

Article

# Impact of COVID-19 Movement Restrictions on Mobile Financing Services (MFSs) in Bangladesh

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**Abstract:** According to the National Financial Inclusion Strategy (NFIS), Bangladesh aims to achieve a 100% financial inclusion target by 2026 through mobile financing services (MFSs). However, despite several efforts, the financial inclusion score remained only 53% at the end of 2021, compared to 50% in 2017. A substantial proportion of this growth came through MFSs during the COVID-19 pandemic. This article investigates the short-run and long-run influence of COVID-19 movement restriction orders on MFSs. An autoregressive distributed lag model (ARDL) is applied to the monthly transaction data over the period of December 2016 to May 2022 of the three most popular MFSs. Movement restriction orders are associated with a significant increase in person-to-person transactions (P2P) and person-to-business transactions (P2B) in the long run, but the effect is positive and statistically insignificant for remittance transfer. Furthermore, using the volume of ATM transactions as a measure of financial inclusion, this study confirms the crucial role of movement restriction orders in intensifying the financial inclusion of Bangladesh through MFSs. The coefficients of error correction models (ECM) indicate that policymakers must act promptly to develop actionable strategies to maintain the short run momentum of the demand for MFSs to achieve the national target.

**Keywords:** financial inclusion; mobile financing services (MFSs); ARDL; bound test; COVID-19; Bangladesh

**JEL Classification:** C22; G20; G21; G28



**Citation:** Rashid, S. Impact of COVID-19 Movement Restrictions on Mobile Financing Services (MFSs) in Bangladesh. *FinTech* **2024**, *3*, 1–16. <https://doi.org/10.3390/fintech3010001>

Academic Editor: David Roubaud

Received: 16 November 2023

Revised: 15 December 2023

Accepted: 18 December 2023

Published: 21 December 2023



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## 1. Introduction

Basic banking facilities are still out of reach for the poor and ultra-poor in Bangladesh, despite the tremendous growth in the banking sector over the last decade. According to Global Findex Database 2021, only 53% of adult men and 43% of adult women have access to a bank account, whereas only 49% of poor adults have access to any financial sector in Bangladesh [1]. Inaccessibility of bank branches (as most of the branches are located in urban or semi-urban areas), high operating costs, higher transportation costs, especially for the people located in rural and remote areas, inadequate financial knowledge, and complex and lengthy bureaucratic process are the driving factors behind this outcome [2–5]. In these contexts, mobile banking can be considered as an effective alternative to reduce the problem of proximity to bank branches while offering similar banking services [6].

Inclusive financial services at affordable costs to all individuals are essential for building a modern and resilient economy, allowing the poor to progress out of poverty through efficient, informed, and safe financial decisions [7–9]. To achieve that milestone, the central bank, Bangladesh Bank (BB), introduced financial interventions like the microcredit program in 1983 and a bank-led mobile banking service known as a mobile financing service (MFS) in 2011 [4]. Moreover, the Ministry of Finance (MoF) of Bangladesh officially introduced the first National Financial Inclusion Strategy (NFIS) on 25 August 2021, which spans a period from 1 July 2021 to 30 June 2026, including a target to achieve 100% financial inclusion by 2026 (Details of the strategy and action plans can be freely found

here: [https://www.afi-global.org/wp-content/uploads/2022/04/NFIS\\_Bangladesh.pdf](https://www.afi-global.org/wp-content/uploads/2022/04/NFIS_Bangladesh.pdf) (accessed on 24 February 2023)) [10]. The government of Bangladesh aims to utilize the country's vastly penetrated mobile phone network as a potential passage to increase financial inclusion. The total number of mobile phone subscribers reached 181.02 million in December 2021 [11]. The broader vision of MFSs is to provide commercially viable, safe, and modernized banking services, especially to the underprivileged unbanked and/or under-banked low-income group [3]. However, despite the government's considerable promotion of MFSs, a large gap between the national target and consumers' usage rate remains [12,13]. Surprisingly, the number of customers registered for mobile banking increased rapidly during the nationwide lockdown in March 2020 to prevent spread of COVID-19 [3,14]. During the pandemic, citizens willingly relied on online transactions and mobile banking services instead of direct cash transfers [15,16]. When worldwide economic activities were paused, people utilized MFSs from a health and safety viewpoint and as a medium for quick, safe, and efficient financial assistance [17].

The volume of mobile money transactions plays a vital role in deepening the financial inclusion of a country [18,19]. Studies on mobile payment continuance are relatively lacking and studies that have covered them only include a few direct antecedents of continuance intention in their research models [20]. Previous studies focusing on the demand for mobile money have mainly emphasized the user perspectives and preferences for mobile financing services [2,21–24] and only a handful of studies aimed to empirically understand the influence of an economic shock on consumers' demand [25]. Using IMF and the World Bank GDP forecast data for 2020, before and after the COVID-19 crisis, ref. [26] projected a significant plummet in the remittance earnings of the Philippines. As the COVID situation in Bangladesh has returned to normal, it is relevant to thoroughly evaluate the influence of the pandemic on the usage of mobile financial services. As the pandemic is over and relevant data are available, it has created a perfect avenue for research to answer an overarching research question: will the effect of movement restriction shock last for a short period or will it cause a paradigm shift in the consumer behavior of Bangladesh in the long run? The economic shock of COVID-19 is an infrequent one-time event, whereas financial inclusion is a long-term macroeconomic phenomenon.

To examine the influence of the movement restriction order, this study uses monthly time series data of the top three most-used MFS transactions in Bangladesh, i.e., person-to-person (P2P), utility bill payments (P2B), and inward remittance (rem) over the period of December 2016 to May 2022. The autoregressive distributed lag model (ARDL), developed by [27], is used as an empirical methodology to examine the short-run and long-run trends. The main advantage of this technique is that it is suited to small sample sizes, such as the present study. This paper also aims to assess the significance of mobile financing services in the financial inclusion of Bangladesh. To date, no previous empirical study has explicitly investigated the effect of COVID-19 movement restrictions on mobile money demand and financial inclusion in Bangladesh. This study contributes to the research domain of post-adoption or continuous use of MFSs, which has global importance as greater use of MFSs can contribute to social welfare, consumer well-being, and greater financial inclusion [28]. Therefore, the findings of this article will be relevant for the financial services sector to reflect on maintaining users of MFSs, as well as for national policymakers to accelerate financial inclusion within the stated timeframe of 30 June 2026.

