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WIDER Working Paper 2021/87

Cash grants to manufacturers after Cyclone Idai

RCT evidence from Mozambique

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May 2021

United Nations University World Institute for Development Economics Research
wider.unu.edu

Abstract: In March 2019, Cyclone Idai hit central Mozambique and caused widespread damage, including businesses in the enterprise sector. We use panel data and a randomized controlled trial to estimate the impact of unconditional cash grants on micro enterprises and their recovery. We find that, on average, the cash grants had a positive effect on firm revenue, profits and savings, and the likelihood of having their roof repaired. The cash had a stronger impact in the more damaged city (Beira) compared to the less affected location (Chimoio) and was particularly effective for carpenters. These findings indicate that access to finance is critically important for firm recovery following disasters.

Key words: firms, manufacturing, natural disasters, cyclone, unconditional cash grants, randomized controlled trial

JEL classification: O12, O14, Q54, H81

Acknowledgements: The authors wish to thank the participants of the PhD course 'Global Disaster Studies: Past, Present, and Future' at the University of Copenhagen, the Inclusive Growth in Mozambique Annual Conference 2019 and 2020, the Climate Talks at the University of Copenhagen, the Oxford CSAE Conference 2021, and the DERG seminar, whose comments improved our paper. We are grateful to John Rand, Sam Jones, Ricardo Santos, Edith Zink, and Sina Smid for excellent feedback and to Mary Lukkonen for copyediting. Moreover, we express our gratitude to the enumerators who collected the data with a lot of dedication and the firm owners who patiently participated in our interviews.

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This study has been prepared within the UNU-WIDER project Inclusive growth in Mozambique – scaling-up research and capacity implemented in collaboration between UNU-WIDER, University of Copenhagen, University Eduardo Mondlane, and the Mozambican Ministry of Economics and Finance. The project is financed through specific programme contributions by the governments of Denmark, Finland, and Norway.

Information and requests: publications@wider.unu.edu

ISSN 1798-7237 ISBN 978-92-9267-027-6

https://doi.org/10.35188/UNU-WIDER/2021/027-6

Typescript prepared by Mary Lukkonen.

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The Institute is funded through income from an endowment fund with additional contributions to its work programme from Finland, Sweden, and the United Kingdom as well as earmarked contributions for specific projects from a variety of donors.

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1 Introduction

A tropical cyclone is a rotating system of clouds that develops over tropical waters. It consists of winds, thunderstorms, torrential rains, large waves, and floods (NOAA 2020). Tropical cyclones are one of the most destructive weather phenomena on the planet, and climate change increasingly affects their intensity. Furthermore, coastal populations are particularly prone to suffer from the consequences of cyclones because of rising global sea levels (Walsh et al. 2019; Peduzzi et al. 2012).

In March 2019, Cyclone Idai hit central Mozambique and destroyed the country's second-largest port city Beira and surrounding areas. Around 1.85 million people were affected, 400,000 displaced, and more than 1,000 died in what is reported to be the most devastating disaster in the history of southern Africa. Roads that connect the area with the rest of Mozambique and neighboring countries were washed away and people suffered from severe food and water shortages, disease outbreaks, and criminal activities (COM 2019a, 2019b, 2019c; WHO 2019a, 2019b). As one of the countries most vulnerable to climate change, similar weather events might occur on a more regular basis in the future. Hence, it is crucial to create scientific evidence on the current limitations to recovery.

Compared to households, firm recovery from cyclone destruction is not studied much. There exists little evidence on firms and disasters in high-income countries, and studies on businesses in the Global South are even scarcer. However, micro, small, and medium enterprises (MSMEs) employ around 90 per cent of all workers in developing countries and are often the only source of income for the poor (Page and Söderbom 2015). Thus, the local community will be able to recover fully only if MSMEs get back on their feet after a disaster (Mendoza et al. 2018).

To our knowledge, only one other randomized controlled trial (RCT) exists that investigates the recovery of enterprises in a low-income country following a natural disaster. Specifically, de Mel et al. (2012) randomly allocated in-kind and cash grants to micro-sized businesses in Sri Lanka after the Asian tsunami of December 2004. They show that access to capital matters for the recovery of enterprises. Those who received grants recovered their profit levels almost two years before comparable firms. Further, business recovery appears to be slow, and therefore, grants might have the potential to boost the recovery process of micro firms after a weather-related shock.

The present study implements an experiment that is comparable to the one by de Mel et al. (2012) but with a few modifications, most notably a different setting and a different type of disaster. Further, our project is smaller as it only covers two survey rounds and focuses only on the manufacturing sector. As the generalizability of RCTs has been questioned (Barrett and Carter 2010), this study contributes to the debate about applications of somewhat similar RCTs in different contexts.

Another contribution is the sampling strategy, which employs a stratified adaptive cluster sampling approach (Thompson 1990, 1991). This allowed us to locate informal enterprises, i.e. those not registered with any government agency. Informal businesses represent the majority of enterprises in Mozambique, so we believe that our results are more representative of an average firm in the country than the studies that look at formal enterprises only. Furthermore, informal firms are likely to be more vulnerable than their formal counterparts because they are smaller and exhibit lower performance, underlining the importance of understanding what can help informal firms after a climate-related shock.

We find that, on average, our cash grants had a positive effect on firm income, profit, savings, and roof repair. We cannot identify any significant effect of the treatment on firm size. More importantly, the grants had a stronger income return in the city affected by Cyclone Idai compared to the less affected location, indicating that access to cash can enhance firm recovery after disasters. In particular, a year after the cyclone, and six months after the treatment, treated firms in Beira had a monthly income of around MZN5,080 more than expected in absence of treatment. When investigating differential effects across manufacturing industries, we find that the treatment was particularly effective for carpenters.

Our paper is structured as follows. The next section outlines the relevant literature. A detailed outline of our sample and intervention follows, including summary statistics. Section 4 provides our methodology, and Section 5 presents the results, while Section 6 concludes.

2 Literature and context

Unconditional cash transfers (UCTs) are cash payments given to underprivileged people without requiring anything in return. Governments, non-governmental organizations (NGOs), and research projects in low- and middle-income countries provide cash transfers as social protection to support people's livelihoods by, for example, reducing poverty or boosting health and education outcomes (Pega et al. 2017). A recent meta-analysis shows that most cash transfer programmes have a statistically significant impact on their intended objectives (Bastagli et al. 2019). '[C]ash transfers not only play a role in reducing poverty by transferring resources but can also foster people's economic autonomy and self-sufficiency' (Bastagli et al. 2019: 589). In terms of medium- or long-term effects, however, the evidence of an effect is weaker and more limited.

