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Cyclone impacts on manufacturing firms in Mozambique

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Abstract: This study investigates how manufacturing companies were affected by tropical Cyclone Idai, which struck Central Mozambique in March 2019. The analysis builds upon a representative sample of 464 enterprises located in the cities of Beira and Chimoio which were interviewed 6 and 12 months after the natural disaster. While Beira was largely destroyed in the event, inland Chimoio was only affected to a minor degree, thus constituting our control group. Overall, we find that the cyclone had a large negative effect on income and profits, especially in the month immediately following landfall. Furthermore, the disaster hit some types of manufacturing firms much harder than others. For instance, businesses in the construction industry saw no significant decline in income, whereas micro enterprises, female-owned businesses, and tailors were among the most affected.

Key words: firms, natural disaster, tropical cyclone

JEL classification: O12, O14, Q54

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1 Introduction

Inclusive growth is at the top of the development agenda in Mozambique, and in many other countries that face a strong need to reduce poverty and improve their populations' well-being. One of the key aspects of inclusive growth strategies is facilitating private-sector job creation, specifically in the productive sectors like manufacturing. However, for years the manufacturing sector in Mozambique has been constrained by stagnating productivity growth due to many factors, including limited access to capital, a low-skilled workforce, and difficulties in complying with official rules. In addition, a steady flow of relatively cheap imported products from China and South Africa has left demand for locally produced goods in decline (Fisker and Schou 2018; IIM 2017).

On the night and morning of 14 and 15 March 2019, the largest city in Central Mozambique, Beira (population 530,000), was struck by the calamitous winds of Cyclone Idai. It has later been confirmed to be the most devastating weather-related disaster in the history of Southern Africa. Around 1,000 people died as a result of the cyclone, and according to estimates from the Red Cross, 80 per cent of the buildings in Beira were left fully or partly destroyed.

This study addresses the question: *What are the effects of exposure to Cyclone Idai on manufacturing firms' performance?* In order to answer this, we exploit a representative panel data set of manufacturing firms in the cyclone-hit city of Beira and a comparable control group in close-by Chimoio with data points corresponding to a month prior to Cyclone Idai and three follow-up rounds.

Extreme weather events such as storms, floods, and droughts cause direct and indirect damage to the economy. Direct damage implies capital and labour losses, often followed by indirect damage due to demand or supply constraints. Empirically, the immediate effects on gross domestic product and economic growth are mostly found to be negative, whereas research is inconclusive about the impacts' direction in the medium to long term. It seems to depend on the type and magnitude of the disaster, as well as the sector and country (Felbermayr and Gröschl 2014; Loayza et al. 2012; Panwar and Sen 2019). Low-income countries are affected more strongly and negatively by extreme weather events than are other regions. Floods often have positive growth effects, but when they are particularly severe, they may become negative. Storms generally seem to be negative for macroeconomic outcomes in developing states. However, the construction sector often benefits as it is involved in recovery measures, whereas other sectors suffer (Panwar and Sen 2019).

The theory is similarly indeterminate about the economic impact of extreme weather events. Neoclassical growth models and the 'recovery to trend' hypothesis state that if a shock destroys a country's capital stock, output per capita will immediately decrease. Next, more investment than usual is made to recover the initial capital stock. Higher capital accumulation leads to higher growth rates that remain until the pre-shock capital stock is reached and the country has regained its steady state, (i.e. its trend level). Consequently, long-run growth remains unaffected because the disaster's effects vanish over time (Felbermayr and Gröschl 2014; Kunze 2020; Noy and Nualsri 2007; Zhou and Botzen 2017). On the other hand, Schumpeter's creative destruction theory and the 'build back better' hypothesis argue that the destruction of capital opens up innovation opportunities. Upgraded technology and infrastructure replace the destroyed capital, which results in long-term economic growth (Crespo Cuaresma et al. 2008; Kunze 2020; Schumpeter 1982). In contrast, the 'no recovery' hypothesis claims that negative exogenous shocks like cyclones imply a permanent decline in income and no potential of ever reaching the pre-disaster state again. This might be driven by ineffective recovery measures (Kunze 2020).

