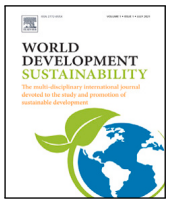
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Mobile money remittances to cope with aggregate shocks: Urban migrants and rural families under the COVID-19 lockdown in Bangladesh

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ABSTRACT

In developing economies, rural households send their members to urban areas to cope with idiosyncratic shocks by sharing resources through internal remittances, which are more prevalent than international remittances. However, there is limited evidence on the role of internal remittances in risk-sharing against aggregate shocks. We analyze the seven-round panel of 723 urban migrant workers paired with their rural families in Bangladesh, covering the pre- and post-lockdown period for COVID-19. During the lockdown, urban migrants and their rural families experienced substantial income losses, particularly severe in urban areas. Our event study analysis suggests that urban migrants and their rural families coped with the aggregate income shock by sharing resources through internal remittances rather than relying on other shock-coping strategies, including selling assets or borrowing from neighbors. Although the travel restrictions prevented urban migrants from carrying remittances by hand, they could continue sending remittances via mobile money, mitigating the negative impact on the welfare of rural families. Moreover, by reducing the amount of remittances they had to send, urban migrants also mitigated their welfare loss. Together, they could fully smooth food consumption and partially smooth general consumption. We support our argument with a novel machine-learning technique.

1. Introduction

In developing economies, households face income shocks from sickness, crop pests and diseases, and erratic rainfall. This chronic vulnerability undermines progress towards the Sustainable Development Goals (SDGs) of the United Nations, particularly SDG 1 (No Poverty) and SDG 3 (Good Health and Well-being). However, these households have few coping strategies due to low assets, imperfect local informal insurance, and limited access to formal insurance [9–12]. As a result, rural households typically send migrants to urban areas to diversify income sources and smooth consumption through remittances [13–16].[1] Indeed, such remittances allow rural households to cope with health and weather shocks [17,18] as well as to meet daily needs [17,19,20]. These risk-sharing mechanisms support SDG 1 by helping households maintain a basic standard of living during difficult times. There is renewed academic interest in remittances due to the rapid spread of mobile money[2] services in developing economies, which have dramatically reduced the cost of remittances [8,21–26].

A rich literature assesses the role of internal remittances against idiosyncratic shocks [8,17,21,24]. However, few empirical studies have examined how internal remittances function in the face of aggregate shocks such as financial crises. McKenzie [27] argued the limited role of internal remittances in coping with aggregate shocks, but did not provide direct evidence due to data limitations. Understanding how internal remittances function during crises is crucial for assessing progress on SDG 1.5 (Building Resilience to Shocks), which focuses on building resilience of the poor to economic shocks. The current study contributes to the dearth of literature by examining the shock-coping behavior of urban migrant workers and their rural families in Bangladesh during the COVID-19 pandemic.

The COVID-19 pandemic and associated containment measures reduced employment and income opportunities, particularly in urban

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[1] Although internal remittances are more often used for income risks sharing than international remittances [1], international remittances have attracted considerable academic interest (for example, [2–6]). Shimizutani and Yamada [7] suggest that international remittances served as insurance against the aggregate shock associated with the COVID-19 pandemic.

[2] Mobile money is an innovative technology that allows people to receive, store, and spend money using mobile phones and has been increasingly used in developing economies (see, for example, Aron [8]).

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areas [1,28,29]. In Bangladesh, the first cases of infection were reported on March 8, 2020,[3] and the government imposed the nationwide lockdown on March 26, 2020. In addition, with the earlier outbreak of COVID-19 in Europe and the United States, western apparel companies canceled or postponed export orders from Bangladesh's garment sector, which is the country's main export sector and employs many rural–urban migrant workers. These incidents had a significant impact on Bangladesh's economy; urban migrant workers faced the closure of their workplaces and lost their earning opportunities for an extended period of time. This acute crisis threatened to reverse progress on multiple SDGs, especially SDG 1.

This study addresses three interrelated research questions closely aligned with SDG 1.5:

- How did urban migrant workers and their rural families in Bangladesh cope with the aggregate shock of the COVID-19 pandemic?
- Did internal remittances serve as an effective shock-coping mechanism against this aggregate shock?
- What role did mobile money play in maintaining financial resource sharing between urban migrants and their rural families during lockdown?

Using an event study approach, we analyze a seven-round panel of 723 migrant workers from Dhaka garment factories and their rural families, conducted via telephone interviews from October 2018 to August 2020.[4] Our findings reveal that migrant workers continued to send remittances to their rural families, although in reduced amounts, using mobile money services. This enabled both groups to share resources and avoid substantial consumption reductions without resorting to other coping strategies like asset sales or borrowing. By examining these questions, our study improves understanding of how family networks in developing countries navigate aggregate shocks, contributing to SDG 1.5's goal of reducing vulnerability.

This study contributes to three strands of the literature. First, it provides descriptive evidence on the role of internal remittances as a shock-coping strategy during the COVID-19 pandemic, highlighting how urban migrant workers and their rural families jointly managed to smooth consumption, and addressing arguments on the limited role of internal remittances (e.g., McKenzie [27]). Second, it underscores the critical role of mobile money in facilitating urban–rural remittances amidst travel restrictions, demonstrating its effectiveness in supporting household resilience during economic challenges. Third, it demonstrates how urban migrants and their rural families collaboratively manage risk through flexible remittance practices, thus enhancing the understanding of risk-sharing in migrant family networks.

The remainder of this paper is organized as follows. Section 2 provides a review of the literature and a contextual background. Section 3 describes our original panel survey and the data collected, while Section 4 develops the empirical strategies (Methods). Section 5 presents the estimation results and the discussion. Section 6 concludes the paper.

2. Literature review and background

Literature review

Remittances and aggregate shocks

This study is most relevant to the literature on remittances between migrant workers and their rural families as a shock-coping strategy against unprecedented aggregate shocks. McKenzie [27] claimed, without providing direct evidence, that internal remittances failed to cope with the aggregate shock of the Mexican peso crisis—both senders and receivers were affected by the shock. Supporting his view on the critical role of international remittances, existing studies indicate that long-distance remittances sent from outside the affected area—mostly international remittances—worked as a shock absorber. For example, remittances from abroad increased following earthquakes in Pakistan and rainfall shocks and cyclones in the Philippines, resulting in improved shock-smoothing [2,31,32]. Moreover, rural households in Vietnam coped with a typhoon through long-distance remittances sent from outside the affected region [18].

The role of remittances in coping with aggregate shocks directly addresses SDG 1.5, which focuses on building resilience against various shocks and disasters, particularly for vulnerable populations. The aforementioned studies [2,18,27,31,32] highlight how remittances can support SDG 1.5 by mitigating the impact of economic, environmental, and social shocks, thus building resilience among poor populations.

To our knowledge, the literature has overlooked the effectiveness of internal remittances during aggregate shocks. This study contributes to the literature by examining how urban migrant workers and their rural families—both impacted by the COVID-19 crisis—jointly used internal remittances to navigate the aggregate shock of the crisis.

Mobile money and shock absorption

Another significant strand of literature explores the role of mobile money in facilitating urban–rural remittances, improving shock absorption, and contributing to sustainable development. The widespread adoption of mobile money services facilitates remittances, which in turn enhances financial inclusion, aligning with SDG 1 (No Poverty) and SDG 9 (Industry, Innovation, and Infrastructure). By providing access to financial services for previously unbanked populations, mobile money contributes to poverty reduction and economic resilience. Previous studies indicate that mobile money remittances help smooth consumption against idiosyncratic shocks such as illness [21] and weather shocks [24]. This consumption-smoothing supports SDG 1 by helping households maintain a basic standard of living during difficult times, preventing them from falling into poverty due to unexpected events.

In addition, studies have examined the effects of mobile money use on various aspects of sustainable development and financial inclusion. Munyegera and Matsumoto [23] and Lee et al. [33] show that rural households increase consumption due to mobile money remittances (supporting SDG1: No Poverty). Other studies demonstrate that the use of mobile money positively affects human capital investment in health (SDG 3) and education (SDG 4) [34–40].

Mobile money transactions increased during the COVID-19 pandemic, highlighting the resilience and adaptability of this financial infrastructure to mitigate economic downturns [41,42]. This resilience aligns with SDG 9's emphasis on building robust infrastructure. Our study enhances the literature by illustrating how mobile money played a critical role during the pandemic, enabling urban migrants to send remittances despite travel restrictions that prohibited hand-carried remittances.

Risk-sharing in migrant family networks

Furthermore, this research enriches the literature on consumption-smoothing among migrant families by examining both their consumption and remittance behaviors. Empirical studies on whether migrant workers receive insurance from rural families have shown mixed results. De Weerdt and Hirvonen [43] found that rural families in Tanzania did not bear the adverse shocks of migrant workers, suggesting unilateral risk-sharing. In contrast, Millán [44] documented bilateral risk-sharing networks where rural-to-urban migrants were insured in Nicaragua. We extend this body of literature by examining bilateral

[3] The cumulative number of confirmed cases exceeded 1.9 million, which is the second-worst in South Asia after India, according to World Meters (https://www.worldometers.info/coronavirus/#countries: last accessed February 2, 2022).

[4] Telephone interviews allow researchers to contact many remote and dispersed populations with a feasible logistical operation [30].

risk-sharing mechanisms, analyzing both urban-to-rural and rural-to-urban remittances as separate variables to capture the nuanced dynamics of support between urban migrant workers and their rural families during the pandemic. This approach reveals how support mechanisms adjusted during the pandemic, including indirect support from rural families through acceptance of reduced remittances.

COVID-19 pandemic context

The following background provides an essential context for our event study, highlighting the timeline of COVID-19 and government measures in Bangladesh. Understanding the pre- and post-lockdown period is crucial for interpreting our results, as the pandemic's impact and the responses from the government, residents, and factories established the environment in which our data was collected and analyzed.

COVID-19 pandemic and containment policies[5]

Shortly after the first case of COVID-19 was confirmed on March 8, 2020, the Bangladesh government closed educational institutions on March 17 and initiated a lockdown on March 26. Originally scheduled to end on April 4, the lockdown was extended multiple times, ultimately lasting until May 30. During this period, the government gradually eased restrictions. In particular, garment factories, Bangladesh's primary industry, resumed operations earlier, on April 27.