In the context of disasters, cash transfers have the potential to protect basic consumption to prevent food insecurity, hamper diseases, recover damaged assets, and preserve human capital by securing children's education. Thereby, people are assisted to avoid falling into deeper poverty (Doocy and Tappis 2017; Gentilini 2016; World Bank 2007). Several studies exist that investigate the effects of UCTs on households following a nature-related disaster. For the case of Fiji, Mansur et al. (2018) find that households that received cash transfers after a tropical cyclone recovered quicker in terms of repair of their dwellings, food stocks, and investments in new livelihoods. Cash grants in the Philippines following typhoon Yolanda reduced malnutrition prevalence and increased school attendance among children (Reyes et al. 2018).

Despite mounting evidence of the benefits of cash grants in post-disaster settings, the Government of Mozambique did not allow international aid agencies to hand out direct cash transfers to the victims of Cyclone Idai in Beira (SARTCWG 2019).

While firms affected by disasters in high-income countries are often covered by insurance, have savings, or can obtain recovery loans (Kemp 2017; Webb et al. 2002), businesses in developing countries rarely have these options. Despite these obstacles, the admittedly limited existing evidence suggests that firms in the Global South repair damages and replace losses at a relatively quick pace. In Sri Lanka, for example, firms had recovered their pre-disaster size 15 months after the tsunami. Most of them relied on personal savings or loans from family and friends during the recovery process (de Mel et al. 2012).

Moreover, de Mel et al. (2012) tested whether cash grants helped disaster-affected firms in their recovery process in Sri Lanka. The principal outcome was that firms that obtained grants after a tsunami recovered their profit levels around two years earlier than enterprises that did not receive

support. This effect, however, is stronger for the retail than for the manufacturing sector. In turn, the authors conclude that a lack of financial capital is not the main constraint in manufacturing firms' recovery process.

3 Data and intervention

3.1 Timeline

On 15 March 2019, the second-deadliest tropical cyclone in the Southern Hemisphere's history hit central Mozambique.[1] With its strong winds of up to 175 km/h, torrential rains, and severe flooding, Cyclone Idai killed more than 1,000 people and left catastrophic damage of more than US$2 billion (EM-DAT 2020). Formal companies reported overall damage of US$145 million and 12,000 destroyed jobs in large enterprises alone (COM 2019d). One of the areas most affected was Mozambique's second-largest port city, Beira (IFRC 2020).

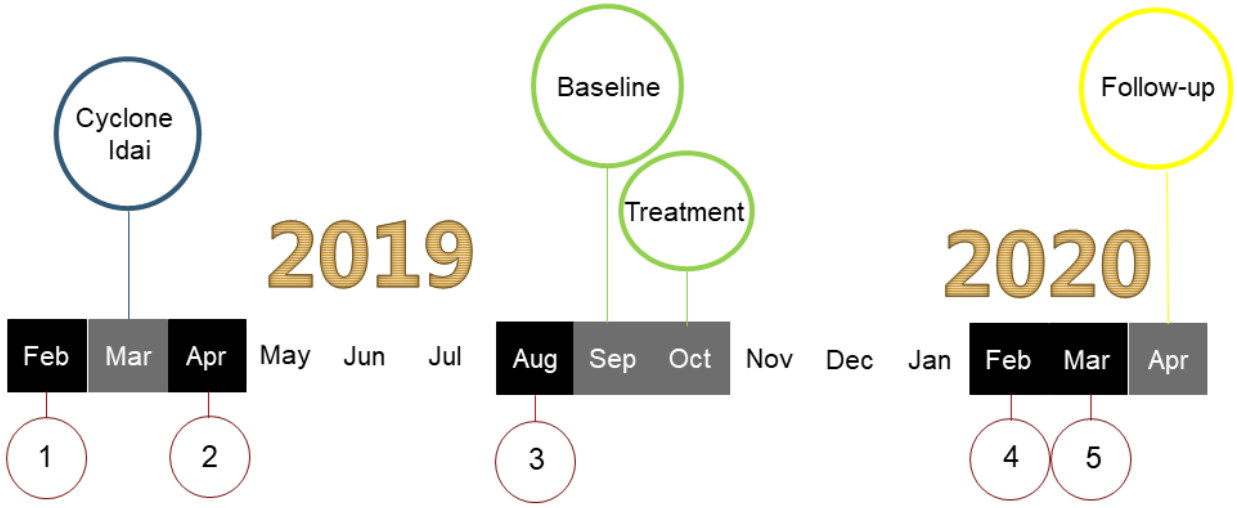
The event timeline in Figure 1 shows that six months after the cyclone, in September 2019, we initiated our sampling approach (see Section 3.3) and baseline data collection in the cities of Beira and Chimoio. After completion of the baseline data collection, we randomly selected 130 firms into our treatment group and handed out cash grants in October 2019. In April 2020, we conducted a follow-up survey. In total, firms were asked to recall five different points in time, i.e. months. In the baseline data collection, enterprises provided information about their pre-cyclone situation in February 2019 (1), post-cyclone condition in April 2019 (2), and baseline state in August 2019 (3). In the follow-up survey, we enquired about their post-treatment situation in February 2020 (4) and one year after the cyclone in March 2020 (5). Hence, we have two survey waves but five different points in time for which the enterprises provided data. The follow-up survey could not take place through personal interviews because of the COVID-19 pandemic and was done by telephone.

3.2 Sample and intervention

Manufacturing firms are an essential part of the industrial sector, and the development of a strong industry carries with it the potential of high and dynamic economic growth and employment generation, which are critically important for a low-income country like Mozambique (Szirmai 2009). We therefore focus on the manufacturing sector. Specifically, we compare the effects of cash grants for firms in the city of Beira, which was strongly affected by Cyclone Idai, with the grants' impact on enterprises in the city of Chimoio, which was also hit but to a much smaller extent. This allows for interpreting the difference-in-difference estimates as a lower bound of the true treatment effect.

[1] The deadliest cyclone recorded in the Southern Hemisphere was the 1973 Flores cyclone in Indonesia, with more than 1,600 deaths.

Figure 1: Event timeline



Source: authors' illustration.

Almost all enterprises in Beira suffered some type of damage caused by the cyclone, while it affected fewer businesses in Chimoio. Our sample shows that in the month following Cyclone Idai (April 2019), firms in Beira only earned 36 per cent of the pre-cyclone income level, while enterprises in Chimoio reported an average of 56 per cent. Further, 85 per cent of the Beira firms had their roof damaged or destroyed, while this was only the case for 43 per cent of the enterprises based in Chimoio. Of the firms that had fixed walls during the cyclone, 40 per cent in Beira declared damaged walls compared to 16 per cent in Chimoio. Similarly, external sources estimate that almost the entire economic infrastructure of Beira was destroyed by Idai, while Chimoio's situation was much more stable (COM 2019d).