Storms seem to be particularly damaging for the economy compared to other natural disaster types (Hsiang and Jina 2014). However, Berlemann and Wenzel (2018) found hurricanes to be favourable for long-term growth in high-income countries. This can probably be explained by capital being 'built back better', and that the more frequent replacement of capital leads to growth. The opposite seems to occur in low-income countries, where investment declines and the pre-shock capital stock is not quickly rebuilt, making it more difficult for the economy to fully recover (Kunze 2020). Besides agriculture, manufacturing is found to be the sector most affected by storms in low-income countries and, therefore, one of the main contributors to economic decline in the aftermath of a disaster (Krichene et al. 2020). As the impact of tropical cyclones is predicted to increase as a result of a rising global sea level, and the manufacturing sector remains crucial for economic development, it is essential to understand the potential consequences of cyclones on manufacturing firms in more detail (Szirmai 2009; Walsh et al. 2019).

Several studies have analysed the effects of a particular extreme weather event on firm outcomes in a country or region at a micro-economic level. Many show that firms experience a decline in output immediately after the disaster, which is followed by an economic boom (Coelli and Manasse 2014; Mohan et al. 2019). In the following, we focus on papers investigating the impacts of floods and storms on economic consequences because the enterprises in our study were hit by a tropical cyclone that also led to widespread floods. Elliott et al. (2019) demonstrate that a typhoon affected Chinese manufacturing firms negatively in terms of smaller turnover and profits for no longer than a year. In the same period, employment rose while wages fell. Concerning multiple hurricanes in the Caribbean islands, Mohan et al. (2019) find that they increased firms' production efficiency (relation of inputs to outputs) for about one year. In contrast, floods in Italy did not have a statistically significant effect on firms' value-added growth one year after the disaster but were significantly positive for value-added growth two years after the event (Coelli and Manasse 2014). Moreover, the authors show that both affected firms that received financial support and affected enterprises that did not receive any financial help experienced growth, but the former more than the latter. De Mel et al. (2012) illustrate that micro enterprises in Sri Lanka that were hit by a tsunami and received unconditional cash grants recovered within the first year after the disaster and two years before comparable enterprises that did not receive any help. Coffman and Noy (2012) examine the long-term consequences of Hurricane Iniki hitting the Hawaiian island of Kauai in 1992. They show that ten years after the disaster, the number of available jobs had returned to pre-Iniki levels, but even then had not recovered to pre-hurricane trends.

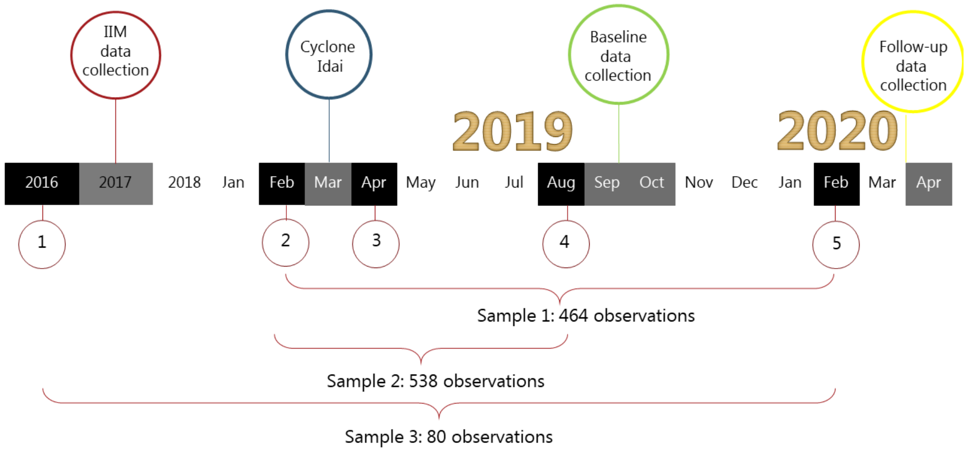
The present study confirms the theoretical expectations and existing empirical findings by demonstrating that in the short term large-scale negative weather-induced disasters can have profound negative implications for manufacturing companies in a low-income setting. However, six months after the cyclone, most firms have recovered to their pre-cyclone trend on a number of outcome indicators. Furthermore, the study contributes to the literature by disaggregating the effects by sector, size, ownership, formality, and years in operation, where substantial amounts of heterogeneity are exposed.

The remainder of the paper is organized as follows: First, we describe the data employed in the study, including summary statistics. Second, we outline the methodology with special attention to the parallel trends assumption of the difference-in-differences approach as well as the estimation models applied. Third, the results are presented starting with a baseline followed by heterogeneous effects and a check of robustness using an alternative sample. Finally, we conclude with a summary of the main findings and point to potential policy implications.