During the lockdown, the government restricted public movement, ordering people to stay home except for emergencies. Travel by water, rail, and air routes was banned, and road traffic was suspended. People were not allowed outside between 8 p.m. and 6 a.m. However, due to Bangladesh's high population density, social distancing and travel restrictions were ineffective. COVID-19 cases spread rapidly from Dhaka to the rest of the country [45,46], likely exacerbated by internal migration.[6]

Pandemic influence on the garment sector

The economic downturn in Western countries severely impacted Bangladesh's economy, even before COVID-19 arrived, as Europe and the U.S. account for 80% of its exports [49].[7] Early COVID-19 outbreaks and lockdowns in February 2020[8] caused Bangladesh's exports to fall by 20.1% year-on-year in March, 85.2% in April, and 62.0% in May [53].[9] However, as the Western economy began to recover around May [54], Bangladesh's exports rebounded, with year-on-year declines reduced to 11.1% in June and 2.1% in July, and an increase of 45.3% in August.[10]

Garment workers faced layoffs, furloughs, and partial salary payments due to the decline in global orders since late February 2020 [56,57]. Consequently, some workers returned to their home villages [58], while others blocked roads and highways to demand unpaid wages [59]. In response to these protests, the government announced in April that it would compensate workers in temporarily closed factories with at least 60% of their unpaid wages [60]. On April 27, the government allowed garment factories to resume operations, and workers returned to work [61].

Migrant workers and mobile money

In Bangladesh, many rural people migrate to Dhaka,[11] seeking employment in the garment industry.[12] The garment sector has attracted many migrant workers to Dhaka [62], where more than 80 percent of garment factories are located.[13] The garment industry employs more than 4 million unskilled workers [63],[14] constituting a significant portion of Dhaka's population of 16 million.[15]

The primary mode of remittance was self-carry or hand-carry by friends, as most migrant workers did not have access to bank accounts [64]. However, since the advent of mobile money in 2011, many migrant workers have shifted to this quick, easy, and secure remittance tool [65,66]. The proportion of adults with access to mobile money increased rapidly from 22% in 2013 to 45% in 2017 [66], while only 20% of adults had a bank account [67]. Penetration was rapid because most adults in Bangladesh had mobile phones—87% in 2017 [68].

3. Data

This study analyzes a seven-round panel of migrant workers in the garment sector in Dhaka and their rural families. The data cover two years from October 2018 to August 2020, five rounds before and two rounds during and after the first lockdown (see Table 1). Unlike most studies of shock-smoothing strategies that survey only rural households (for example, De Weerdt and Dercon [17] and Jack and Suri [21]),[16] we interviewed both the migrant workers (we call them the Dhaka households) and their rural families (the village households).[17] This data structure allows us to examine how migrants and their rural families jointly coped with the aggregate shock of the COVID-19 pandemic.

Initially, we started collecting data to assess the impact of remittances on educational investment and children's school performance in 2017 ('EduMatch project')[18] during regular periods without anticipating the COVID-19 pandemic outbreak. We conducted a pre-baseline survey at 13 randomly selected garment factories in Dhaka[19] in 2017–2018. In each factory, we randomly sampled workers and then conducted a short survey (pre-baseline survey) to collect the basic information (e.g., whether they regularly remit money to their

[5] Information about the lockdown was obtained from the following websites: (i) https://tbsnews.net/coronavirus-chronicle/COVID-19-bangladesh/general-holiday-not-extend-further-state-minister-85870; (ii) https://spc.jst.go.jp/experiences/asiaplan/asiaplan_2032.html; (iii) https://tbsnews.net/bangladesh/education/govt-orders-closure-all-educational-institutions-march-17-56947; (iv) https://www.business-humanrights.org/en/latest-news/bangladesh-500-garment-factories-reopen-amid-COVID-19-risks/; (v) https://www.aa.com.tr/en/asia-pacific/bangladesh-imposes-new-restrictions-on-public-movement/1828684

[6] Although anecdotal evidence suggests that internal migration played a role in spreading the virus, scientific evidence is mixed [47,48].

[7] The garment industry contributes over 80 percent of the exports [50].

[8] The United States declared a public health emergency on February 3, 2020 [51], and the first COVID-19 lockdown in Europe was implemented in Italy on February 21, 2020 [52].

[9] Italy ended its national lockdown in May 2020 [54], while the United Kingdom also began easing its lockdown in May [55].

[10] A table of the export values is given in Appendix A.

[11] Almost half of the internal migrants in Bangladesh are rural–urban migrants. See https://www.bpb.de/gesellschaft/migration/laenderprofile/english-version-country-profiles/216108/urbanization-migration-systems-within-bangladesh-and-translocal-social-spaces,

[12] The garment exports are the largest national exports, contributing 11% to GDP.

[13] https://map.rmg.org.bd/

[14] https://www.dhakatribune.com/business/2021/11/29/bangladesh-is-a-greenfield-for-investment-in-apparel-sector

[15] https://worldpopulationreview.com/world-cities/dhaka-population

[16] A few exceptions include De Weerdt and Hirvonen [43] and Millán [44]—as mentioned in the introduction. In addition, a mobile money study [33] conducts interviews with both migrant and village households, although the study does not focus on shock-smoothing.

[17] More specifically, the village households are the households in rural areas to which the migrant workers most frequently send remittances.

[18] The project was registered with EGAP (https://osf.io/5pf6b/) before analysis. In addition, details of the project, including the eligibility criteria, sampling procedures, and surveys, are provided in Appendix B.

[19] Specifically, we selected Gazipur, the largest garment factory cluster zone (according to the Bangladesh Garment Manufacturers and Exporters Association: https://www.bgmea.com.bd/page/member-search), as the field for our project.

Table 1
Overview of EduMatch survey.

		Pre-baseline survey	Baseline survey Round 1	Follow-up Round 2	Follow-up Round 3	Follow-up Round 4	Follow-up Round 5	Follow-up Round 6	Follow-up Round 7
	Interview Periods	12/12/2017 ~8/10/2018	10/21/2018 ~11/30	4/19/2019 ~6/28	7/7/2019 ~8/20	9/13/2019 ~10/26	12/5/2019 ~1/1/2020	3/20/2020 ~5/16	7/20/2020 ~8/30
Dhaka	Notes on HHs interviewed on different dates		40 HHs interviewed on 1/5/2019 ~4/17		One HH interviewed on 9/19/2019		Ten HHs interviewed on 1/22/2020 ~1/30		
	# of HHs (excluding those returned to villages)	6318	723	545	686	661	622	595	546
Village	Notes on HHs interviewed on different dates		40 HHs interviewed on 1/3/2019 ~6/24		Four HHs interviewed on 9/22/2019 ~9/30	Four HHs interviewed on 11/9/2019 ~11/20	33 HHs interviewed on 1/22/2020 ~1/30		
	# of HHs		672	533	692	632	660	628	643

Note: The attrition rate for the Round 2 survey is relatively high because it was the first telephone survey. We have improved the survey administration process in subsequent rounds.

rural families). A total of 6318 randomly selected workers were interviewed. This sampling procedure ensures that the sample workers are representative of the garment workers in the 13 factories.

According to the pre-baseline survey,[20] most of the sample workers were permanent migrant workers from rural villages.[21] 87% of the sample workers regularly sent remittances to rural families; 61% financed child's education in the village households; 69% used mobile money.

Later, we attempted to conduct telephone interviews with 1715 migrant workers of the 6318 workers sampled. These were those who (i) regularly sent remittances to village households and (ii) financed the education of children of certain school ages in village households.[22] As a result, 740 migrant families agreed to participate in our survey.

Fig. 1 describes the sampling procedures. We conducted face-to-face interviews in the (pre-)baseline surveys and telephone interviews in the follow-up surveys with the Dhaka households. On the other hand, we conducted telephone interviews with the village households. The locations of the garment factories and the village households are presented in Fig. 2.

Our analysis sample consists of 723 pairs of the Dhaka households and their corresponding village households,[23] interviewed at least once before the COVID-19 pandemic (see Table 1 for the survey dates). The lockdown began on March 26, 2020, during the Round 6 survey, and ended on May 30 during the Round 7 survey. The timing and frequency of interviews are shown graphically in Fig. 3. In the figure, the vertical blue lines separate the bins used in our event study.

In the panel survey, sample attrition occurred at different times due to loss of telephone connections or relocation of households from rural to urban areas.[24] We have 112 attriting cases and attempt to address possible attrition bias using several methods described in the next section. In contrast, there are 611 non-attriting cases in which we successfully collected information from the Dhaka households and their corresponding village households before and after the COVID-19 lockdown.

Tables 2 and 3 present the baseline characteristics of the Dhaka and village households.[25] In the tables, the characteristics are presented separately according to the attrition status of the Dhaka households. Column (1) presents the non-attriting sample of Dhaka households (Group 1 in Fig. 1), and Column (2) the attriting sample of Dhaka households (Groups 2, 3, and 4 in Fig. 1). In Table 2, the Dhaka workers in the non-attriting sample are on average 29 years old; 57% are male; 77% are married; 65% are household heads (Column 1). These households have two members, earn more than 15,000 Taka (or 188 USD) per month,[26] consume more than 10,000 Taka per month, and remit 3000 Taka per month.[27] Only 0.3% of them received remittances from village households in the 30 days before baseline.[28] Note that about 80% of them used mobile money in October 2018, while almost 100% used mobile money a year later, just before the COVID-19 pandemic. Dhaka workers in the attriting sample (Column 2 in Table 2) are significantly younger, more likely to be female, and less likely to be married than the Dhaka workers in the non-attriting sample. They also have fewer household members and consume less than the non-attriting sample.

In Table 3, the baseline characteristics of the village households are similar between the non-attriting and attriting samples. The heads of village households are on average 54 years old; 72% are male; 82% are married. On average, the village households have 4.6 members and spend 12,000 Taka per month. Notably, about 86% of the village households were using mobile money at baseline, while almost 100% were using it one year later. About 70% of the village household heads are parents or siblings of the migrant workers. Meanwhile, 20% are the parents-in-law or siblings-in-law of the migrant workers, which means

[20] Descriptive statistics of the pre-baseline survey are shown in Appendix J.

[21] The workers in our sample stay in Dhaka for a long time. For example, one year after the baseline survey—just before the COVID-19 outbreak, 92% of the workers were still in Dhaka, according to the Round 5 survey. In addition, 76% of the workers had worked in the garment industry for three or more years.

[22] These are the eligibility criteria for our original project, EduMatch, detailed in Appendix B.