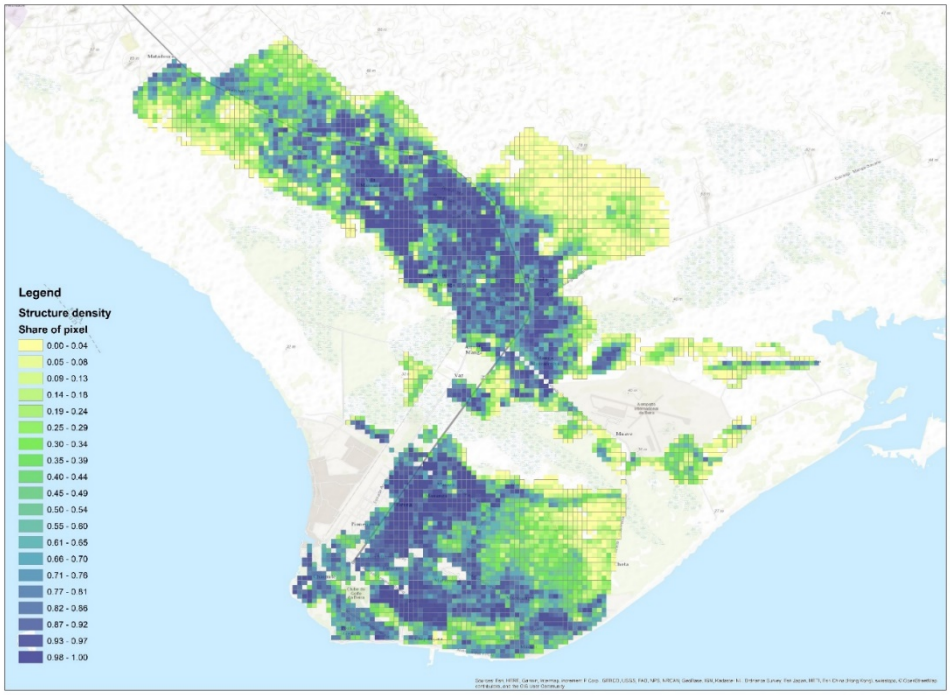
In Mozambique, a majority of micro enterprises are informal. In the case of Beira, a recent study shows that for each formal enterprise there are 17 informal businesses (Jolevski and Ayana Aga 2019). Because informal firms are unregistered with government authorities, there does not exist any representative enterprise sample for the country or any Mozambican city. To obtain a representative sample of the population of micro-sized firms from the manufacturing sector, we therefore used a stratified adaptive cluster sampling approach (Thompson 1990, 1991) similar to Jolevski and Ayana Aga (2019). We divided the areas for examination (e.g., the cities of Beira and Chimoio) into squares of 115 m x 115 m (see Figure 2). In each city, we randomly selected 200 squares. To account for the uneven population density across the area, we weighted the random draw of cells by information on the density of structures in each cell, following Sohnesen et al. (2020). A group of enumerators located all micro businesses that were operative in the selected squares. When one or more firms were found in a square, its neighbouring squares (i.e. the squares north, south, east, and west of the square) were also inspected for enterprises.

Additionally, we managed to re-interview 80 micro firms that were already included in our previous enterprise surveys (IIM 2018, 2013).[2] These IIM enterprises report larger profits, more employees, higher educational levels, and a smaller likelihood to be informal because we sampled them from government data sets in the past. The firms that we found with our cluster sampling approach are more likely to be representative of an average micro enterprise in Mozambique as there exist many

[2] IIM stands for manufacturing enterprise survey and was implemented in 2012 and 2017 with support from the Development Economics Research Group (DERG) at the University of Copenhagen. See more details in our reports. See IIM (2013, 2018).

more informal than formal businesses in the country. Overall, we believe that our sample is representative of the manufacturing sector in the respective cities because almost all firms located when walking through the whole town participated in our enquiry. Most firms agreed to participate for compensation of mobile phone credits of MZN200.

Figure 2: Beira decomposed into squares with colours indicating structure density



Source: authors' illustration using ArcMap and Google Earth.

We conducted a panel survey with 427 micro enterprises from the manufacturing sector affected by Cyclone Idai. Some 215 firms are in Beira, the city most affected by the cyclone. The other 212 enterprises are located in Chimoio, a city about 200 km away from Beira and much less affected by Idai (COM 2019d). Micro-size implies that a firm employs less than 10 workers. A few of the enterprises employed more than nine workers at some point in time during the studied period. However, they did not exceed the size requirement when taking the average number of workers during the whole period (February 2019–March 2020). Our classification of manufacturing industries follows the definitions by the International Standard Industrial Classification of All Economic Activities (ISIC codes) at the four-digit level (UNSD 2008).

The baseline questionnaire asked enterprises about owner characteristics such as age, education, risk attitude, and gender as well as firm characteristics like registration status, number of employees, sales, expenses, and savings. Further, we enquired which assets were damaged or destroyed by the cyclone and if they had been repaired or replaced. We also posed a few questions on the type of help received following the cyclone, insurance, knowledge about climate change, and future adaptation.

After the baseline survey, we randomly selected 130 enterprises and provided them with unconditional cash grants of MZN6,000 (about US$100). In the end, only 121 firms received the money because the remaining eight were unavailable or refused to receive the grant. Of those who received the grant, 61 are located in Beira and 60 in Chimoio. The grant amount matches the median yearly investments made by a micro-sized firm in Beira prior to the cyclone (IIM 2018)

and ensures comparability with a similar study (de Mel et al. 2012). We transferred most grants to interviewees' mobile money accounts (MPesa), and, in case they did not have a mobile account, we handed over the grants in cash. Our guidance instructed recipients to use the money for their business and not for any personal or household-related purchases. We did not specify the type of business-related spending they were supposed to make with the money. We framed the treatment in terms of a lottery in which all enterprises that participated in the interview were taking part.

Using standard power calculation tools (see Duflo et al. 2006) jointly with knowledge about micro businesses from the IIM 2017 survey (IIM 2018), we aimed at interviewing a sample of around 400 manufacturing companies with less than 10 employees. We assumed that the detectable effect of our treatment would be relatively low (around 25 per cent of a standard deviation in the outcome variable) and that we could explain 50 per cent of the variation in the outcome variable by a combination of the treatment variable and covariates. Hence, a sample of 400 firms would yield a power of around 90 per cent at a 0.05 significance level. This is a high level of power because 80 per cent is acceptable in most of the cases. We were able to interview more than 400 firms in both survey rounds and handed the treatment to 130 enterprises instead of 140.

Attrition is low. In total, we interviewed 475 firms in the baseline and less than 10 per cent could not be re-interviewed in the follow-up (442). If we had been able to implement the survey in person, attrition would probably have been lower because several entrepreneurs refused to submit confidential information over the phone. During the cleaning process, we dropped a few businesses, for example, because they did not fulfil the requirement of being micro-sized. The final panel data set consists of 427 enterprises. All firms that received the treatment are included in the panel except for one.