This paper continues as follows: First, a brief review of the existing literature and an overview of the MFS structure of Bangladesh is presented. The subsequent section describes the methodology used in this study and issues relating to model specification, including variable selection based on previous studies. The penultimate section presents the empirical results, and the final section summarizes the key developments of the paper.

## 2. Literature Review

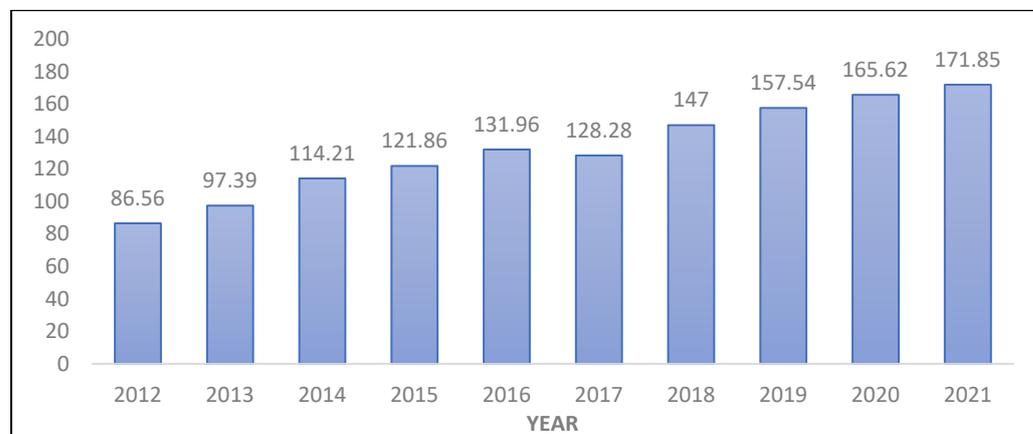
The broader concept of digital financial services comprises financial services offered through digital platforms with minimal to no usage of cash, including mobile phones, in-

ternet, cards, and Point of Sale (POS) terminals [2,4,19]. Over the last two decades, mobile financing services have been considered one of the most innovative and effective means to extend financial services' accessibility to unbanked and/or ultra-poor population, especially in developing countries [8]. Along with daily money transactions, MFSs can facilitate interaction with mainstream banks via mobile channels, send or receive international remittances, and make payments for purchasing goods and services either at the point of sale or remotely [26].

Financial inclusion ensures easy, available, and affordable access to the formal financial system for all members of an economy [7]. A financially inclusive system facilitates stable economic growth by providing citizens with an efficient allocation of productive resources, better management of daily finances by helping families and businesses plan for everything in advance, and lowering the use of informal lending facilities [29]. A significant amount of research has examined the role of mobile banking in improving a country's financial inclusion. In developing countries, mobile banking is considered the most essential tool to promote financial inclusion for the previously unbanked population [2,30]. M-Pesa, mobile banking in Kenya, was found to facilitate a large scale of financial inclusion in Kenya [22,31]. A substantial positive contribution of m-Pesa was also recorded in expanding financial inclusion through remittance transfer services in Kenya [32]. This trend was also observed in Bangladesh [30]. However, other studies also found insignificant influence of mobile money on financial inclusion. Using data from 2012 to 2019, ref. [33] showed that the amount of mobile money distribution was not a statistically significant determinant of financial inclusion in Burundi. Apart from banking services, the creation of new delivery channels such as mobile banking services through third-party agents are also playing an important role in providing greater financial access in Africa [6].

#### Structure of MFSs in Bangladesh

An initial guideline on "Mobile Financing Service" was issued by Bangladesh Bank in September 2011 [3], encouraging commercial banks to introduce mobile financing services in their banking facilities. Later, various mobile phone operators were advocated to facilitate the service throughout the country and become active partners of MFSs. Figure 1 shows that the number of mobile phone subscribers has increased from 86.56 million to 171.85 million between the years 2012 and 2021. With the spread of mobile banking services like bKash, the share of adults (age 15 and above) reported making or receiving a digital payment rose to 34% in 2017 [34]. According to recent data from Bangladesh Bank, 55% of MFS users reside in rural areas and 42% of users are women [35]. MFSs aim to utilize the ongoing high-penetration mobile phone network to provide a secure, low-cost, and prompt service to the underprivileged, underserved, unbanked, and/or under-banked low-income nationals [3].



**Figure 1.** Number of mobile phone subscribers (in millions). Source: Bangladesh Telecommunication Regulatory Commission (BTRC).

MFSs offer transaction facilities such as checking account balances, transferring funds, and assessing other banking services via mobile devices or personal digital assistants (PDAs). This digital money service is designated to a particular mobile or cellphone number of a client, also known as a mobile account (m-wallet). Available funds in the mobile account are stored on an electronic general ledger. The client can allocate these virtual funds to different services through a mobile phone, alternative digital process, or a device by ensuring an appropriate authentication process [3].

Bangladesh Bank permits only scheduled commercial bank-led mobile financial service providers, also known as payment service providers (PSPs). Before providing a service as a PSP, the scheduled commercial bank must establish a subsidiary with a bank or non-bank entity as an equity partner and obtain a license as a PSP from the Payment Systems Department of Bangladesh Bank. MFS providers can deliver the following payment services throughout the country: (i) cash in/out using mobile account through agents/Bank branches/ATM's/Mobile Operator's outlets; (ii) person to person payments (among registered account holders of the same bank) (iii) person to business payments (e.g., utility bills payment); (iv) business to person payments (e.g., salary disbursement by corporate bodies/industries/offices, etc.); (v) disbursement of inward foreign remittances; (vi) government to person payments (e.g., elderly allowances, freedom fighter allowances, subsidies, etc.); (vii) person to government payments, e.g., tax, levy payments; and (viii) other payments like microfinance, overdrawn facility, insurance premium, etc [3,36].