[23] We interviewed 740 families in the baseline survey. For 17 families, we were only able to contact either the migrant workers or the village households until the Round 5 survey. We exclude these families from the analysis because we want to examine the shock-coping behavior of migrants and village households simultaneously.

[24] Appendix C explains attrition in detail.

[25] If a household did not respond to the Round 1 survey but did respond to subsequent surveys, the values reported in the subsequent surveys are used instead.

[26] 1 USD = 81.7 Taka in PPP in January 2019.

[27] Our remittance data are self-reported. To reduce report errors, when respondents reported sending mobile money remittances, we asked them to check their remittance records stored in their mobile phones. In addition, if there were large discrepancies between the responses of the Dhaka workers and their village families, we called them and double-checked.

[28] Baseline information for key outcome variables not shown in Tables 2 and 3, including remittances from village to Dhaka households, is presented separately in Appendix D.

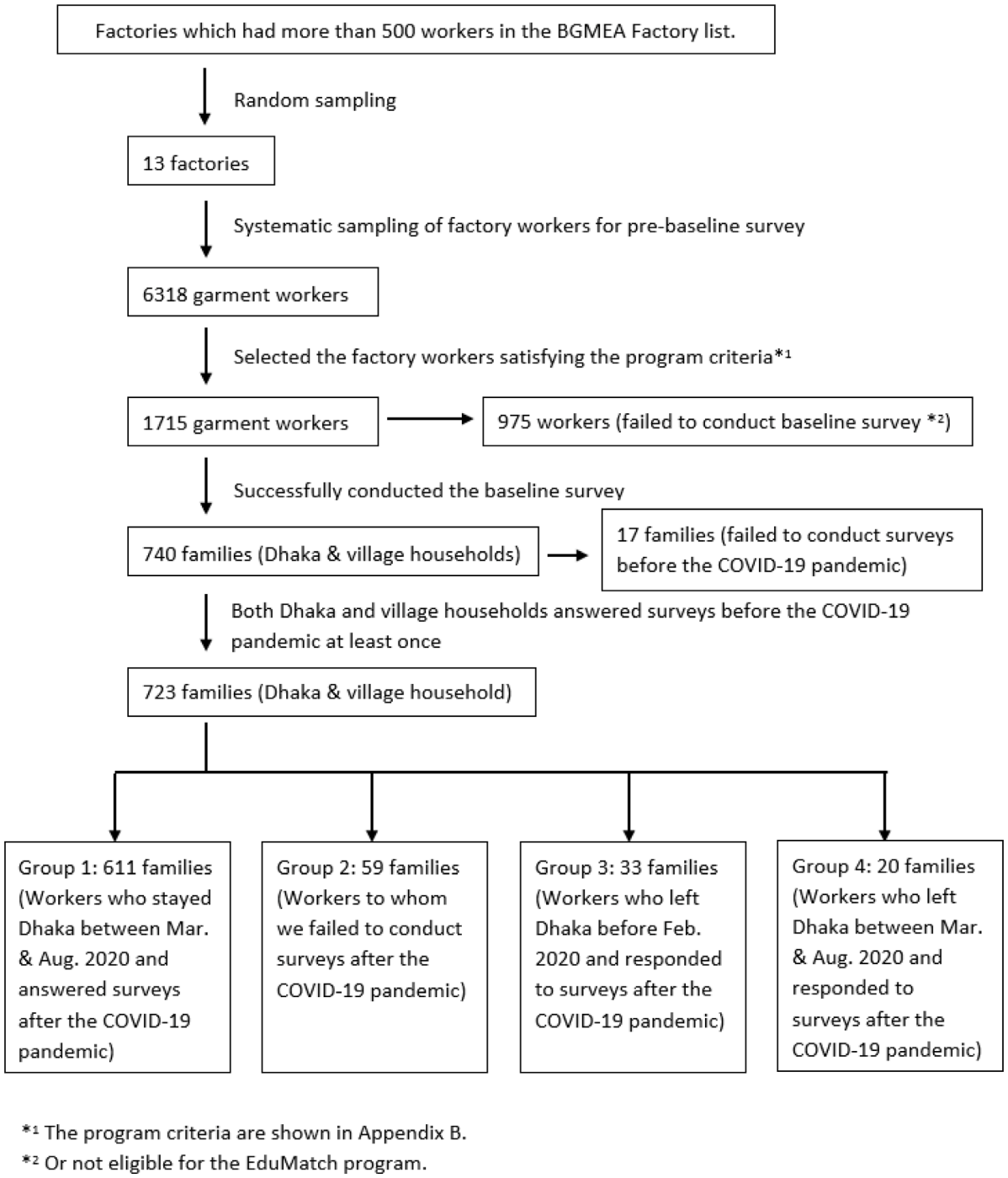


Fig. 1. Sampling and contacting respondents before and after the COVID-19 pandemic.

that some workers regularly send remittances to support their spouses' families.

Some baseline characteristics of the non-attriting and attriting samples are statistically different in their means, as shown in Column 3 of Tables 2 and 3. As a result, we observe the jointly significant differences in the full list of the baseline characteristics between the attriting and non-attriting samples, which is reflected in the significant F-value shown at the bottom of Table 3—based on the attrition status of the Dhaka households.[29] Similarly, using the attrition status of the village households, we conducted another joint significance test on the baseline characteristics and found a significant difference.[30] Therefore, we need to address possible attrition bias and use the inverse probability weighting approach that incorporates these baseline characteristics, as explained in the following Sections 4 and 5.

[29] The joint significance test is conducted by using the full set of the baseline characteristics for both the Dhaka households and the village households. The full list of the baseline characteristics is presented in Table A2 in Appendix C.

[30] A table of baseline characteristics by the attrition status of the village households, including the joint-test result, is presented in Table A3 in Appendix C.

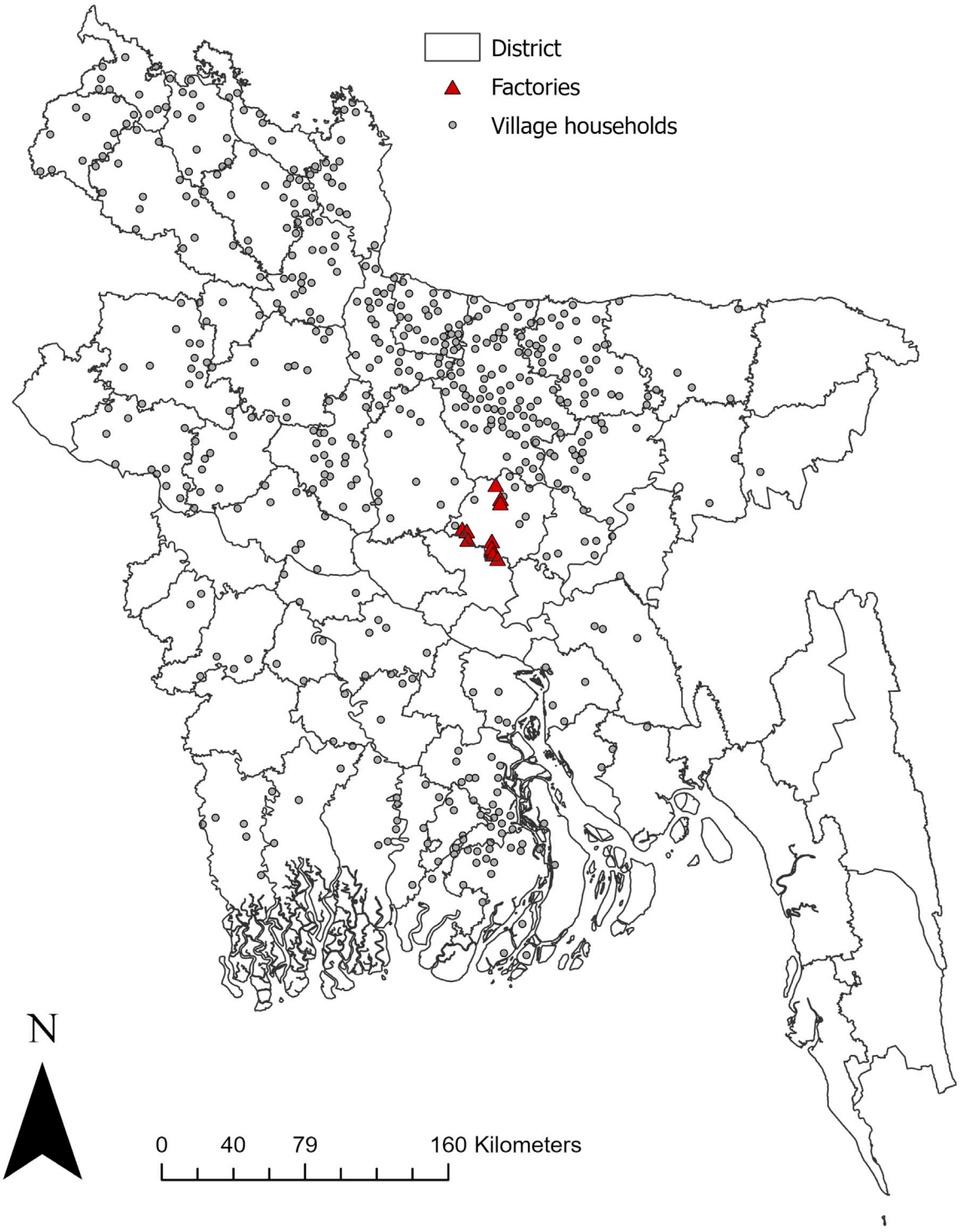


Fig. 2. Location of factories and village households
Notes: Location information is derived from the Round 7 survey. 98% of the village households had lived in the same district since the baseline survey.