3.3 Recovery counterfactual

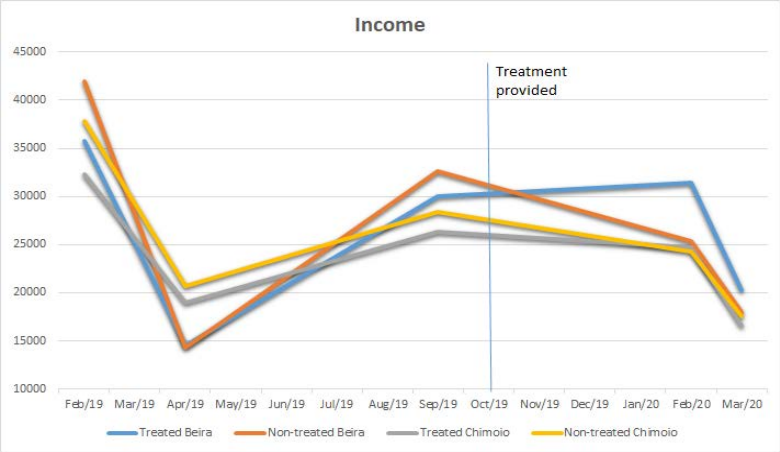
To find the causal effect of our treatment, the cash grant, we should ideally observe the same firm in a situation where it receives the treatment and compare it to a counterfactual situation where it does not receive a cash grant. This, however, is impossible because we can only observe one outcome per firm. Random assignment of enterprises into treatment and control groups in combination with the law of large numbers allows us to establish solid counterfactuals (Seawright 2016). Specifically, we can estimate the expected average effect of our treatment on a group of enterprises by comparing them to a similar group of enterprises that did not receive the treatment. The two groups should only differ by their exposure to the cash grant (Duflo et al. 2006).

Furthermore, to understand the recovery process of firms, we need to know how they would have developed in the absence of the cyclone. Therefore, we compare Beira, a city the catastrophe destroyed almost entirely, with Chimoio, the next biggest city that was also affected but to a much smaller extent. Both cities are located in central Mozambique, only 200 km apart, and both depend to some extent on trade with neighboring Zimbabwe. In 2016, the micro-sized IIM enterprises located in Beira and Chimoio reported statistically different average income levels than the firms in the country's five other major cities combined. In terms of firm size, businesses in Beira and Chimoio were slightly larger than in the remaining provinces. Moreover, only 17 per cent of firms in Beira and Chimoio reported paying taxes, while 34 per cent did so in the other areas (see Appendix Table A1). As Chimoio was also to some degree affected by the cyclone, it is furthermore likely that our estimates are slightly biased towards zero, i.e. showing a smaller effect of the cash grants than the true effect.

3.4 Exploring the data

We start by looking at firm revenue gained from sales (income) in Table 1. Before the cyclone, an average business made MZN37,000 per month. This value dropped sharply to MZN17,000 in the month following Cyclone Idai. Six months later, the income had already increased to MZN30,000, around 80 per cent of the pre-cyclone revenue level. However, one year after Idai, the average firm's income had not recovered to pre-cyclone values. The income was even lower (MZN26,000) than the income six months after Idai (MZN29,000).

Figure 3: Firm income over time



Source: authors' illustration based on cyclone data.

When differentiating between treatment and control groups in the two cities, we find that Beira and Chimoio had similar income levels before the cyclone (see Figure 3). However, after the cyclone, average enterprise revenue dropped much more in Beira than in Chimoio. Firms recovered in both locations but did not reach pre-cyclone income levels six months after the cyclone in September 2019. Beira did slightly better than Chimoio, but the difference is statistically insignificant. After our cash grants had been handed out, the treatment group in Beira reported higher income levels (MZN32,000) than both the treatment group in Chimoio and the control groups in the two cities (MZN25,000). In March 2020, revenue dropped again, perhaps because of the COVID-19 pandemic. The treatment group in Beira, however, still had higher income than the three remaining groups.

Our income data are based on recall, so one may raise the concern that firms in Beira systematically underreported the baseline income from February 2019 (pre-cyclone) because of the large shock they experienced. If the actual baseline income in Beira was statistically different from the one reported, we would obtain biased estimations of the causal effect. Therefore, we apply a parallel trends analysis in Appendix Figure A1. Using a data set of manufacturing firms from previous years (IIM 2013, 2018), we find that enterprises in Beira and Chimoio had very similar income levels between 2011 and 2016 and followed the same trend over time (see also Appendix Table A2).

Table 1: Summary statistics

	Whole sample	Beira		Chimoio	
		Treated	Control	Treated	Control
Income before Idai (Feb'19)	37,418	34,760	40,993	31,071	37,368
Income after Idai (Apr'19)	17,207	14,489	14,247	18,917	20,622
Income 6 months after Idai (Sep'19)	29,790	29,879	32,577	26,234	28,335
Income 1 year after Idai (Feb'20)	26,259	31,459	25,393	25,779	25,238
Savings before Idai (Feb'19)	3,705	2,675	4,555	1,940	3,954*
Savings after Idai (Apr'19)	1,034	613	888	548	1,543
Savings 6 months after Idai (Sep'19)	2,510	2,696	2,523	1,533	2,810
Savings 1 year after Idai (Feb'20)	2,993	3,582	2,691	2,513	3,252
Firms without employees	0.08	0.11	0.08	0.10	0.07
Firm size before Idai (Feb'19)	3.38	3.28	3.62	2.78	3.40
Firm size after Idai (Apr'19)	2.93	2.75	3.03	2.45	3.09**
Firm size 6 months after Idai (Sep'19)	3.10	2.95	3.27	2.72	3.13
Firm size 1 year after Idai (Feb'20)	3.22	3.13	3.25	2.68	3.44*
Roof damaged/destroyed	0.64	0.88	0.85	0.41	0.42
Roof repaired 6 months after Idai	0.78	0.82	0.78	0.81	0.72
Primary education	0.38	0.51	0.43	0.37	0.29
Secondary education or higher	0.29	0.21	0.32	0.25	0.30
University degree	0.01	0.02	0.01	0.03	0.01
Business-related education	0.26	0.30	0.27	0.20	0.24
Informal	0.77	0.84	0.75	0.78	0.77
Female	0.10	0.13	0.11	0.00	0.11***
Owner age	40.25	42.57	42.60	37.43	38.06
Electricity access	0.79	0.75	0.81	0.85	0.76
Internet access	0.05	0.03	0.07	0.05	0.04
Smartphone owner	0.38	0.25	0.40**	0.43	0.40
Bank loan	0.04	0.03	0.07	0.00	0.03
Carpenter	0.35	0.30	0.42*	0.33	0.31
Tailor	0.23	0.33	0.25	0.15	0.20
Blacksmith	0.15	0.15	0.12	0.33	0.13***
Food producer	0.10	0.05	0.06	0.11	0.15
Observations	427	61	154	60	152

Note: mean estimates; stars represent significance levels for t-tests. *Significance at a 10 per cent level, **significance at a 5 per cent level, and ***significance at a 1 per cent level.