Bangladesh Bank initially approved 28 banks to operate mobile banking services, and despite experiencing strong growth, it is still in its infancy. As of June 2023, 12 commercial banks and the Bangladesh Post Office (with interim approval of BB) are providing MFSs throughout the country [37]. A list of current MFS providers and the name of their respective services are presented in Appendix A (Table A1).

### 3. Methodology

The paper aims to examine the role of movement restriction orders in enhancing financial inclusion in Bangladesh using mobile financing services.

#### *Data and Variable Selection*

MFSs provide diverse categories of services to their registered clients. However, because of the unavailability of long-term monthly data for all the MFSs, this study considers only the three most-used services: person-to-person transactions (P2P), person-to-business transactions, or utility bills payments (P2B), and inward remittances from December 2016 to May 2022. The best way to assess the effect of the stay-at-home order on mobile banking services is to put adequate controls on all the seasonal, macroeconomic, and other factors which might influence the demand for mobile banking services. Also, a dummy variable ( $D_{C19}$ ) is included with the value 1 for all the months when the nationwide movement restriction order was in place to capture its effect. After controlling the significant effects of the external factors, the actual impact of the movement restriction shock can be fully assessed.

Unemployment rates, a popular business cycle indicator, are effective metrics that predict changes in the direction of an economy by measuring economic activities such as production and employment. However, as unemployment rates are recorded annually in Bangladesh, it is insufficient for this research. Instead, the monthly wage index is applied as an indicator of the business cycle and a significant demand shifter. Gross domestic product (GDP) is frequently used as a standard indicator for measuring economic activity and overall growth for any country. Because GDPs are often recorded quarterly or annually, several studies have applied the general index for industrial production (IPI) as a proxy for GDP [38]. Monthly money supply (M2) is used in the analysis after logarithmic transformation to evaluate the influence of seasonality [39]. A dummy variable to control for the seasonal and cultural component is also added since the demand for mobile transactions is highly seasonal [31], e.g., biannual Eid festivals, puja festivals, and other religious and

cultural festivals. A crucial factor of the demand for MFSs is the price/costs associated with using mobile financing services (e.g., connection fees, prices of mobile phones, etc.). But this study could not use cost of MFS transactions due to the unavailability of the data.

As supply-side influencers, the total number of MFS agents is added to the analysis as a proxy for the agent network. Agent network, proximity, and availability of local agents are found to be significant determinants in the demand for mobile financing services [2,21]. Prior studies also showed that, for low-income groups, proximity to the nearest agent location could significantly increase consumer usage [40]. A detailed description of all the variables described above is presented in Table 1.

**Table 1.** Variable Name and definition, descriptive statistics, and data source.

Variable	Definition, Mean and Standard Deviation for the Period December 2016 to May 2022	Source
Dependent variable for Model 1	$P2P_t$ Natural log of the person-to-person transaction (in million BDT) in month t Mean (S.D): 11.15 (0.5473)	Bangladesh Bank
	$P2B_t$ Natural log of utility payments (in million BDT) in month t Mean (S.D): 8.219 (0.558)	Bangladesh Bank
	$Rem_t$ Natural log of inward remittances (in million BDT) in month t Mean (S.D): 5.612 (1.185)	Bangladesh Bank
Dependent variable for Model 2	$atmV_t$ Natural log of monthly volume of ATM transactions throughout the country. Mean (S.D): 7.313 (0.616)	Bangladesh Bank
Control variables for Models 1 and 2	$lnM2_t$ Natural log of money supply (M2) (in million BDT) in month t Mean (S.D): 16.286 (0.139)	Bangladesh Bank
	$wageIndex_t$ Labor Wage Index in month t Mean (S.D): 161.88 (12.84)	Bangladesh Bureau of Statistics (BBS)
	$Agents_t$ Natural log of the number of total agents providing MFSs in month t Mean (S.D): 13.695 (0.126)	Bangladesh Bank
	$IPI_t$ General industrial production index for the month t. Mean (S.D): 406.57 (72.12533)	Bangladesh Bureau of Statistics (BBS)
	$D_{C19}$ A dummy variable with a value of 1 for the month when the nationwide lockdown was in place, and 0 otherwise. Mean (S.D): 0.226 (0.126)	N/A
	$D_{fest}$ A dummy variable taking the value 1 for a month if the month contains any major religious and cultural festivals like Eid and Puja festivals in that year and is 0 otherwise. Mean (S.D): 0.226 (0.126)	N/A
$N$	The number of observations. N = 66	

This article used the autoregressive distributed lag model (ARDL) developed by [27] to estimate the short-run and long-run influence of the movement restriction order on MFSs. However, before analyzing the data it is essential to determine whether the variables are stationary in first or second differences. The Augmented Dicky Fuller (ADF) test is applied to all variables for stationarity (if any). The ADF test outcomes are reported in Appendix A (Table A2). If the variables are stationary in first or second differences, then autoregressive distributed lag (ARDL) models can be applied [29].

The advantage of ARDL methodology is that it is applicable for testing the relationship between variables irrespective of whether they are purely I (0), purely I (1), or mutually cointegrated [27]. Also, ARDL is a good fit for small sample data like this study, with 66 observations only [41]. The model also includes error correction factors of the past terms, which shows how quickly current deviation will converge into the long-run equi-

librium. The coefficient of error correction model (ECM) is of particular interest for this study. The direction and size of the ECM will help to answer whether the short-run upward trend of MFSs, if any, will converge or diverge in the long run. The analysis of error correction terms and lag difference terms can test both short-run and long-run relationships between variables [27]. Appropriate lag selection is based on the Akaike Information Criterion (AIC).