4. Methods

We analyze how the sample households responded to the COVID-19 pandemic and containment policies by estimating the following equation:

$$Y_{hbt} = \sum_{k=-3}^{k=3} \beta_k E_k + \mu_h + \gamma_b + \omega_t + \epsilon_{hbt} \quad (1)$$

where y_i represents the outcome variables of the Dhaka household (or village household) h in the bi-monthly season b in year t, E_k the event study dummy variables corresponding to the bins in Fig. 3, indicate time windows before or after the start date of the lockdown (i.e., March 26, 2020). More specifically, E_{-3} to E_3 correspond to each of the following periods; [−542, −211], [−150, −91], [−90, −31], [−30, +30], [+31, +90], [+91, +150], [+151, +158], where two numbers in brackets indicate the first and the last day of the window period E_k counted backward or forward from March 26, 2020. We set the period [−210, −151] (i.e., August 28 to October 26, 2019) as the

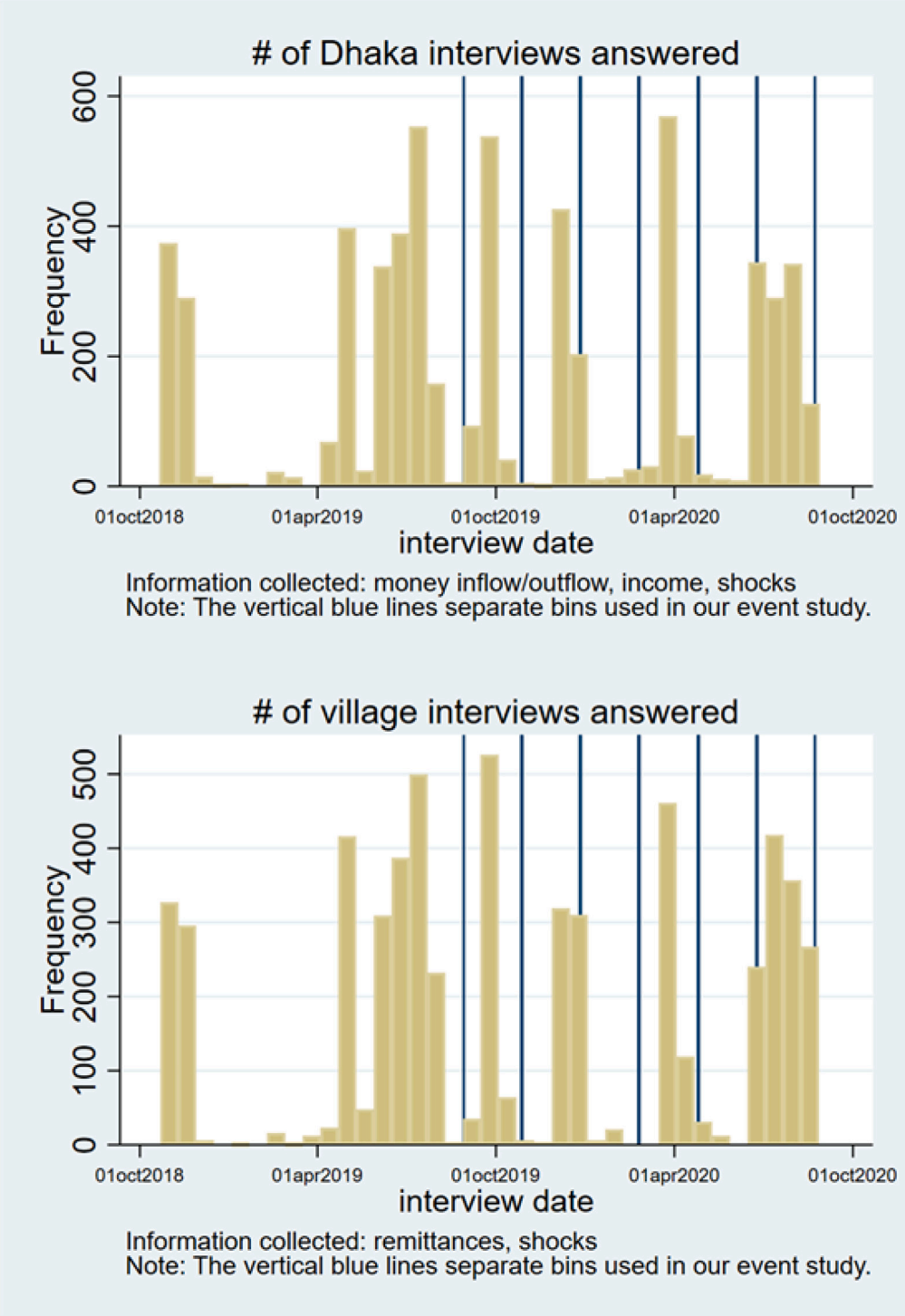


Fig. 3. Histogram of the number of interviews (with Dhaka respondents and village respondents) by interview dates
Notes: (1) March 26th, 2020 was the date of implementation of the lockdown in Bangladesh. (2) Bins for the event study are separated by vertical blue lines.

reference period.[31][32] We define the event dummy E_0 to represent [−30, +30] instead of [0, +60] because the decline in the garment export demand due to the COVID-19 pandemic started before the beginning of the lockdown.[33] Note that in this specification, the coefficient on E_0 captures the difference in the outcome variables of the Dhaka households (or village households) in the period of 30 days before

[31] Note that most of the outcome variables capture activity over the past 30 days from the interview dates. For example, a figure reported at an interview on March 26, 2020, is equal to the activity of [−30, 0] days relative to the lockdown implementation.

[32] The Round 4 survey (the timing of which can be found in Table 1) covers the reference period. The bins for the event dummies are plotted in Fig. 3.

[33] To examine the robustness of this approach, we also use an alternative definition of the event dummies and divide the period [−30, +30] into two subperiods: [−30, −1] and [0, +30]. The results presented in Appendix E support our argument (discussed in Section 5).

Table 2
Baseline characteristics of Dhaka households by Dhaka household attrition status.

Variable	N	(1) The non-attriting sample Mean/SD	N	(2) The attriting sample Mean/SD	Diff in mean (1)-(2)
Dhaka households					
Age of the Dhaka worker	611	28.856	112	26.652	2.204***
		[6.689]		[6.336]	
1 if the Dhaka worker is male	611	0.565	112	0.429	0.136***
		[0.496]		[0.497]	
1 if the Dhaka worker is married	611	0.768	112	0.634	0.134***
		[0.423]		[0.484]	
1 if the Dhaka worker is household head	611	0.655	112	0.580	0.074
		[0.476]		[0.496]	
# of household members in Dhaka	611	2.013	112	1.830	0.183*
		[0.956]		[0.815]	
1 if using mobile money	611	0.823	112	0.821	0.002
		[0.382]		[0.385]	
Household income of last 30 days (Taka)	611	15 484.710	112	15 532.634	−47.924
		[5748.215]		[6519.007]	
Consumption of last 30 days (Taka)	611	10 340.616	112	9617.301	723.315*
		[3721.261]		[3517.172]	
Amount of remittances sent to village HH (last 30 days) (Taka)	611	3064.746	112	3205.357	−140.611
		[2707.509]		[2591.178]	

Notes: (1) The values displayed for t-tests are the differences in the means across the groups. Significance level: ***p < 0.01; **p < 0.05; *p < 0.1. (2) Taka is the currency of Bangladesh. As of December 21st, 2020, 1 USD is 85 Taka.

and after the implementation of the lockdown compared to those in the reference period. The household fixed effect is denoted by μ_h; γ_b denotes the bi-monthly season effect, ω_t the year effect, and ϵ_{hbt} the random error term.[34]

We employ the inverse probability weighting (IPW) method to address bias due to non-random attrition [69]. Specifically, we run probit regressions of non-attrition of the Dhaka and village households, respectively. Using the inverse of the predicted probability of non-attrition of the Dhaka and village households as the weight, we estimate the regression Eq. (1) for the outcome variables of the Dhaka and village households, respectively.[35]

In the Dhaka household regressions, standard errors are clustered at the household level, and there are about 700 clusters. In the village household regressions, standard errors are clustered at the Upazila level, the smallest administrative unit, and there are about 230 Upazila clusters.[36]

This event study makes before–after comparisons while controlling for seasonality and household-specific unobserved time-invariant factors. In addition, we test for validity by examining the pre-trend. For example, a significant coefficient β_{-1} implies that the regression does not fully control for confounding factors. Thus, while we do not claim to make causal inferences, we do attempt to make rigorous before–after comparisons.

5. Results and discussion

We use the event study to describe the COVID-19 pandemic shock on the various economic activities of the Dhaka and village households. In particular, we are interested in the changing trend of their remittances and consumption before and after the lockdown policy. The estimated coefficients of the event dummies with 95% confidence intervals are presented in the following figures (See Appendix D for descriptive statistics of all outcome variables).

COVID-19 shock to income

Fig. 4 presents the event study estimates of the income of the Dhaka households. We do not observe a significant pre-trend, which supports the event study analysis. One might be surprised to see that there was no significant change in income in the [−30, +30] period, which covers 30 days before and 30 days after the start of the lockdown. However, the salary was paid monthly and reflected their work during the month prior to the lockdown.[37] As a result, the Dhaka households experienced a substantial drop in income of about 3000 Taka, or 20% of monthly income, in the [+31, +90] period. Thereafter, their income recovered to the pre-shock level in the [+91, +150] period. These results are consistent with the fact that the lockdown lasted for two months and the garment factories were closed for about 30 days.

[34] As the baseline survey started in October 2018, we define the year dummy as taking one from October 2019 to September 2020 and zero from October 2018 to September 2019.

[35] See Appendix F for the estimation results of the first-stage probit regressions.

[36] Clustering standard errors at the household level for the village-side regressions—a robustness check—produces results similar to our main results (shown in Appendix L).

[37] Anecdotal evidence collected from garment workers indicates that although garment factories were affected by the economic downturn in the US and Europe, factory production did not decrease dramatically in March 2020. This is because garment factories increased production before the start of the lockdown (March 26, 2020) to cover the production that was scheduled during the lockdown. In fact, we confirmed from the Dhaka household data that the garment workers' March salaries (which were to be paid in April) did not decrease significantly.

Table 3
Baseline characteristics of village households by Dhaka household attrition status.

