none

(*continued on next page*)

(*continued*)

Source	Duration of travel bans and sharp decline in domestic demand	Tourism and travel bans	Decline in PRC Consumption relative to no-outbreak scenario	Decline in PRC Investment relative to no-outbreak scenario	Decline in Domestic Consumption in selected economy
Moderate case	3 months	-Chinese outbound tourism drops by 50% for three months -For economies imposing travel bans, no tourism receipts from PRC for three months -Inbound PRC tourism and receipts falls by an additional 10% relative to the base case -Tourism from outside Asia to non-PRC East and Southeast Asian economies falls by an additional 10% relative to the best case (i.e., one additional month)	2% (based on 2pp decline in PCE growth in 2003 vs. 2000–2002 average)	none	none
Worse case	6 months	-Chinese outbound tourism drops by 50% for six months -For economies imposing travel bans, no tourism receipts from PRC for six months -Inbound PRC tourism and receipts falls by an additional 30% relative to the base case -Tourism from outside Asia to non-PRC East and Southeast Asian economies falls by an additional by an additional 40% relative to the best case (i.e., four additional months)	2% (based on 2pp decline in PCE growth in 2003 vs. 2000–2002 average)	2% (protracted outbreak worsens business sentiment)	none
Hypothetical Worst case	6 months; plus outbreak in selected economy lasting 3 months	-Chinese outbound tourism drops by 50% for six months -For economies imposing travel bans, no tourism receipts from PRC for six months -Inbound PRC tourism and receipts falls by an additional 30% relative to the best case -Tourism from outside Asia to non-PRC East and Southeast Asian economies falls by an additional 40% relative to the best case (i.e., four additional months)	2% (based on 2pp decline in PCE growth in 2003 vs. 2000–2002 average)	2% (protracted outbreak worsens business sentiment)	2% (selected economy only)

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