Source: authors' calculations based on cyclone data.

Column 1 of Table 1 shows that eight per cent of the sampled businesses do not have any employees. Before the cyclone, they had an average of 3.4 workers, which dropped to 2.9 after the cyclone but slowly increased in the following months to 3.2 one year after the disaster. Around 40 per cent of the entrepreneurs have completed primary education, and one-third have attended secondary school or hold at least a secondary school degree. Only one per cent have a university degree, whereas one-quarter went through an education programme related to their business activity. Almost 80 per cent of the enterprises are informal in the sense that they do not pay taxes. However, given their low revenue level, 70 per cent of the informal firms were tax exempt in 2019 such that they do not need to have to be formal in the sense of paying taxes anyway.[3] Only 10 per cent of the enterprises have female owners or managers. The firm owners' average age is 40 years, with entrepreneurs in Chimoio being slightly younger (38 years) than in Beira (43 years). About 80 per cent of the sample has electricity access but only five per cent has internet access, while 38 per cent own a smartphone. A very small share of four per cent has a bank loan. More than one-third of the sample are active as carpenters in the furniture industry, i.e. they produce products made of

[3] Of 209 informal firms, 145 were tax exempt in 2019 because they had an annual turnover of less than MXN252,000, which is 36 times the minimum wage of the manufacturing industry (GOM 2019).

wood such as tables, beds, and closets. The second-largest industry is composed of tailors (23 per cent), followed by blacksmiths (15 per cent) and food producers (10 per cent).

Because we randomly assigned the cash grants to firms, the treatment assignment should not be related to any firm characteristics. To validate this assumption, Table 1 compares the averages of observable features of the treatment and control groups in Beira to the treatment and control groups in Chimoio (Appendix Table A3 compares Beira with Chimoio and the treatment with the control group). T-tests show whether the averages are statistically different across groups. There are almost no statistically significant differences between the treatment and control groups in both locations. Firms' income levels, savings, and size are similar over time. However, in Chimoio, the savings between the treated and control firms differed significantly in the month before the cyclone, as they were lower for treated (MZN1,940) than for control firms (MZN3,954). Further, the firm size of Chimoio's enterprises differed significantly between the treatment and control groups in April 2019 (2.5 vs. 3.1) and one year after the cyclone (2.7 vs. 3.4), while the firm size of Beira's treatment and control groups did not differ statistically.

Treatment and control groups in both cities are similar in terms of education, informality, age, electricity access, internet access, and usage of bank loans. We find a few statistically significant differences in firm/owner characteristics among each city. In Chimoio, the treatment group does not include any female owner or manager, while 11 per cent of the control group's firm owners are women. Surprisingly, Beira's treated firms have significantly fewer smartphone users (25 per cent) than the control group (40 per cent). Regarding manufacturing industries, there are significantly more carpenters in Beira's control group (42 per cent) than in its treatment group (30 per cent), while there is no statistically significant difference in carpenter shares in Chimoio. Among Chimoio's firms, there are significantly more blacksmiths in the treatment (33 per cent) than in the control group (13 per cent).

4 Methodology

We start by estimating whether the treatment, i.e. the cash grants, had an effect on the treated firms (ATT), independently of their location:

$$Y_{i,m} = \alpha_i + \beta_1 T_{i,m} + \beta_2 M_i + \beta_3 X_i + \gamma_m + \varepsilon_{i,m} \quad (1)$$

In equation 1, $Y_{i,m}$ denotes the outcome of interest for firm i at time m, which is measured along several firm performance indicators, with firm revenue from sales being the main one. T is a dummy variable indicating whether a firm is part of the treatment group. To control for time trends, we count the event of Cyclone Idai as being a shock for firm performance. Thus, we create a dummy for the month before the cyclone (M=0 for Feb 2019) and for the four months for which we have data after the cyclone (M=1 for Apr 2019, Sep 2019, Feb 2020, Mar 2020). X are variables controlling for a firm owner being female, age, education, and if she owns a smartphone because these are the variables that differ significantly between the different groups. Furthermore, we include firm fixed effects (FE) into our specification, which are denoted by α_i.

Our main purpose is to find out whether access to finance enhances firm recovery. Recovery does not only imply that firms manage to recover to pre-cyclone levels but that they catch up to levels at which they would have been in absence of the cyclone. In our case, Chimoio represents the situation in which the enterprises would have found themselves if Idai had not happened. Thus, we have to look at the differential impact of the treatment between Chimoio and Beira.

$$Y_{i,m} = \alpha_i + \beta_1 MBTi_{,m} + \beta_2 B_i + \beta_3 T_{i,m} + \beta_4 M_i + \beta_5 MB + \beta_6 MT + \beta BT + \varepsilon_{i,m} \quad (2)$$

B is a dummy variable indicating if a firm is located in Beira (1) or Chimoio (0), and the interaction of being located in Beira and in the treatment group during the post-cyclone period, β_1, is our main estimate of interest.

5 Results

We begin by investigating if the cash grants had an effect on the treatment group, independent of whether being located in the cyclone-affected Beira or the less affected Chimoio. Table 2 shows that the cash grants increased firms' income by 65 per cent. The estimate increases to 91 per cent when including firm FE. Further, the grants increased profits by 15 per cent and savings by 164 per cent compared to the control group. Enterprises that received the grants are also more likely to have their roof repaired compared to the control group. One channel through which the treatment might have affected firm performance is the hiring of new employees. We test this hypothesis but have to reject it, i.e. the cash grants did not increase the treated firms' size.

Table 2: Cash grants and firm outcomes

	Income OLS	Income FE	Profits FE	Savings FE	Firm size FE	Repaired roof FE
Treatment	0.651***	0.906***	0.153*	1.642***	0.101	0.109**
	(0.151)	(0.218)	(0.082)	(0.412)	(0.068)	(0.048)
Post-cyclone	-1.511***	-1.542	-0.451***	-1.506***	-0.077***	0.043***
period (M)	(0.097)	(0.083)	(0.056)	(0.171)	(0.018)	(0.009)
Female	0.055	0.277	-0.074	-1.245	-0.219**	0.148
	(0.214)	(0.630)	(0.193)	(1.112)	(0.111)	(0.117)
Age	-0.007	0.011	-0.000	-0.004	0.006	0.001
	(0.005)	(0.013)	(0.008)	(0.031)	(0.005)	(0.002)
Primary education	-0.319**	-0.046	0.170*	-0.615	-0.073	-0.024
	(0.135)	(0.234)	(0.103)	(0.464)	(0.085)	(0.056)
Smartphone	0.309**	-0.065	0.090	-0.349	-0.007	0.053
	(0.130)	(0.211)	(0.126)	(0.408)	(0.049)	(0.043)
Observations	2,135	2,135	2,135	2,135	1,528	1,275
Number of firms	427	427	427	427	407	279
R2	0.09	0.06	0.03	0.06	0.03	0.06

Note: ordinary least squares (OLS) regression in Column 1 and fixed-effects (FE) regressions in Columns 2–6. Robust standard errors in parentheses. *Significance at a 10 per cent level, **significance at a 5 per cent level, and ***significance at a 1 per cent level. We include industry dummies for carpenters, tailors, blacksmiths, and food producers. Income, profits, savings, and firm size are logged.