Variable	N	(1) The non-attriting sample Mean/SD	N	(2) The attriting sample Mean/SD	Diff in mean (1)-(2)
Village households					
Age of HH head	611	54.227	112	54.545	−0.317
		[13.304]		[11.532]	
1 if HH head is male	611	0.728	112	0.723	0.005
		[0.445]		[0.449]	
1 if HH head is married	611	0.828	112	0.813	0.016
		[0.378]		[0.392]	
HH head: wife/husband/son/daughter of the Dhaka worker (=1)	611	0.074	112	0.045	0.029
		[0.261]		[0.207]	
HH head: father/mother/brother/sister/ grandfa/grandmo of the Dhaka worker (=1)	611	0.710	112	0.723	−0.013
		[0.454]		[0.449]	
HH head: (In law) father/mother/ brother/sister of the Dhaka worker (=1)	611	0.187	112	0.214	−0.028
		[0.390]		[0.412]	
# of household members	611	4.597	112	4.563	0.035
		[1.611]		[1.626]	
1 if using mobile money	611	0.866	112	0.821	0.044
		[0.341]		[0.385]	
Total value of assets per HH member (Taka)	611	3857.787	112	3888.132	−30.345
		[4971.054]		[4570.210]	
Total value of productive assets per HH member (Taka)	611	4921.773	112	4489.689	432.084
		[8212.589]		[6072.310]	
Consumption of last 30 days (Taka)	611	12 525.885	112	12 134.615	391.270
		[6322.756]		[5006.142]	
F-test of joint significance (F-stat)					1.496**
F-test, number of observations					723

Notes: (1) The values displayed for t-tests are the differences in the means between the groups. The values displayed for F-test are the F-statistic of the joint significance test for 49 baseline characteristics between the groups in Tables 2 and 3. Those include not only characteristics shown in the tables but also the unreported observables (all the characteristics found in Table A2). Significance level: ***p < 0.01; **p < 0.05; *p < 0.1. (2) Taka is the currency of Bangladesh. As of December 21st, 2020, 1 USD is 85 Taka.

COVID-19 shock to remittances

Fig. 5 presents the event study estimates of remittance sent by the Dhaka households to the village households in the 30 days prior to the interview date. We show two aspects of the remittances: the amount of remittances (Panel a)[38] and a binary indicator of whether the Dhaka households sent remittances to the village households (Panel b), both based on the village household surveys. The amount of remittances decreased significantly by 2000 Taka in the [+31, +90] period when the migrants' income decreased by 3000 Taka. The likelihood of the village households receiving remittances also decreased, but not significantly, in the same period. The amount of remittances and the likelihood of receiving remittances recovered to the pre-shock levels in the [+91, +150] period.

Fig. 6 presents the event study estimates of the amount of remittances the village households sent to the Dhaka households during the 30 days prior to the interview date (Panel a), and a binary indicator of whether the village households sent the remittances to the Dhaka households (Panel b). We find no significant change in either the amount or likelihood of remittances from village households in response to the pandemic.[39] For context, remittances from rural to urban areas were rare, with only 0.3% of Dhaka households reporting receiving remittances from village households during the 30 days prior to the baseline survey (Table A4).[40]

These results reveal a nuanced picture in which migrant workers reduced their remittances to village households during the pandemic, while remittances from village households to urban migrants remained low. Despite previous evidence suggesting that rural households occasionally assist urban migrants in response to idiosyncratic shocks [70], our analysis found no increase in rural-to-urban remittances in response to the COVID-19 shock. Instead, rural households accepted a decrease in regular remittances from urban migrants. This reduction in urban-to-rural remittances can be interpreted as indirect rural-to-urban aid, as it effectively affects the net flow of remittances in the same way as an increase in rural-to-urban transfers. Additionally, this remittance pattern implies that the negative economic impact was more severe for urban migrant workers, a finding consistent with previous studies on the differential impact of the pandemic [28,29,71].

[38] The amount includes zero, which means no remittances.

[39] Since there is a marginally significant pre-trend in the amount of remittances in the [−150, −91] period, the estimates may not reflect only the pandemic effect. Nevertheless, we demonstrate the robustness of the results by testing both the amount and the likelihood of remittances.

[40] While rural-to-urban remittances are uncommon, they are not entirely non-existent. Previous analysis of this data set in Egami [70], which examined responses to idiosyncratic shocks such as job loss experienced by urban migrants, found that rural households occasionally send remittances to urban migrants in times of specific individual need. Yet, these transfers are less frequent compared to more regular urban-to-rural remittances.

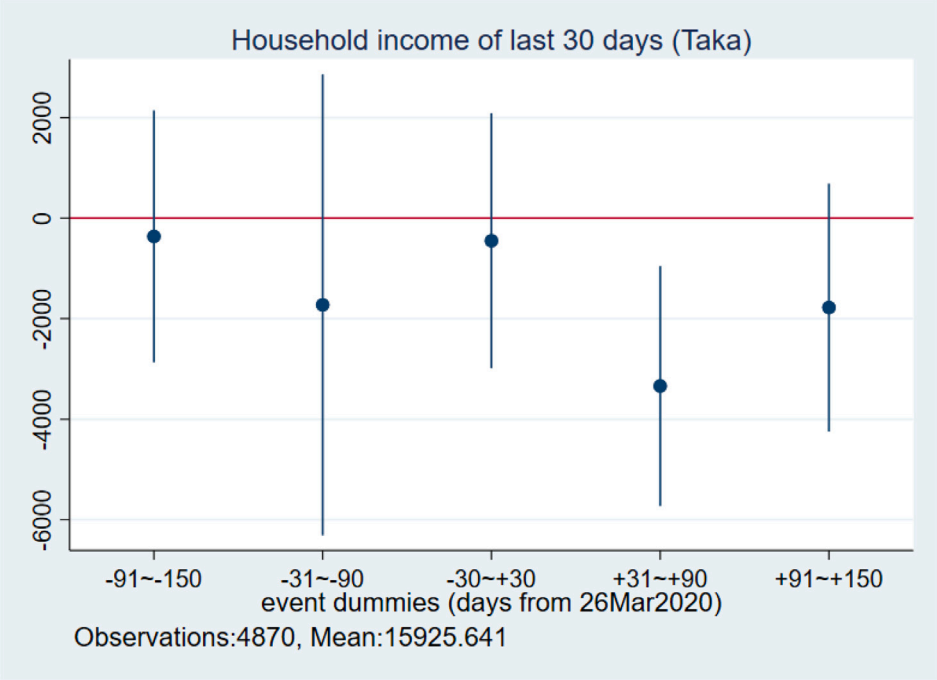
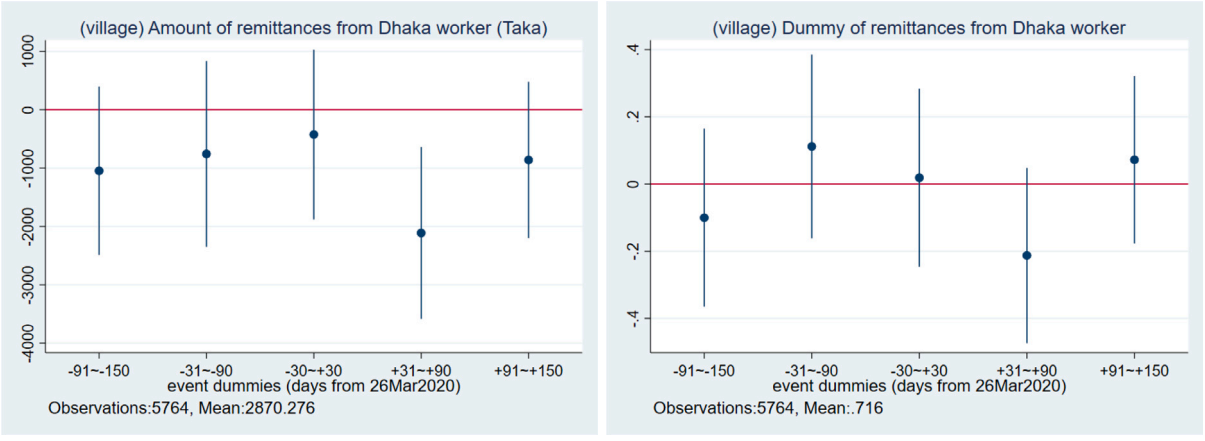


Fig. 4. COVID-19 shock to income
Notes: (1) Standard errors are clustered at household-level. (2) Together with 95% confidence intervals, the figure reports the dynamic coefficients obtained from the specification of Eq. (1) in the main text.



(a) Amount of remittances (Taka) **(b)** Dummy of remittances

Fig. 5. Cut of remittances sent from Dhaka workers to village households in response to COVID-19 lockdown
Notes: (1) Standard errors are clustered at Upazila-level. (2) Together with 95% confidence intervals, the figures report the dynamic coefficients obtained from the specification of Eq. (1) in the main text. (3) The measures of remittances in the figures are those answered by the village households.

COVID-19 shock to asset sales

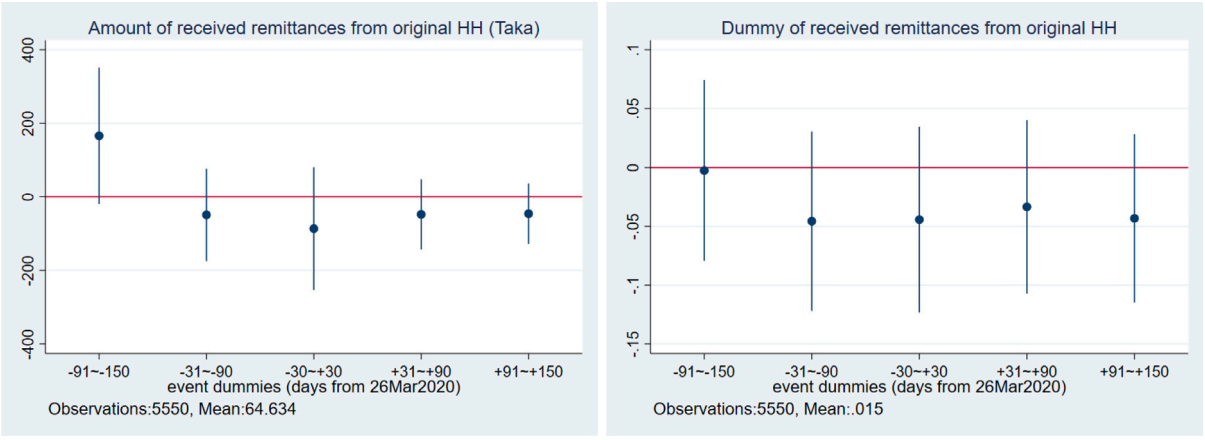
Following Fafchamps and Lund [72], we examine whether the Dhaka or village households sold assets to cope with the COVID-19 shock (figures shown in Appendix G).[41] The value of assets held by both the Dhaka and village households did not change significantly, suggesting no asset sales in response to the COVID-19 shock.