The proposed demand of MFS transactions that includes the shock of movement restriction takes the following form:

$$\ln Y_t = \alpha + \beta_0 IPI_t + \beta_1 wageIndex_t + \beta_2 \ln M2_t + \beta_3 agent_t + \beta_3 D_{C19_t} + \beta_4 D_{Fest_t} + \epsilon_t \quad (1)$$

where  $\alpha$  refers to the drift component,  $Y_t$  is the type of MFS transaction in interest,  $IPI_t$  is the general industrial production index used as a proxy for GDP.  $wageIndex_t$  measures the movement of wages in the main sectors of economy and is used here as proxy for unemployment.  $\ln M2_t$  is the logarithm of money supply and  $agent_t$  is the log no of agents providing the MFS.  $D_{C19}$  is the dummy variable capturing the impact of stay-at-home orders.  $D_{Fest}$  is the dummy variable with 1 for the months for the major religious and cultural festival between the study period, and 0 otherwise.  $\epsilon_t$  is the error term.

In the absence of prior information about the direction of the long-run relationship among variables, the following unrestricted error correction model is estimated:

$$\Delta \ln Y_t = \alpha + \sum_{i=0}^{n_1} \beta_0 \Delta IPI_{t-i} + \sum_{i=0}^{n_2} \beta_1 \Delta wageIndex_{t-i} + \sum_{i=0}^{n_3} \beta_2 \Delta \ln M2_{t-i} + \sum_{i=1}^{n_4} \beta_3 \Delta \ln Y_{t-i} + \sum_{i=0}^{n_5} \beta_4 \Delta agent_{t-i} + \beta_5 D_{C19_t} + \beta_6 D_{Fest_t} + \vartheta_1 IPI_{t-1} + \vartheta_2 wageIndex_{t-1} + \vartheta_3 \ln M2_{t-1} + \vartheta_4 \ln Y_{t-1} + v_4 agent_{t-1} + \epsilon_t \quad (2)$$

where  $\Delta$  is the first-difference operator,  $n_1$  to  $n_5$  are the lag lengths based on the AIC. From the first part of Equation (2),  $\beta_0$ ,  $\beta_1$ ,  $\beta_2$ ,  $\beta_3$ ,  $\beta_4$ ,  $\beta_5$ , and  $\beta_6$  represent the short-run dynamics of the model, whereas, in the second part,  $\vartheta_1$ ,  $\vartheta_2$ ,  $\vartheta_3$ , and  $\vartheta_4$  represent the long-run relationship.

The null hypothesis in the ARDL is as follows:

**H0.**  $\vartheta_i = 0$  for all  $i$  ( $i = 1, 2, 3, 4$ ).

**H1.** At least one  $\vartheta_i$  does not equal zero for all  $i$  ( $i = 1, 2, 3, 4$ ).

If the F-statistic of our bounds test is higher than the upper value, then we reject the null hypothesis and conclude that there is a long-run equilibrium relationship among the variables. On the other hand, if the F-statistic is less than the lower value, we cannot reject the null of any cointegration relationship among the variables. Otherwise, the inference is inconclusive [41]. The detailed cointegration results are presented in Appendix A (Table A3).

Equation (2) can be represented as a general error correction model as follows:

$$\Delta \ln Y_t = \alpha + \sum_{i=0}^{n_1} \beta_0 \Delta IPI_{t-i} + \sum_{i=0}^{n_2} \beta_1 \Delta wageIndex_{t-i} + \sum_{i=0}^{n_3} \beta_2 \Delta \ln M2_{t-i} + \sum_{i=1}^{n_4} \beta_3 \Delta \ln Y_{t-i} + \sum_{i=0}^{n_5} \beta_4 \Delta agent_{t-i} + \beta_5 D_{C19_t} + \beta_6 D_{Fest_t} + \lambda EC_{t-1} + \epsilon_t \quad (3)$$

where  $\lambda$  is the speed of the adjustment parameter and is expected to be negative. This parameter indicates how fast the current differences in MFS transactions respond to the error correction term disequilibrium in the previous period.  $EC$  represents the residuals obtained from the estimated cointegration model of Equation (3).  $\epsilon_t$  is a white noise error term.

As the ARDL model will show how movement restrictions influence MFS demand in Bangladesh, it is crucial to examine how MFSs affect the country's financial inclusion. Financial inclusion can be assessed by people's access to basic financial services by comparing three main financial inclusion indicators: ownership of a bank account, savings in a bank account, and use of bank credit [7,42]. A number of studies have examined the mea-

asures of financial inclusion such as the percentage of the population aged 15 and above with bank accounts, credit cards, debit cards [43], and mobile money accounts [9], number of automated tellers machines (ATMs) [29], volume of ATM transactions [29], and number of bank branches for 100,000 people [44]. Using the measure suggested by [29], this paper uses the monthly volume of financial transactions through automated teller machines (ATMs) as an indicator of financial inclusion in Bangladesh, mainly due to the availability of information during the study period. To empirically examine the influence of MFSs on financial inclusion and whether movement restrictions have any significant role, the following econometric analysis is performed:

$$atmV_t = \beta_0 + \beta_1 MFS_{it} + \beta_2 * D_{C19} + \beta_3 MFS_{it} * D_{C19} + \beta_4 * X_t + \varepsilon_t \quad (4)$$

where  $atmV$  is the financial inclusion variable, i.e., logarithm of volume of ATM transactions,  $MFS_i$  is the three different MFS variables used in the analysis, and  $X$  is vector of control variables.