Source: authors' calculations based on cyclone data.

To understand if firms located in the cyclone-affected city managed to recover to the level at which they would have been if Idai had not occurred, we add an interaction term (treatment X Beira X post-cyclone period) as specified in equation (2). Table 3 shows that the treatment effect is positive and statistically different for enterprises located in Beira. Treated firms in Beira report an increase in income of 109 per cent compared to the counterfactual, and when adding firm FE, this estimate increases to 175 per cent. In monetary terms, Beira's treated firms' income is around MZN5,070 higher than what would have been expected in absence of treatment.

We also investigate the effect of the grants on other firm outcomes. We do not find any statistically different effect of the grants in Beira compared to Chimoio regarding profits, savings, the likelihood of a repaired roof, and firm size.

Table 3: Cash grants and firm outcomes in Beira

	Income	Income	Profits	Savings	Firm size	Repaired roof
	OLS	FE	FE	FE	FE	FE
Post-cyclone period (M) x Treatment x Beira	1.088*** (0.313)	1.750*** (0.395)	0.237 (0.151)	0.090 (0.811)	0.133 (0.135)	-0.026 (0.097)
Post-cyclone period x Beira	-0.993*** (0.200)	-1.087*** (0.154)	-0.115 (0.110)	-1.147*** (0.336)	-0.060* (0.035)	-0.014 (0.021)
Post-cyclone period (M)	-0.987*** (0.120)	-0.984*** (0.096)	-0.391*** (0.063)	-0.912*** (0.229)	-0.044* (0.025)	0.054*** (0.018)
Observations	2,135	2,135	2,135	2,135	1,528	1,275
Number of firms	427	427	427	427	407	279
R2	0.06	0.07	0.03	0.05	0.02	0.05

Note: robust standard errors in parentheses; income, profits, savings, and firm size are logged. *Significance at a 10 per cent level, **significance at a 5 per cent level, and ***significance at a 1 per cent level.

Source: authors' calculations based on cyclone data.

To check the robustness of our results, we run the same regressions separately for the Beira and Chimoio sample, and we obtain very similar findings (see Appendix Tables A4 and A5). The cash grants positively affected firm income and profits in Beira but not in Chimoio. In Beira, treated firms' income increased by 180 per cent and their profits by 25 per cent compared to the control group. However, in both cities, the grants had an effect on savings. In Beira, treated firms' savings increased by 174 per cent compared to the control group, and in Chimoio, the magnitude was similar with 165 per cent. Moreover, in Beira, the treatment had a positive impact on the likelihood of a repaired roof and on firm size, while there was no significant effect on these outcomes in Chimoio.

As outlined, Beira was the location most affected, whereas Chimoio also suffered from the consequences of Cyclone Idai, albeit to a smaller extent. To validate the finding that the firms located in the most-affected location benefit the most from cash, we substitute our Beira dummy with a damage index. The damage index measures the extent of damage and destruction a firm suffered because of the cyclone. It is composed of five different dummies, asking about the damage of a specific firm asset, i.e. whether the roof, walls, raw material, finished products, and machinery were fully destroyed or damaged. If all of these assets were destroyed or parts of them damaged, a firm gets the value of 5 on the index and if none were destroyed or damaged a value of 0. Appendix Table A6 shows that the cash grants had a stronger impact on income and profit among firms that suffered stronger damage or destruction. Because the enterprises located in Beira, on average, report more damage than in Chimoio, our previous results showing that our cash grants enhanced firm recovery in the most-affected location are confirmed.

5.1 Heterogeneous treatment effects

Next, we look at heterogeneous treatment effects on income across manufacturing industries. Overall, Table 4 shows that there exist differential effects of the grants by industry. Treated carpenters stand out as their income increased by 102 per cent compared to the remaining firms. We do not find any statistically significant effect of the cash grants on tailors, blacksmiths, or food producers.

One explanation for why the treatment had a positive impact on carpenters might be related to the demand of their services. Many people lost their homes or parts of them during the cyclone. Carpenters provide repair services and basic furniture, both of which might have been in high

demand after the cyclone. As carpenters might have been in high demand, they could make effective use of the cash grants, which then would lead to positive performance outcomes, while the other industries might have been less vital in the post-disaster period. The work of tailors, for example, was probably less requested because most people did not lose or damage their clothes in the cyclone. Therefore, tailors did not have outstanding returns on the cash grants. Overall, access to finance might be effective for the recovery of some manufacturing industries but not for all.

Table 4: Treatment effects by manufacturing industry

	Income			
	Carpenters	Tailors	Blacksmiths	Food producers
M X Treatment X Industry	1.023**	-0.525	-0.258	-0.487
	(0.441)	(0.482)	(0.442)	(0.640)
Post-cyclone period (M)	-1.334***	-1.575***	-1.581***	-1.605***
	(0.099)	(0.092)	(0.089)	(0.087)
Treatment	0.596**	1.049***	0.976***	0.968***
	(0.242)	(0.242)	(0.252)	(0.223)
Observations	2,135	2,135	2,135	2,135
Number of firms	427	427	427	427
R2	0.06	0.06	0.06	0.06

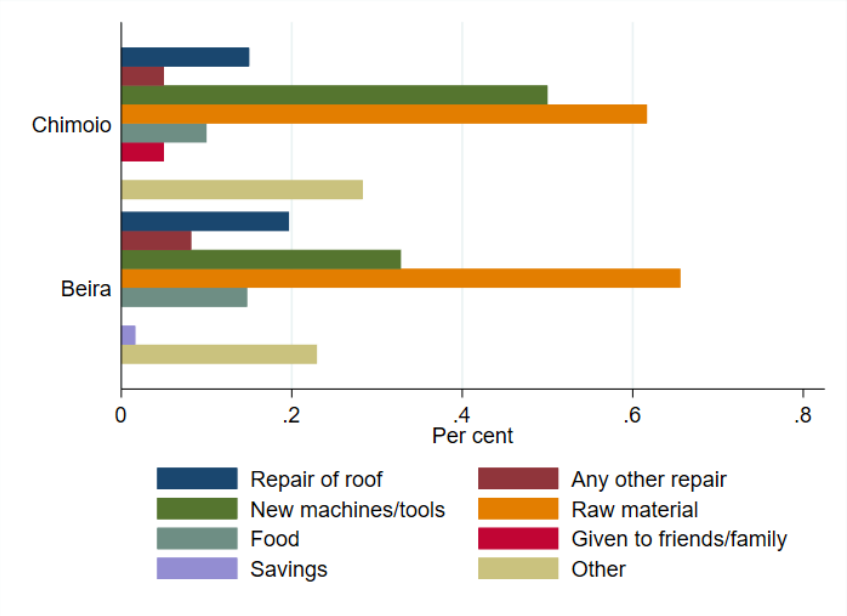
Note: we control for firm FE. Robust standard errors in parentheses. Income is logged. *Significance at a 10 per cent level, **significance at a 5 per cent level, and ***significance at a 1 per cent level.