COVID-19 shock to consumption

Fig. 7 presents the result of the event study on the consumption of Dhaka and village households.[42] The consumption of the Dhaka households decreased by about 2000 Taka in [−30, +30] and more substantially by 4000 Taka in [+31, +90] when they experienced a sharp decline in income. The consumption of the village households decreased by about 5000 Taka in [−30, +30] and [+31, +90].[43]

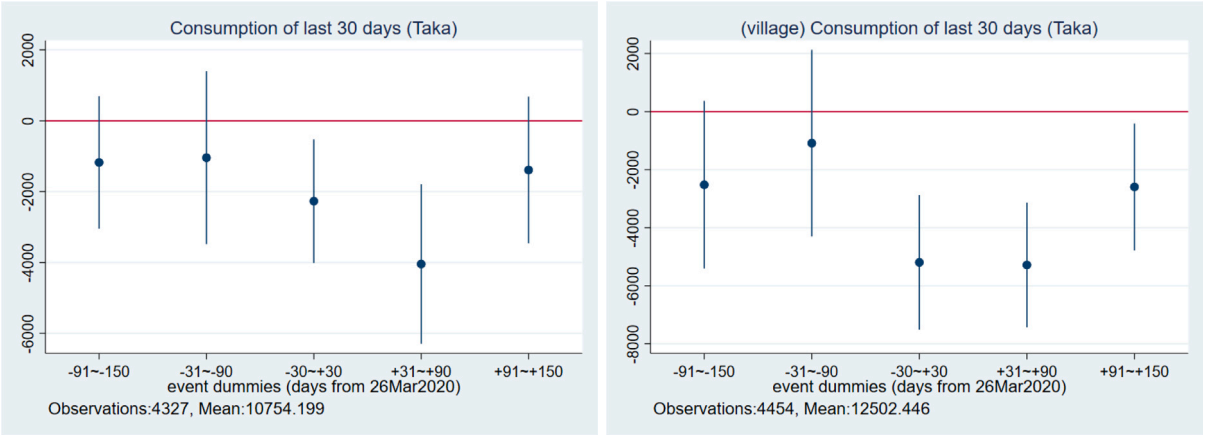
[41] Asset values are calculated based on self-reports. We asked the following questions along with the list of asset items: (i) Does your household have these assets now? (ii) Report the current value (=if you sell the asset today, how much would you receive?) in Taka.

[42] We use household-level consumption, which is not divided by the number of household members. This is useful for comparing with other household-level variables, such as remittances and other kinds of money inflows and outflows. As a robustness check, we examine per-capita consumption, and our findings do not change qualitatively (Appendix H).



(a) Amount of remittances (Taka) (b) Dummy of remittances

Fig. 6. No remittances sent from village households to Dhaka workers in response to COVID-19 shock
Notes: (1) Standard errors are clustered at household-level. (2) Together with 95% confidence intervals, the figures report the dynamic coefficients obtained from the specification of Eq. (1) in the main text. (3) The Dhaka households answered remittances. (4) Only 0.3% of Dhaka households reported receiving remittances from village households at baseline (Table A4).



(a) Dhaka household consumption (Taka) (b) Village household consumption (Taka)

Fig. 7. COVID-19 shock to consumption of Dhaka households and village households
Notes: (1) For panel (a), standard errors are clustered at household-level. For panel (b), standard errors are clustered at Upazila-level. (2) Together with 95% confidence intervals, the figures report the dynamic coefficients obtained from the specification of Eq. (1) in the main text. (3) We collected household consumption for the last 30 days of each interview.

To disentangle the effect of the early economic downturn during the post-COVID-19 outbreak but pre-lockdown period from the effect of the lockdown implementation, we conduct a similar event study using an alternative definition of the event dummies ((Appendix E). We divide E_0, which represents [−30, +30], into two subperiods, [−30, −1] and [0, +30], which allows us to differentiate the effect of the early economic downturn and the lockdown. We find that both the Dhaka and village households reduced consumption more substantially after the lockdown (i.e., the [0, +30] period). This is consistent with our expectations and thus serves as another robustness check.

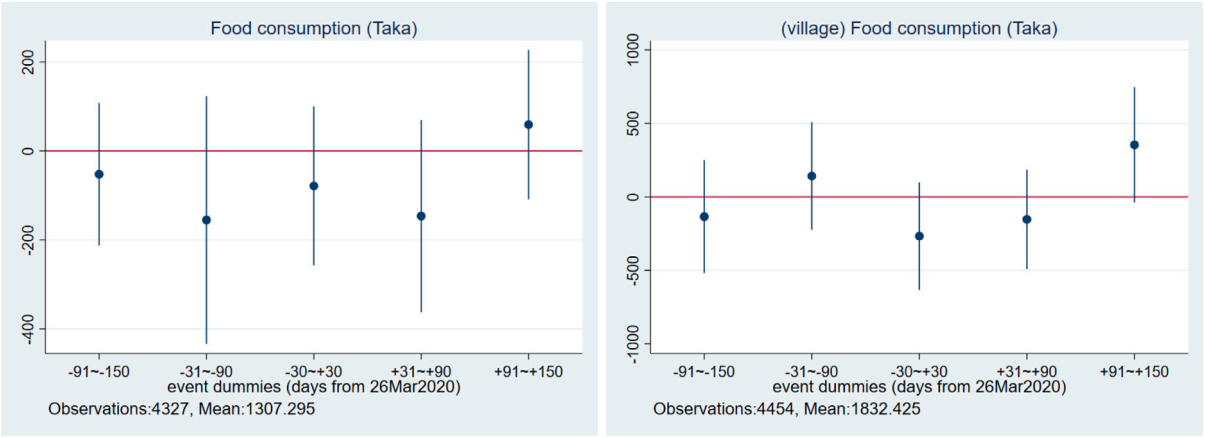
In Fig. 7, it may seem puzzling that while the income of the Dhaka households did not change during the [−30, +30] period, their consumption decreased substantially during the same period.[44][45] However, with foreign buyers canceling a number of orders from the garment factories, it is likely that the migrant workers anticipated the future drop in income and saved cash or stocked up on food and daily necessities by reducing consumption. Although our data do not allow us to directly confirm these possibilities, we find suggestive evidence that the savings of Dhaka households increased by 25% during the [−30, 30] period.[46]

[43] For the pre-COVID-19 periods, it can be seen that the point estimates are already negative, though they are not statistically significant. This implies that the magnitude of the reduction in consumption after the COVID-19 shock is likely to be overestimated.

[44] The village households also reduced consumption after the lockdown period (i.e., [0, 30]), as shown in the figure in Appendix E, when their income declined. They may also have reduced consumption and stocked up on food or other necessities in advance.

[45] Similarly, the decline in consumer spending in the advanced economies preceded the imposition of lockdowns [73].

[46] We run a simple regression of savings controlling for household fixed effects and make a before–after comparison—without controlling for the seasonal dummies and without testing for the pre-trend. The estimation results are reported in Appendix I. Because we collected data on savings less frequently than data on other variables, we cannot run the same regression used in our main analyses.



(a) Dhaka food consumption (Taka) **(b)** Village food consumption (Taka)

Fig. 8. Fully smoothed food consumption of Dhaka households and village households
Notes: (1) For panel (a), standard errors are clustered at household-level. For panel (b), standard errors are clustered at Upazila-level. (2) Together with 95% confidence intervals, the figures report the dynamic coefficients obtained from the specification of Eq. (1) in the main text. (3) We collected the food consumption for the last seven days of each interview.

Overall, the event study results in Fig. 7 suggest that the Dhaka and village households collectively tried to mitigate the COVID-19 shock. Indeed, when we restrict the analysis to food consumption, presented in Fig. 8, we find that food consumption was fully smoothed against the COVID-19 shock in both Dhaka and village households. This finding is consistent with the literature such as McKenzie [74], which shows that smoothing food consumption by reducing other expenditures is an important strategy for coping with aggregate shocks.

The event study results for total consumption presented in Fig. 7 have another important implication. The average total consumption in the reference period was 10,228 Taka for the Dhaka households and 12,465 Taka for their village households. Due to the pandemic, the consumption of Dhaka households decreased by 39% (about 4000 Taka), and the consumption of the village households decreased by 40% (about 5000 Taka). Recall that the urban–rural remittances decreased by 2000 Taka. If there had been no drops in remittances, consumption would have fallen by 59% (about 6000 Taka) for the Dhaka households and by only 24% (3000 Taka) for the village households. Thus, these results suggest that risk-sharing within the family network was effective in coping with the aggregate shock.[47]

Although establishing causality is difficult, we can strengthen our argument by examining the correlation between the decline in remittances from the Dhaka households and the decline in consumption of the village households. To do this, we use a machine learning algorithm called causal forest developed by Wager and Athey [75] to predict the impact of the COVID-19 shock on each household in the [+31, 90] period.[48] Our first step is to estimate the conditional average treatment effects (CATEs) of the remittances from Dhaka in the [+31, 90] period (recall that this is the event dummy of our interest estimated in panel (a) of Fig. 5) and the CATEs of village households' consumption in the same period. We then examine the association between the CATEs of the remittances from Dhaka and the CATEs of the consumption of the village households.

Panel a of Fig. 9 shows a positive correlation between remittances from Dhaka and village households consumption during the [+31, 90] period. Village households that received lower remittances experienced lower consumption during the COVID-19 period, in contrast to no strong correlation during the pre-COVID-19 period (i.e., [−90, −31]), as shown in Panel b. The relationship between remittances and consumption is ambiguous in the absence of significant shocks.[49] These results support our contention that migrant workers and village households share resources to overcome the aggregate shock.

While the income of the Dhaka households fell by 3000 Taka (Fig. 4), they reduced consumption by 4000 Taka (Fig. 7) and remittances by 2000 Taka (Fig. 5) in the [+31, 90] period. Thus, the reduction in expenditures exceeded the reduction in income. This finding suggests the possibility of precautionary saving, as discussed above. However, it may also be due to changing trends in other financial flows. Therefore, in the next section, we will examine other money flows.