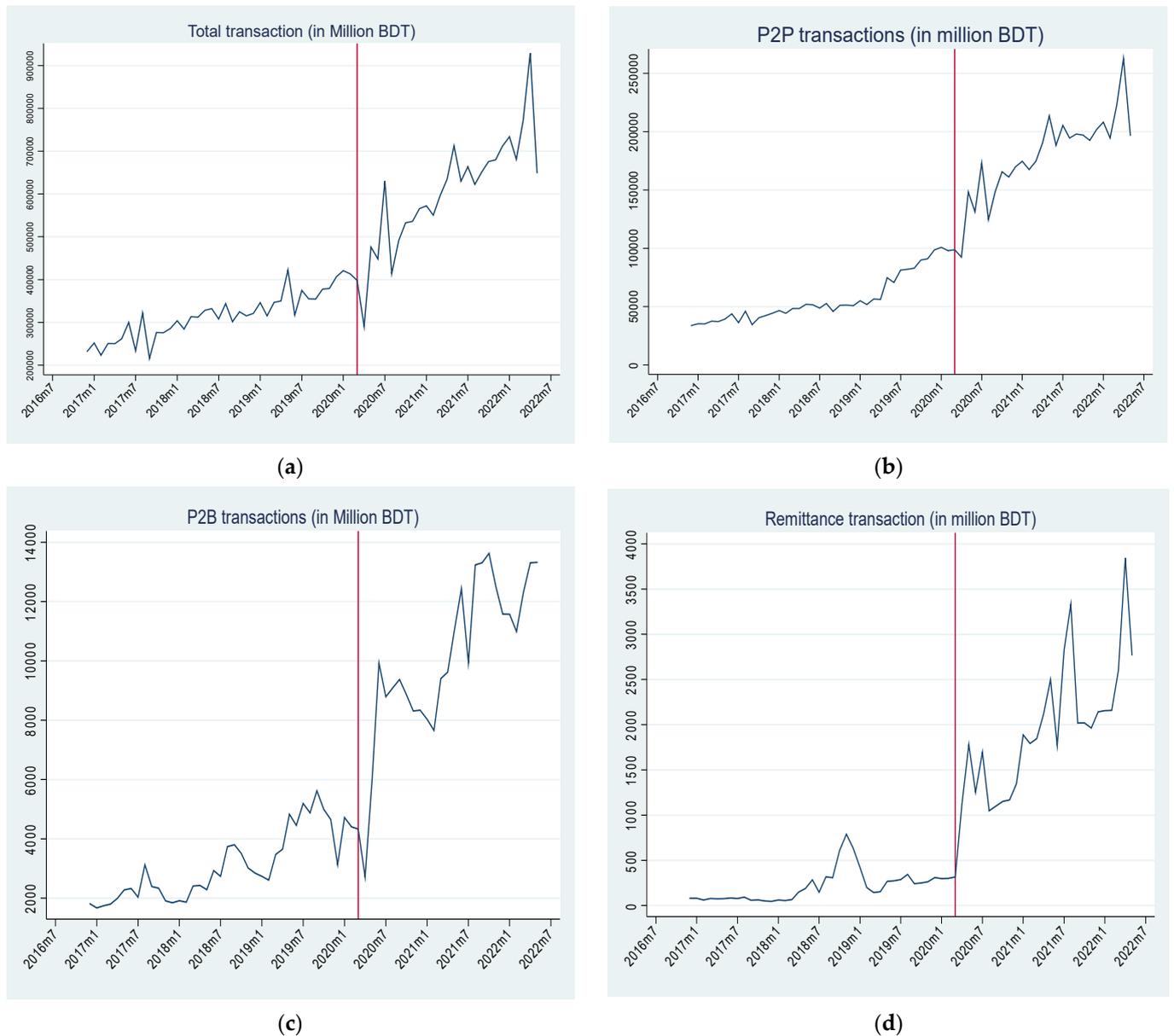
#### 4. Empirical Results

Figure 2 displays monthly P2P, P2B, and inward remittance transactions in million BDT. Each trend shows a sharp decline in March 2020, the month of the official announcement of the movement restriction order [45]. However, the trend starts increasing significantly after that period. After the initial shock of movement restriction, demand for digital payments surged as people had extremely limited available modes of daily transactions. Utility bill payment (P2B) transactions record the highest rebound inflow. After a sharp plummet in March 2020, the trend of P2B transactions increased instantaneously by roughly around 150% (Figure 2, Panel b). This can be viewed as a clear reflection of the positive impact of lockdown on the behavioral pattern of general people towards MFSs. Since MFSs allow their customers to avail themselves of diverse services through a mobile phone with a cellular connection, they became the most feasible and practical option during the pandemic.

The long-run estimates of ARDL models are presented in Table 2. The co-movements in the MFS demand model indicate a long-run relationship between the volume of transactions, industrial production index, wage index, number of agents, and money supply. In the long run, all variables become interconnected. The industrial sector plays a significant role in the economic development of Bangladesh. The industrial production index (a proxy for GDP) has a positive long-run impact on the volumes of the types of MFS transactions. A similar trend is recorded by [46]. However, Table 2 shows that results are statistically significant only for the P2B series.

The velocity of money is likely to increase as the economy grows, and this trend is also expected with MFSs. The percentage increase in money supply will significantly increase P2P and P2B by 4.64% and 7.23%, respectively, in the long run. Movement restriction orders are associated with a significant increase in P2P and P2B in the long run, but the effect is positive and statistically insignificant for remittance transfer. Specifically, the nationwide lockdown will increase P2P transactions by  $[\exp(0.175) - 1] = 19.12\%$ , and 6.28% for P2B in the long run. Remittance transfers will also increase by 15.8%, but the result is statistically insignificant. Religious and cultural festivals are found to influence MFS transactions positively, but the results are found to be significant only for remittance transfers.

The results of the short run trend and the error correction model for MFSs are presented in Table 3. The error correction  $ECM_{t-1}$  is the parameter for the speed of adjustment. It calculates how much of the disequilibrium of the previous period is being corrected in the subsequent periods [47]. The negative coefficients indicate that a short-term imbalance from the previous period may be adjusted during this period, with error corrections that resume the long-term equilibrium. This also proves the validity of the long-term relationships among variables.



**Figure 2.** Trends of the volume of MFS transactions from December 2016 to May 2022. Source: Bangladesh Bank. Panel (a) shows the amount of MFS transactions in million BDT. Panel (b–d) shows the monthly trend of person-to-person (P2P), utility bill (P2B), and remittance (rem) payments in million BDT. The red line in the figures show the beginning of lockdown period.