Source: authors' calculations based on cyclone data.

5.2 How the grants were spent

In our follow-up survey, we asked the treated firms for what purposes they spent the grant money. About 97 per cent reported having spent all of the grant money, and a majority (70 per cent) indicated that the cash was of great help. Figure 4 shows that two-thirds used it for more than one purpose. About 14 per cent of the enterprises used some part of the money for non-business purposes such as food and helping family/friends, but at the same time, the remaining part of the money was used for business goals. Only one firm handed over the whole grant to family/friends. In 'other' purposes, entrepreneurs specified that they paid their employees, paid to transport raw materials, repaid some debt, or purchased a piece of land. The most common business-related expense was the purchase of raw materials (63 per cent bought raw materials) followed by the acquisition of new machinery or tools (41 per cent). In Chimoio, however, enterprises were significantly more likely to buy new machinery and give some part of the money to family or friends than in Beira. One reason why the returns on the grants were significantly higher in Beira might be related to higher returns on raw materials in the cyclone-affected area.

Figure 4: Types of expenses paid for with the cash grants



Source: authors' illustration based on cyclone data.

We investigate whether the grants had differential effects depending on how they were spent. Table 5 illustrates that the grants were particularly effective for firm income when they were used for the purchase of raw materials, machinery, or 'other' purposes. Enterprises that bought some type of raw material for their economic activity experienced an increase in income by 126 per cent compared to firms that used the grants for any of the other purposes instead. A rise in income of 88 per cent was the result for business owners who acquired new machinery. Even businesses spending their money on 'other' purposes had an increase in income of 87 per cent compared to the enterprises that used the money for other goals. In contrast, roof repair or handing over the money to family/friends did not have statistically significant income effects.

Table 5: Differential effects by spending purpose

	Income				
	Roof repair	Raw materials	Machinery	Non-business purpose: family/friends	Other
Spending purpose X M	0.745	1.262***	0.880***	0.759	0.865*
	(0.531)	(0.341)	(0.298)	(0.631)	(0.457)
Post-cyclone period (M)	-1.313***	-1.530***	-1.431***	-1.293***	-1.359***
	(0.130)	(0.160)	(0.146)	(0.126)	(0.135)
Observations	605	605	605	605	605
Number of firms	121	121	121	121	121
R2	0.05	0.07	0.06	0.05	0.05

Note: we control for firm FE. Robust standard errors in parentheses. Income is logged. *Significance at a 10 per cent level, **significance at a 5 per cent level, and ***significance at a 1 per cent level.

Source: authors' calculations based on cyclone data.

6 Conclusion

This paper investigates whether access to finance after a natural disaster can boost micro-enterprise recovery. In 2019, we handed out cash grants to randomly selected firms in the manufacturing sector following Cyclone Idai in central Mozambique. Overall, the grants had a significant and positive effect on firm income, profit, the likelihood of having the roof repaired, and savings. More importantly, we find that our treatment had stronger returns in the city of Beira, which was almost entirely destroyed by Idai, compared to the control city, which was affected to a smaller extent. Specifically, the grants only had a statistically significant effect on performance measured as income or profits in Beira but not in Chimoio. Thus, as has been found in a different context after a different natural disaster (de Mel et al. 2012), our results confirm that cash grants can enhance firm recovery following disasters. Investigating differences by industry, we find that the grants were particularly effective for carpenters, showing that the grants may be helpful for some manufacturing industries but not all. Further, we are the first to illustrate that the grants had the strongest effect on firms that spent the money on raw materials, new machinery, or other business purposes relative to enterprises who used the cash to repair their roof or on non-business goals. Overall, cash grants for firms seem to be an effective type of aid in disaster-ridden areas. As natural disasters are likely to increase because of anthropogenic climate change, our study's results are valuable for policies and development programmes.

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Appendix

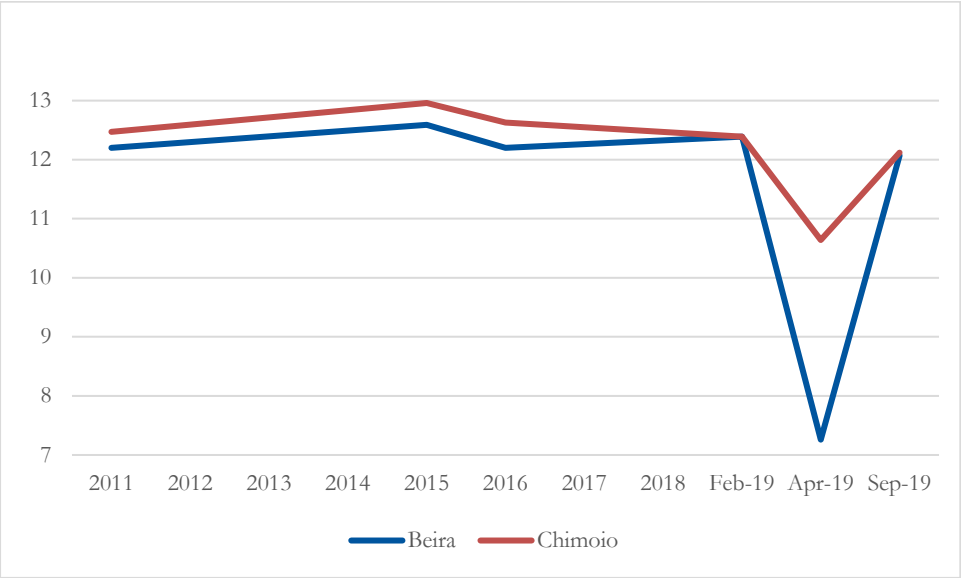
Table A1: Summary statistics of IIM 2017 data

	(1) Beira	(2) Chimoio	(3) Beira and Chimoio	(4) Remaining provinces combined	(5) Maputo
Income	1,002,394	874,073	953,596	5,363,763	6,550,823
Firm size	3.19	3.69	3.38	2.93*	3.05
Secondary degree	0.52	0.65	0.57	0.56	0.58
Female	0.08	0.19*	0.12	0.07*	0.05*
Informal	0.82	0.85	0.83	0.66***	0.74*
Blacksmith	0.11	0.22*	0.15	0.22*	0.21
Tailor	0.09	0.06	0.08	0.17**	0.22***
Observations	88	52	142	236	91

Note: the combined provinces in column 4 are Maputo province, Gaza, Nampula, and Tete. Stars represent the significance level of two-sample t-tests. In column 2, Beira is compared with Chimoio. Column 4 compares the remaining provinces with the combined sample of Beira and Chimoio. Column 5 compares the city of Maputo with the combined sample of Beira and Chimoio. *Significance at a 10 per cent level, **significance at a 5 per cent level, and ***significance at a 1 per cent level.