COVID-19 shock to borrowing and loaning behavior

To provide a more comprehensive picture of the response of the Dhaka households to the COVID-19 shock, we examine the change in their borrowing and loaning behavior. Fig. 10 presents the event study results for borrowing money from friends and neighbors[50] and borrowing money from institutions such as shops and microfinance institutions, which we call 'loaning.'[51] The pandemic and the lockdown affected everyone and probably made it more difficult for the Dhaka households to borrow money from others. In fact, the amount and the

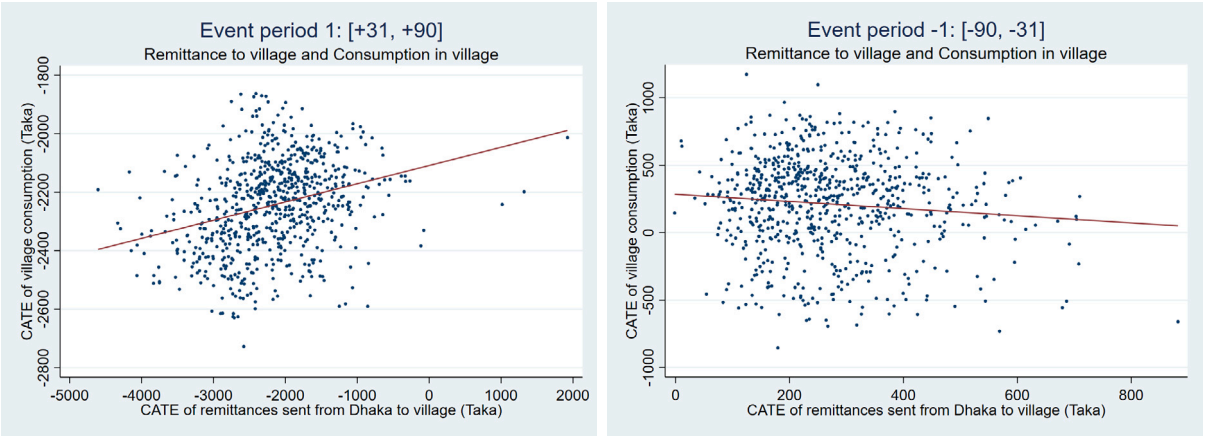
[47] The hypothetical case of 'no remittance cuts' should not be taken as a counterfactual but rather an extreme case. For example, in the absence of remittance cuts, migrant workers may have used loans or other means to avoid further reductions in consumption. The hypothetical case of 'no remittance cuts' assumes that the migrant workers did not use such alternative shock coping strategies.

[48] The method used in recent studies (i.e., [76,77]) facilitates the estimation of the treatment effect on each individual. Initially, causal forest were used with experimental data, but recent developments have extended their application to observational data. Specifically, we employ causal forest with orthogonalization, which is designed for application to observational data [78, 79]. While we do not claim that our estimates of event dummies during the COVID-19 pandemic establish causality, the machine learning technique remains useful for predicting conditional estimates of event dummies for each household. For more information on our machine learning design choices, see Appendix M.

[49] While remittances tend to increase consumption, impoverished households with lower consumption levels are likely to receive a larger amounts of remittances. This selection mechanism may mask the expected positive correlation between remittance amounts and consumption in the absence of shocks.

[50] This includes money borrowed with interest. Also, repaid money is included in 'borrowing.'

[51] Pawning, use of rent arrears, and other informal credit schemes such as ROSCA are also included.



(a) During COVID-19 lockdown (b) Pre-COVID-19 period

Fig. 9. Correlation between the decline in remittances from Dhaka households and the reduction in village consumption
Notes: CATE, Conditional Average Treatment Effect. Consumption and remittances for the last 30 days of each interview were used.

likelihood of borrowing money decreased after the lockdown (Panels a and b),[52] while loaning from shops and microfinance institutions did not change (Panels c and d). This restriction on borrowing from friends and neighbors may be another key to explaining the decline in consumption among the Dhaka households during the pandemic.

Mode of remittances during the COVID-19 lockdown

Finally, we examine the mode of remittances during the lockdown. Before the pandemic, the Dhaka workers brought money by themselves or asked someone to do so for 21% of the remittances, while they sent 77% through mobile money. However, the COVID-19 pandemic and containment policy prevented the Dhaka workers from physically bringing money. Fig. 11 presents the event study results on the amount and the likelihood of remittances from the migrant workers to the village households by mode.[53] Both the amount and the likelihood of hand-carry remittances declined significantly during the pandemic (Panels c and d). In contrast, mobile money remittances did not change significantly (Panels a and b), suggesting that the mobile money services enabled the Dhaka households to remit to the village households under travel restrictions.

Robustness checks

We have demonstrated the robustness of our main results using alternative event dummies (Appendix E), alternative standard errors (Appendix L), and alternative outcome variables (Appendix H). In this subsection, we examine further robustness using alternative inverse probability weights.

In this paper, we examined the welfare implications of the remittance behavior of 723 migrant workers selected from the 6318 garment workers. One might be concerned about sample selection due to the eligibility requirements of the EduMatch program and sample attrition. To address these concerns, in Appendix K we present alternative estimates of the inverse probability weighting approach using alternative weights based on the initial sample of 5460 randomly selected migrant workers in the garment sector.[54] The estimation results (Figure A4) are similar to those of our main analysis (Fig. 7). Thus, our main estimation results are robust to the sample selection process.

Connections to sustainable development goals

Our findings have substantial implications for the SDGs, particularly SDGs 1 (with its target SDG 1.5) and 9.

SDG 1 and internal remittances during aggregate shocks

Our results demonstrate the crucial role of internal remittances in supporting the SDG 1 goal of ending poverty. By showing how urban migrant workers continued to send remittances to their rural families during the COVID-19 crisis, albeit at reduced levels, we highlight the resilience of family networks in coping with aggregate shocks. This risk-sharing mechanism helped urban and rural households maintain a basic standard of living during a challenging period. Notably, we did not observe asset sales or borrowing from money lenders in response to the shock, indicating that households were able to preserve their assets and avoid high-interest debt. The absence of these distress coping strategies, combined with continued remittances, prevented households from falling deeper into poverty.

More specifically, our findings address SDG 1.5, which focuses on building the resilience of people in poverty to economic shocks. The ability of households to fully smooth food consumption and partially smooth general consumption through internal remittances demonstrates a key mechanism to improve resilience. This is particularly noteworthy given the aggregate nature of the COVID-19 shock, which affected both urban and rural areas simultaneously.

Unlike idiosyncratic shocks, where unaffected people can support those in need, aggregate shocks pose a more substantial challenge to informal risk-sharing networks. Our findings suggest that even under these circumstances, internal remittances played a vital role in mitigating the impact of the shock. This challenges earlier perspectives, such as that of McKenzie (2003), which suggested a limited role for internal remittances during aggregate shocks.

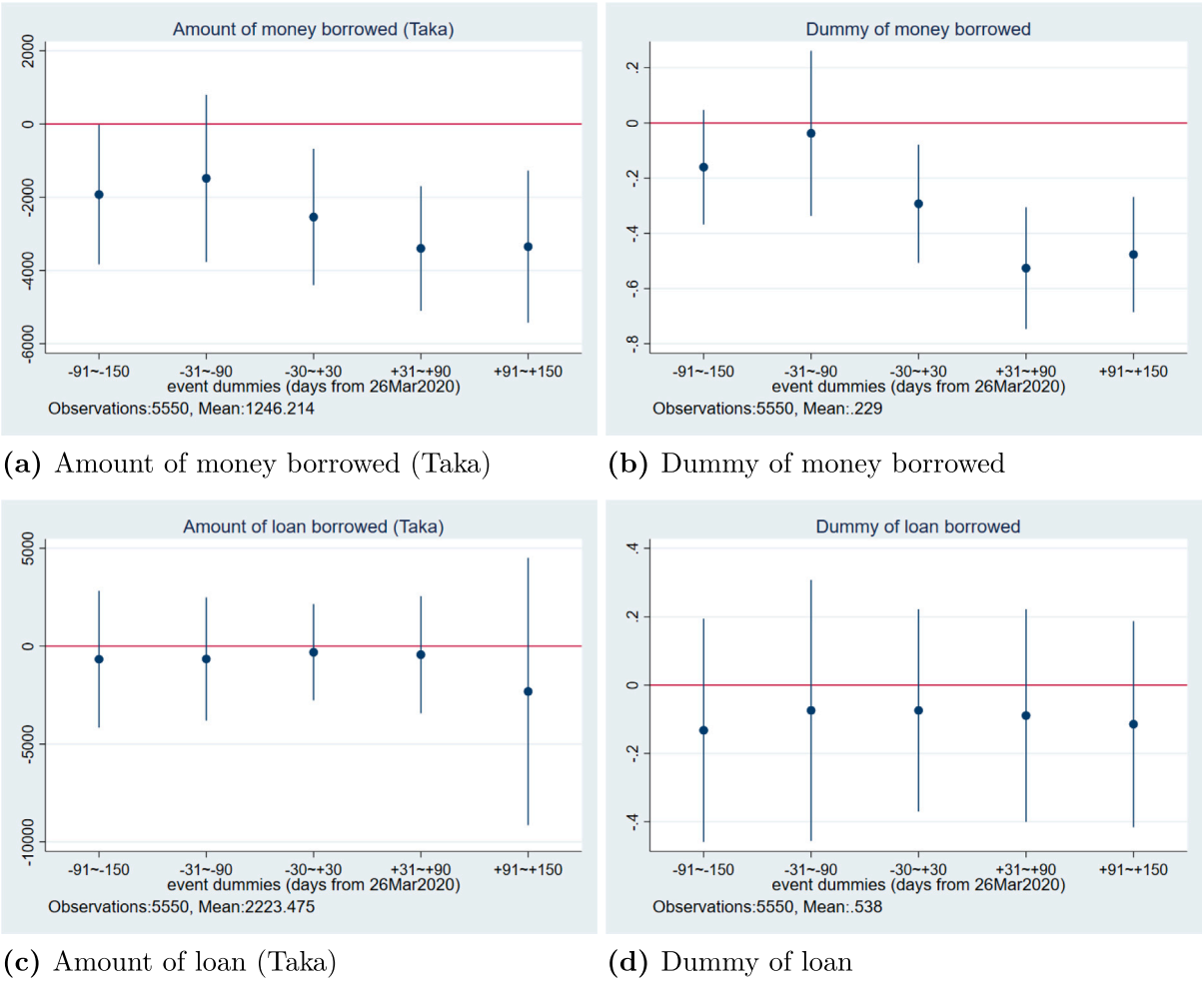
Role of mobile money in supporting SDGs

Our study also highlights the critical role of mobile money in facilitating urban–rural remittances during lockdown, supporting the emphasis of SDG 9 on building resilient infrastructure and fostering innovation. The rapid adoption and use of mobile money services by urban migrants and rural families demonstrate how inclusive financial innovation can significantly improve economic resilience, particularly

[52] In panel a, a marginally significant pre-trend was found. Yet, panel a's implication is consistent with panel b, showing no significant pre-trend.

[53] Migrants also used bank transfer, post office, and other modes for less than 1% of the remittances. We categorized them as hand-carried remittances.