**Table 2.** Econometric results for long-run model.

Variables	P2P	P2B	rem
Industrial Production Index (IPI)	0.000456 (0.22)	0.00163 * (0.67)	-0.0117 (-1.48)
Money supply (lnM2)	4.644 ** (2.03)	7.232 ** (2.62)	-0.5233 (-0.59)
Agents	-3.193 ** (-2.26)	-1.463 (-0.62)	7.9126 * (0.85)
Wage Index	0.0271 (1.01)	0.02682 (0.96)	0.0390 (0.15)
Movement restriction (dummy)	0.175 ** (2.05)	0.06232 * (0.66)	0.1473 (1.14)
Festivals (dummy)	0.1308 (1.36)	0.1643 (1.82)	0.2413 (0.61)

Note: The number inside the parentheses is the t-value. \*\* and \* are significant at 5% and 10% level, respectively.

**Table 3.** Error correction model for person-to-person (P2P), utility payment (P2B), and remittance transfer.

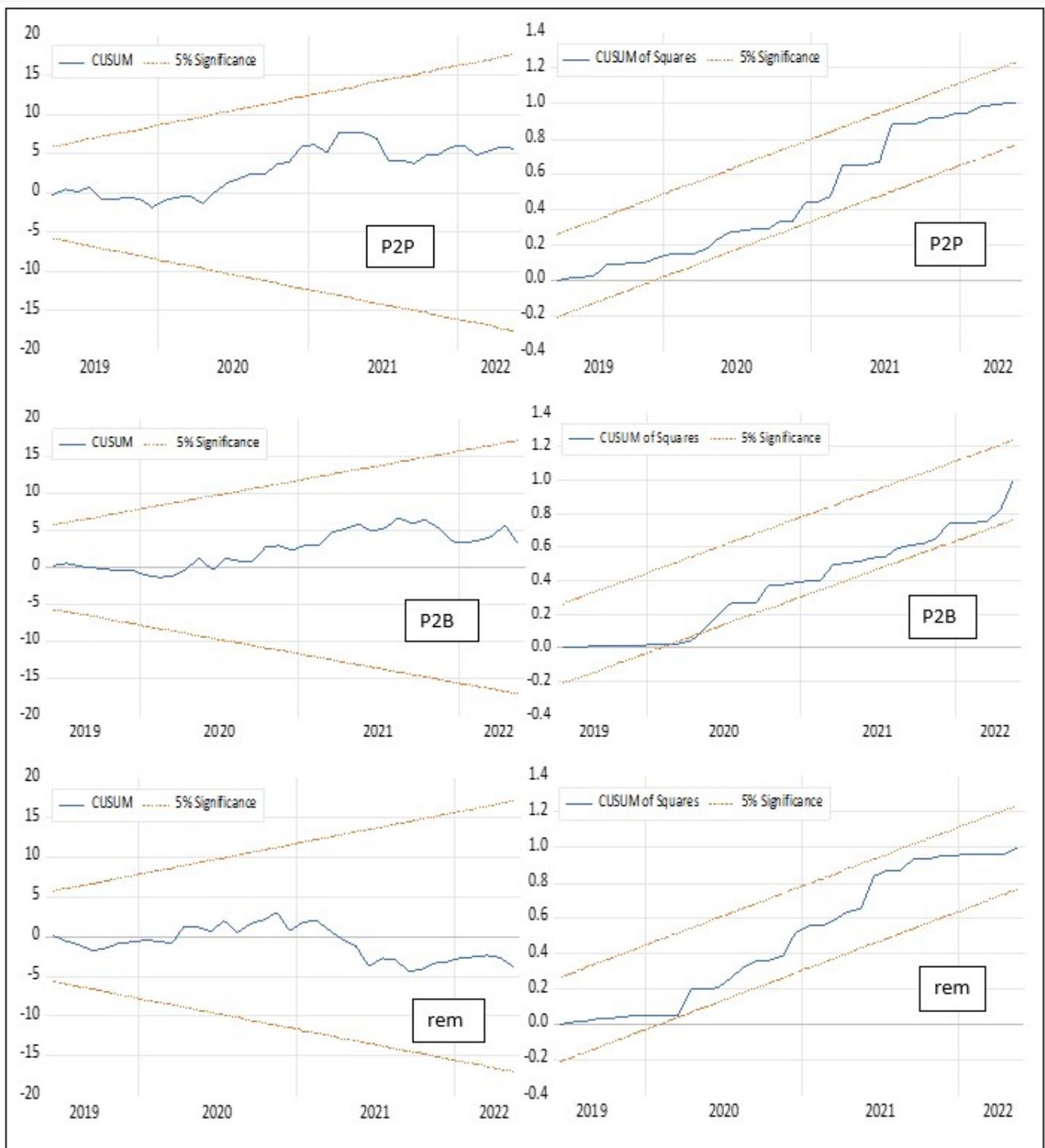
Variable	P2P	P2B	rem
$\Delta \ln Y_{t-1}$	−0.4669 *** (−3.31)		
$\Delta IIP_t$	0.001227 *** (3.01)	0.00108 (1.44)	0.00755 (0.46)
$\Delta IIP_{t-1}$	0.00044 (1.25)		0.000245 (0.19)
$\Delta \ln M2_t$	1.7631 (1.02)		1.413 (0.56)
$\Delta \ln M2_{t-1}$	−1.8158 (−1.20)		
$\Delta agents_t$	0.8042 (0.76)		1.887 (0.82)
$\Delta agents_{t-1}$	0.2888 (0.31)	1.4332 (0.71)	
$\Delta wageIndex_t$		0.0751 * (1.43)	−0.20078 ** (−2.15)
$\Delta wageIndex_{t-1}$	−0.0327 (−1.25)	−0.2408 *** (−3.99)	
$D_{C19}$	0.06778 *** (2.66)	0.1458 (0.96)	0.11305 * (1.08)
$D_{fest}$		0.09998 ** (2.06)	0.199 ** (2.39)
$ECM_{t-1}$	−0.383 ** (−2.23)	−0.635 *** (−3.11)	−0.2385 ** (−2.60)
Constant	9.4709 (0.68)	−57.575 ** (−2.52)	−45.976 (−1.16)
Adj R <sup>2</sup>	0.6861	0.6252	0.5628
Log likelihood	81.0178	46.362	31.5729
DW test	2.1808	2.092	1.985
$\chi^2_{white}(61)$	61.84	62.05	58.24

Note: The number inside the parentheses is the t-value. \*\*\*, \*\*, and \* is significant at 1%, 5%, and 10% level, respectively. AIC (Akaike Information Criterion) was used in the lag length selection criteria for the ARDL specification. DW test is the test for autocorrelation.  $\chi^2_{61}$  White test for heteroscedasticity.