Source: authors' calculations based on IIM 2017 data (IIM 2018).

Figure A1: Parallel trends analysis, log income over time



Source: authors' illustration based on IIM 2017 data (IIM 2018) and cyclone data.

Table A2: Log income by year and location

	Beira	Chimoio	Observations
2011	12.2	12.47	25
2015	12.59	12.96	66
2016	12.2	12.63	65
Feb 2019	12.39	12.39	427
Apr 2019	7.26	10.64	427
Sep 2019	12.07	12.12	427

Note: means of log income; the samples only cover micro-sized enterprises. The observations for 2011–16 are much fewer than in Table A1 because many enterprises did not report financial information. The monthly data from 2019 were multiplied by 12 to make them comparable to the values of the previous years (2011–16).

Source: authors' calculations based on IIM 2012 and 2017 data (IIM 2013, 2018) and cyclone data.

Table A3: Summary statistics by treatment group and city

	Whole sample	Treated	Control	Beira	Chimoio
Income before Idai (Feb'19)	37,418	32,931	39,192	39,225	35,586
Income after Idai (Apr'19)	17,207	16,685	17,414	14,316	20,139
Income 6 months after Idai (Sep'19)	29,790	28,071	30,470	31,812	27,740
Income 1 year after Idai (Feb'20)	26,259	28,642	25,316	27,114	25,391
Savings before Idai (Feb'19)	3,705	2,311	4,256**	4,021	3,384
Savings after Idai (Apr'19)	1,034	581	1,214	810	1,261
Savings 6 months after Idai (Sep'19)	2,510	2,119	2,665	2,572	2,448
Savings 1 year after Idai (Feb'20)	2,993	3,052	2,969	3,043	2,943
Firms without employees	0.08	0.11	0.08	0.09	0.08
Firm size before Idai (Feb'19)	3.38	3.03	3.51*	3.53	3.23
Firm size after Idai (Apr'19)	2.93	2.60	3.06*	2.95	2.91
Firm size 6 months after Idai (Sep'19)	3.10	2.83	3.20	3.18	3.01
Firm size 1 year after Idai (Feb'20)	3.22	2.91	3.35	3.22	3.23
Roof damaged/destroyed	0.64	0.66	0.64	0.86	0.41
Roof repaired 6 months after Idai	0.78	0.82	0.76	0.79	0.75
Primary education	0.38	0.44	0.36	0.45	0.31***
Secondary education or higher	0.29	0.23	0.31	0.29	0.29
University degree	0.01	0.02	0.01	0.01	0.01
Business-related education	0.26	0.25	0.26	0.28	0.23
Informal	0.77	0.81	0.76	0.77	0.77
Female	0.10	0.06	0.11	0.12	0.08
Owner age	40.25	40.88	40.83	42.59	37.88***
Electricity access	0.79	0.80	0.78	0.80	0.78
Internet access	0.05	0.04	0.06	0.06	0.04
Smartphone owner	0.38	0.34	0.40	0.36	0.41
Bank loan	0.04	0.02	0.05	0.06	0.02**
Carpenter	0.35	0.31	0.37	0.39	0.32
Tailor	0.23	0.24	0.22	0.27	0.18**
Blacksmith	0.15	0.24	0.12***	0.13	0.18*
Food producer	0.10	0.08	0.10	0.06	0.14***
Observations	427	121	306	215	212

Note: *significance at a 10 per cent level, **significance at a 5 per cent level, and ***significance at a 1 per cent level.

Source: authors' calculations based on cyclone data.

Table A4: Treatment effect on firm performance (only Beira sample)

	Income FE	Profits FE	Savings FE	Roof repaired FE	Firm size FE
Treatment	1.792***	0.253**	1.743***	0.114**	0.193*
	(0.314)	(0.132)	(0.527)	(0.049)	(0.099)
Post-cyclone	-2.071***	-0.506***	-2.059***	0.040***	-0.104***
period (M)	(0.121)	(0.090)	(0.246)	(0.011)	(0.025)
Observations	1,075	1,075	1,075	866	761
Number of firms	215	215	215	186	205
R2	0.08	0.03	0.07	0.05	0.04

Note: robust standard errors in parentheses. Income, profit, savings, and firm size are logged. *Significance at a 10 per cent level, **significance at a 5 per cent level, and ***significance at a 1 per cent level.

Source: authors' calculations based on cyclone data.

Table A5: Treatment effect on firm performance (only Chimoio sample)

	Income FE	Profits FE	Savings FE	Roof repaired FE	Firm size FE
Treatment	0.042	0.016	1.653***	0.140	0.061
	(0.241)	(0.073)	(0.618)	(0.085)	(0.092)
Post-cyclone	-0.984***	-0.391***	-0.912***	0.054***	-0.044*
period (M)	(0.096)	(0.063)	(0.229)	(0.018)	(0.025)
Observations	1,060	1,060	1,060	409	767
Number of firms	212	212	212	93	202
R2	0.04	0.04	0.03	0.06	0.001

Note: robust standard errors in parentheses. Income, profit, savings, and firm size are logged.
*Significance at a 10 per cent level, **significance at a 5 per cent level, and ***significance at a 1 per cent level.

Source: authors' calculations based on cyclone data.

Table A6: Treatment effect on performance, using damage index instead of city dummy

	Income FE	Profits FE	Savings FE	Roof repaired FE	Firm size FE
Post-cyclone period	0.522***	0.161**	0.067	0.014	0.024
(M) X Treatment X	(0.160)	(0.082)	(0.271)	(0.045)	(0.045)
Damage index					
Post-cyclone period	-0.312***	-0.044	-0.323***	-0.006	-0.062***
(M) X Damage index	(0.056)	(0.058)	(0.112)	(0.008)	(0.012)
Post-cyclone period	-1.027***	-0.378***	-0.967***	0.059***	0.025
(M)	(0.107)	(0.082)	(0.236)	(0.022)	(0.023)
Observations	2,135	2,135	2,135	1,275	1,528
Number of firms	427	427	427	279	427
R2	0.07	0.03	0.05	0.05	0.03

Note: robust standard errors in parentheses. Income, profit, savings, and firm size are logged. *Significance at a 10 per cent level, **significance at a 5 per cent level, and ***significance at a 1 per cent level.

Source: authors' calculations based on cyclone data.