[54] Of the 6318 garment workers in our sample, we excluded those who were not migrants, resulting in 5460 randomly selected migrant workers. In the questionnaire, we did not ask whether the respondent was a migrant or not. Instead, we excluded those who (i) did not send remittances to their rural families and (ii) did not provide us with information on their rural families.



(a) Amount of money borrowed (Taka) **(b)** Dummy of money borrowed

(c) Amount of loan (Taka) **(d)** Dummy of loan

Fig. 10. COVID-19 shock to borrowing and loaning behavior of Dhaka HHs
Note. (1) Standard errors are clustered at household-level. (2) Together with 95% confidence intervals, the figures report the dynamic coefficients obtained from the specification of Eq. (1) in the main text.

in developing countries.

Mobile money services played a critical role in sustaining the risk-sharing mechanism between urban and rural households during the COVID-19 crisis. While traditional hand-carried remittances declined significantly, mobile money transfers remained resilient, underscoring how inclusive finance enhanced economic resilience. This technological solution not only facilitated continued remittance flows, but also demonstrated how inclusive financial innovation can strengthen the ability of developing economies to withstand crises.

Limitations

There are several limitations to this study. First, returning home could be treated as another shock-coping strategy for migrant workers. However, we observed few returning migrants in our sample (only 20 out of 723 families), which prevented formal statistical analysis. Therefore, we excluded them from our study and addressed the potential problems of attrition.

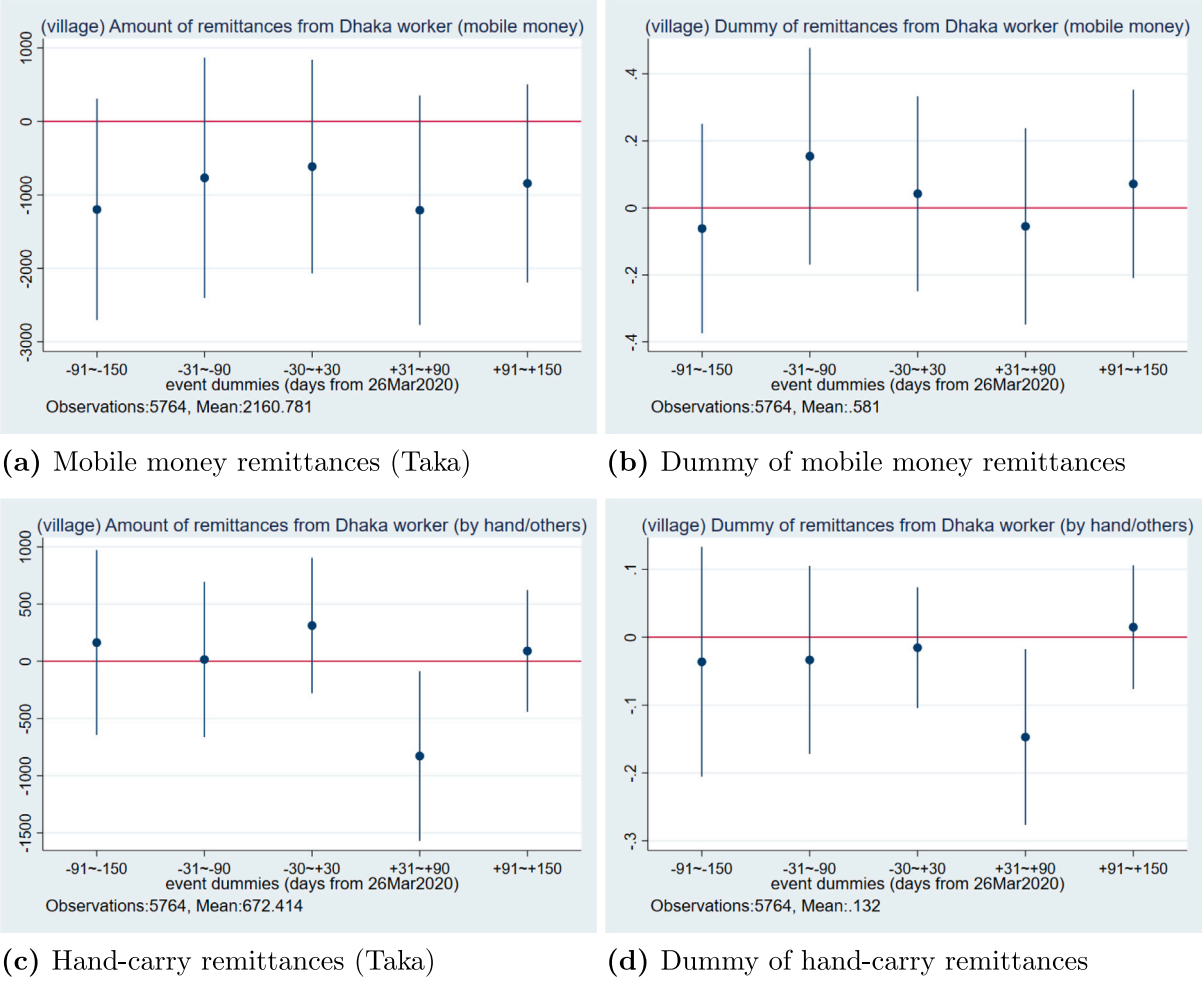
Second, we do not have data on the income of the village households or detailed information on money flows other than remittances. If we had the data, we would have been able to analyze the changes in rural families' cash inflows during the lockdown in more detail. However, it is not practical to conduct an in-depth interview through telephone surveys. Instead, we focused on collecting accurate data on village households' consumption and shock-coping strategies within the family network.

Third, this study is designed to provide descriptive rather than causal evidence. Making a causal inference in our context is challenging because the pandemic affected the entire population. However, to enhance the rigor of our before-and-after comparisons in the event study,[55] we control for seasonality and household-specific unobserved time-invariant factors. Additionally, we test the validity of our event study by checking for pre-trends and report several robustness checks, including alternative event dummies, standard errors, and inverse probability weights.

6. Conclusion

This study uses an event study approach to examine how migrant workers and their rural families coped with the COVID-19 pandemic. First, we show that migrant workers responded to the income shock by continuing mobile money remittances to their rural families at a reduced level. In contrast to McKenzie [27], who argued for the limited role of internal remittances in coping with aggregate shocks,

[55] The existing studies on the COVID-19 pandemic have used similar event study methods—before-and-after comparisons with control variables—to describe various household responses [73,80–85] or the stock market response [86,87]. The current paper adds to the literature. The advantage of including leads and lags into a regression model—our approach—is elaborated in Cunningham [88].



(a) Mobile money remittances (Taka)

(b) Dummy of mobile money remittances

(c) Hand-carry remittances (Taka)

(d) Dummy of hand-carry remittances

Fig. 11. Stable mobile money remittances and no hand-carry remittances amid COVID-19 lockdown
Note. (1) Standard errors are clustered at Upazila-level. (2) Together with 95% confidence intervals, the figures report the dynamic coefficients obtained from the specification of Eq. (1) in the main text. (3) The village households answered remittances.

we find that the urban migrants and their rural families shared the income shock through remittances—rather than through other shock-coping tools such as selling assets or borrowing from neighbors. As a result, both urban and rural households were able to fully smooth food consumption and partially smooth general consumption. Furthermore, the observed change in net remittance flows, in which rural households accepted reduced remittances from urban migrants without sending direct assistance, demonstrates a form of indirect assistance from rural to urban areas, reinforcing the concept of bilateral risk-sharing during the pandemic. Thus, this study contributes to understanding of the role of family networks in coping with aggregate shocks and provides suggestive evidence of bilateral risk-sharing between migrant workers and their rural families.

Second, we identify a new benefit of mobile money. This innovative technology allows migrant workers to continue sending remittances even when hand-carried remittance was impossible due to containment regulations. This finding highlights the importance of mobile money as a financial inclusion tool that allows families to self-insure against the pandemic and related containment regulations. Therefore, governments in developing countries should facilitate the spread of mobile money services by providing appropriate infrastructure and regulations. This implication is in line with Londoño-Vélez and Querubín [89] based on experiences from Colombia and Kenya.

Finally, our findings have profound post-COVID implications, particularly with respect to the SDGs. The study illustrates the interconnectedness of SDGs 1 (No Poverty), 1.5 (Build Resilience), and 9 (Industry, Innovation, and Infrastructure) in the context of internal remittances and mobile money usage during the crisis. Family networks demonstrated resilience by maintaining remittance flows, highlighting their importance in alleviating poverty (SDG 1) and enhancing economic resilience for migrant families (SDG 1.5). Facilitating these transfers through mobile money services during movement restrictions underscores the critical role of digital financial infrastructure (SDG 9) in crises. This interplay between traditional coping strategies and technological innovation suggests the need for increased investment in digital financial services while supporting informal risk-sharing mechanisms in future policy frameworks.

However, it is essential to note that even after lockdowns were lifted, migrants faced difficulties in borrowing money. This observation stresses the need for public intervention to protect low-income families, especially those without extensive family networks. Such interventions could be critical to prevent vulnerable populations from sinking deeper into poverty.

Looking ahead, policymakers and development practitioners should adopt an integrated approach to address future economic challenges. This approach should: (1) recognize and support informal family networks as social safety nets (e.g., facilitating digital financial transfers by implementing temporary fee waivers during crises); (2) invest in digital infrastructure to ensure widespread access to mobile money and other financial services; (3) create regulatory frameworks that encourage innovation while protecting consumers; and (4) establish public support mechanisms, such as low-interest loans or targeted cash

transfers, for vulnerable populations, especially those without strong family networks. Our research contributes to understanding how to build more resilient and inclusive economies by leveraging synergies between traditional support systems, modern digital solutions, and complementary policy interventions. This multifaceted strategy can enhance the resilience of a country to large economic disruptions while advancing multiple SDGs.

CRediT authorship contribution statement

Hiroyuki Egami: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Yukichi Mano:** Conceptualization, Formal analysis, Supervision, Writing – review & editing. **Tomoya Matsumoto:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Supervision, Validation, Writing – review & editing.

Ethics statement

The survey was approved by the institutional review board of the Otaru University of Commerce (approval number OUC-2021-03-00). Informed consent was obtained from all participants by the survey agent prior to the interview. All data was kept confidential and used only for research purposes. The study posed minimal risk to participants, and the participants' privacy was protected throughout the study.

Declaration of competing interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.wds.2024.100197.

Data availability

The data is available from the authors upon reasonable request.

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