The results of Table 3 indicate that economic growth (IPI) positively impacts MFSs, but the results are statistically significant only for P2P transactions in the short run. The wage index, used as a proxy for general income level, has a significant negative impact on remittance transfers and a significant positive impact on utility payments in the short run. Finally, as expected, in the short run  $D_{C19}$  has a positive impact on MFS transactions. A similar influence of COVID-19 on MFSs is found by [48]. Unfortunately, the results show significance only for P2P and rem transfer. In the short run, the festival dummy is found to have a positive and strong significant influence on utility payment and remittance transactions. These findings are consistent with [31].

The lagged error correction term  $ECM_{t-1}$  is negative and significant at least at 5% level for all the series. The coefficients of −0.383, −0.635, and −0.238 for P2P, P2B, and remittance, respectively, indicate a moderate rate of convergence to equilibrium for P2P and remittance. However, for P2B more than 60% of the adjustment takes place each month to correct the previous disequilibrium.

The stability of the regression coefficients can be evaluated using the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) [49]. All three series used in the regression analysis appear stable as neither the CUSUM nor the CUSUMSQ test statistics exceed the 95% confidence bound (Figure 3). Durbin–Watson statistics show that there is no serial autocorrelation to the error correction model (Table 3). Also, Breusch–Pagan tests suggest that errors are homoscedastic and independent of the regressors.



**Figure 3.** Cumulative and cumulative sum of square of recursive residual plot for P2P, P2B, rem.

The estimation results in Table 4 show that mobile financing services have a positive and significant influence on the financial inclusion of Bangladesh in all three regression models. As expected, movement restrictions are consistently found to be negatively and significantly related to the financial inclusion. However, the interaction effect between MFSs and the restriction dummy for all three models describes a different and fascinating scenario. A positive and significant interaction coefficient signifies that financial inclusion was even more intensified during the movement restriction period. For instance, a percentage increase in P2P is positively related to a 0.0634 percent increase in the financial

inclusion of Bangladesh, although, during the pandemic, the percentage increase in P2P was associated with a  $0.0634 + 0.3993 = 0.4627\%$  upsurge of financial inclusion. A similar trend was also noticed for P2B and remittance transfer services (Table 4: Models 3 and 4). These results suggest that during the movement restriction period, mobile financing services significantly amplified the financial inclusion of the country.

**Table 4.** Estimation results for financial inclusion.

	Dependent Variable: Volume of ATM Transactions (in Log)		
	Model 1	Model 2	Model 3
P2P	0.0634 * (0.2228)		
P2B		0.38005 *** (0.13094)	
Rem			0.07719 * (0.04463)
D <sub>C19</sub>	-4.3469 * (1.6272)	-3.0521 *** (1.1118)	-1.0389 *** (0.37756)
P2P*D <sub>C19</sub>	0.3993 *** (0.14117)		
P2B*D <sub>C19</sub>		0.3852 *** (0.1283)	
Rem*D <sub>C19</sub>			0.21756 *** (0.059063)
IPI	0.00187 *** (0.000577)	0.001922 *** (0.000586)	0.000906 * (0.0005208)
D <sub>fest</sub>	0.000723 (0.04153)	0.01322 (0.03936)	0.01024 (0.03478)
Agents	3.1939 * (1.2115)	-2.567 ** (1.0525)	2.901 *** (1.020)
wageIndex	0.0453 (0.0123)	0.05839 *** (0.01322)	0.04053 *** (0.0102)
M2(log)	1.4817 (1.8895)	-1.9855 (1.5985)	2.3933 * (1.1990)
Constant	19.447 * (9.836)	61.3557 *** (20.4287)	1.4658 (14.940)
N	66	66	66
Adj-R <sup>2</sup>	0.9411	0.9834	0.9569
F-statistic	125.09 ***	130.78 ***	181.28 ***
Root MSE	0.12803	0.15283	0.14965

Note: Robust standard errors are reported in the parenthesis. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

## 5. Conclusions

This paper was motivated by the need for an empirical analysis to understand and evaluate the short run and long run impact of movement restriction orders on financial inclusion through mobile financing services. Despite the national target for financial inclusion and role of MFSs identified in policies, the low levels of financial inclusion in Bangladesh with the large number of mobile phone subscribers make it imperative to investigate if an expansion of MFSs can contribute to greater financial inclusion. The COVID-19 pandemic is a rare natural experiment and gives us the opportunity to assess consumers' responses to mobile money transactions. The bounds testing approach to cointegration (developed within an autoregressive distributed lag framework) is applied to analyze the relationship between MFS transactions and the COVID-19 lockdown and other macroeconomic demand and supply shifters. In general, the study confirms the short-run and long-run positive impact of movement restrictions on MFSs. Moreover, movement restriction orders have reinforced the financial inclusion of Bangladesh through the MFS channel.

Financial exclusion has always been a perennial issue for Bangladesh. According to the National Financial Inclusion Strategy Bangladesh (NFIS-B), the country aims to achieve

100% financial inclusion by 2026. To achieve this target, the government must bring nearly 18 million adults under at least one regulated finance service. To achieve this target, authorities are relying on digitization and innovation strategies like MFSs. However, the services were not widely adopted until the lockdown period of COVID-19. Limited banking hours and a selective range of banking services due to movement restriction orders have influenced people to adopt a hygienic non-contact lifestyle and rely on mobile money transactions. The total number of transactions has increased by 103% between the years 2018 and 2021 [50]. Short run results also show a similar influence of movement restriction on MFSs (Table 3). However, the coefficient of error correction (Table 3) showed that the majority of the upsurge will phase out in the long run. The empirical results show that P2P, P2B, and remittance transfer will increase only by 19.12%, 6.28%, and 15.8%, respectively, in the long run due to movement restriction shock.

Since sustainable financial inclusion through MFSs is the ultimate objective of Bangladesh, the government needs to act promptly to utilize the current short run momentum before its convergence to the historic long run equilibrium. Financial inclusion through mobile banking in Bangladesh is not free from challenges like insufficient security, lack of basic financial literacy, poor mobile connection, etc., [51]. Banks should educate its mobile banking customers about the safety features of mobile banking so that customers are aware that all transactions conducted via mobile banking are secure and will be kept confidential [52]. A huge investment is required to make MFSs available, which makes it more important that the consumer accepts and continuously uses the company's technology and services [28]. To maintain the current short run momentum, best practice strategies of the past can act as guidelines for policymakers to expand the MFSs. However, thorough consideration is needed for each case to identify the underlying cause of a failure, if any. In the past, several strategies have provided noteworthy success in increasing MFS usage in Bangladesh. Specifically, digital wages for garment workers significantly improved financial inclusion during the pandemic when the government started the digital wage support program for export-oriented sectors in March 2020 [53]. More than 2.5 million new accounts were opened through MFSs within 25 days after the initiative [54]. Unfortunately, after the government wage support ended in August 2020, the number of digital payments fell by around 56% [55]. To reach the targeted financial inclusion goal by 2026, the government should reinstate the digital wage scheme for garment workers and expand this successful scheme to other manufacturing sectors.

Government policy to distribute social security allowances and grants through MFSs can also be viewed as another accomplishment toward financial inclusion. The initiative significantly improved financial inclusion for marginalized people, especially char dwellers [56]. However, this program suffered from a serious operational flaw. The recipients of those safety net programs are unable to choose their preferred MFS provider. To receive the benefit, recipients must have access to state-authorized commercial banks and MFS providers only [50]. As a result, usage of those government-approved MFS accounts remains limited to receiving the benefit only and stays inactive otherwise [57]. Since MFS registration does not solely inspire usage [58], the government should pay more attention to reduce inactive and infrequent accounts. In this regard, limiting bureaucratic practices and emphasizing consumers' preferences can be an appropriate and actionable strategy.

This study found the long-term growth of remittance transfer through MFSs to be slower and insignificant compared to other services. This directly opens a policy window to address bottlenecks to ensure higher remittance transfer through MFSs. Bangladesh is highly dependent on remittance, and remittance flow has led to increased probability of owning e-bank accounts and the use of mobile banking for a household's financial transactions [30]. The government recently took some positive steps such as doubling the maximum limit so that expatriates can send more remittances through MFSs [59]. There are also plans to set up expats' centers in 36 countries to ease the process of sending money through MFS platforms [60]. Future research may consider using other research methods, such as experimental research and simulation, to connect these practices with their impact.

The empirical results of the short-run influence (Table 3) show that social and cultural festivals positively and significantly affect MFSs. The government policy framework should also prioritize these findings and design an agenda to further encourage usage of MFSs during the festival periods.

#### Limitations

As with all research works, this study also has several limitations. The major limitation is being unable to consider the cost of using MFSs due to unavailability of relevant information. The service charges of mobile banking platforms are subject to the service provider, amount of transaction, cost of internet, etc. Second, due to focusing only on Bangladesh, the results of this study may not be comparable to other economies. Future research can be designed using extensive data from similar economies considering the cost of MFS usage.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not available.

**Informed Consent Statement:** Not available.

**Data Availability Statement:** Available upon request.

**Conflicts of Interest:** The author has no competing interests to declare that are relevant to the content of this article.

## Appendix A

**Table A1.** List of MFS providers in Bangladesh.

Serial No	Name of the Business Entity	Name of the MFS Service
1	Dutch Bangla Bank Ltd.	ROCKET
2	bKash Ltd.	bKash
3	Mercantile Bank Ltd.	MYCash
4	Islami Bank Bangladesh Ltd.	Islami Bank mCash
5	Trust Axiata Digital Ltd.	Trust Axiata pay:tap
6	First Security Islami Bank Ltd.	FSIBL FirstPay
7	UCB Fintech Company Ltd.	Upay (উপায়)
8	One Bank Ltd.	OK Wallet
9	Rupali Bank Ltd.	Rupali Bank
10	Southeast Bank Ltd.	TeleCash
11	Al-Arafah Islami Bank Ltd.	Islamic Wallet
12	Meghna Bank Ltd.	Meghna Bank
13	Bangladesh Post Office (with interim approval of Bangladesh Bank)	Nagad

Source: Bangladesh Bank 2023.

**Table A2.** Augmented Dicky Fuller test (ADF).

Series	Level	First Difference
$P2P_t$	-0.931	-15.502 ***
$P2B_t$	-1.070	-9.804 ***
$rem_t$	-0.889	-7.939 ***
$lnM2_t$	-0.084	-9.488 ***
$agent_t$	-0.865	-9.581 ***
$wageIndex_t$	1.072	-4.276 ***
$IIP_t$	-2.356	-11.196 ***

Note: \*\*\*  $p < 0.01$ .

**Table A3.** F-statistics for cointegration relationship.

Models	Dependent Variable	F-Statistics	Cointegration
Model 1	P2P <sub>t</sub>	F = 3.862 t = −2.895	Yes
	lnM2 <sub>t</sub>	F = 9.608 t = −4.918	Yes
	IPI <sub>t</sub>	F = 10.582 t = −4.900	Yes
Model 2	P2B <sub>t</sub>	F = 8.214 t = −4.556	Yes
	lnM2 <sub>t</sub>	F = 2.272 t = −2.072	No
	IPI <sub>t</sub>	F = 12.126 t = −5.306	Yes
Model 3	rem <sub>t</sub>	F = 4.272 t = −2.898	Yes
	lnM2 <sub>t</sub>	F = 2.658 t = −2.172	No
	IPI <sub>t</sub>	F = 11.497 t = −5.798	Yes

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