2 Data

The analysis in this paper is mainly based on a balanced panel data set that covers four different points in time between 2019 and 2020, as depicted by 'Sample 1' in Figure 1. The data originates from a survey implemented with the objective of understanding how micro, small, and medium-sized enterprises were impacted by and experienced Cyclone Idai. The project consists of a baseline survey, initiated five months after the cyclone in September 2019, and a follow-up survey, in which we collected data 13 months after the disaster in April 2020. While the survey consists of two rounds, it includes data on four different points in time that the firm owners recalled. Specifically, we asked the entrepreneurs about: (1) the month immediately before Idai (February 2019, recalled in September 2019); (2) the month immediately following Idai (April 2019, recalled in September 2019); (3) the fifth month after the cyclone (August 2019, recalled in September 2019); and (4) the eleventh month after the disaster (February 2020, recalled in April 2020).

Figure 1: Event timeline and samples



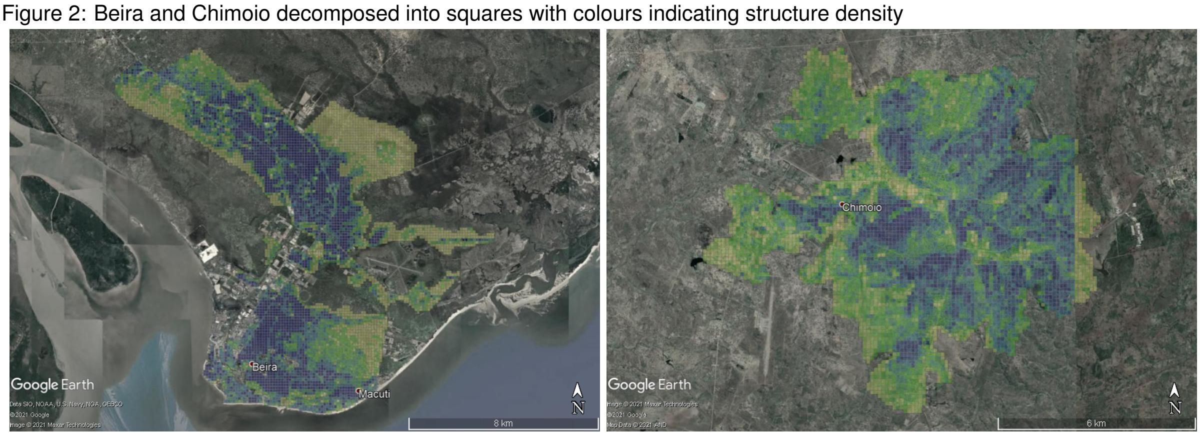
Source: authors' elaboration.

Sample 2, which is used as a robustness check, includes the same data as our first sample for the first three rounds: (1) the month immediately before Idai; (2) the month immediately after Idai; and (3) the fifth month after the disaster. The reason for excluding the eleventh month after the cyclone in this sample is to increase the number of observations due to the relatively high exit rate between the baseline and follow-up rounds, especially among the small and medium-sized enterprises (SMEs). Specifically, we aim at finding out whether we obtain different results when using the second instead of the main cyclone sample.

The main sample contains 464 observations, while Sample 2 without the follow-up round includes 538 enterprises. The exit rate of 14 per cent can partly be attributed to the COVID-19 pandemic, due to which the follow-up survey had to be conducted over the phone instead of personally. Many enterprises, and especially the SMEs, of which half (37 firms) dropped out, were unwilling to provide confidential information over the phone or were partly closed as a result of the crisis. Hence, even though they dropped out of the survey, they did not fully stop operating. Appendix Table A1 compares exit firms with Sample 1. Exit firms are statistically and significantly different from Sample 1, as they reported much higher income and savings, hire many more employees, have higher educated owners, and are more formal. The higher performance of exit firms also shows that it is unlikely they did not survive between our two data collection periods. Instead, exit firms might have been able to afford to close their operations at the beginning of the pandemic. Moreover, due to their higher productivity and formality, exit firms might have been more careful to provide information over the phone. As exit firms are fundamentally different from Sample 1, we have to be concerned about obtaining biased results using Sample 1. However, in Table A2 we compare Sample 1, which has fewer observations due to the exits, with Sample 2, which includes fewer points in time but also the exit firms. We find no statistically significant difference in income, savings, or any owner or firm characteristics between the two samples. Among SMEs only, Sample 1 has higher income, more employees, and higher educational levels. Due to the statistical insignificance of the differences between Sample 1 and Sample 2, our results are unlikely to be biased by firms that exited between the baseline and follow-up rounds.

A majority of enterprises in Mozambique are not registered with the government. For example, in Beira, the ratio of formal to informal enterprises is 1:17 (Jolevski and Ayana Aga 2019). The high incidence of informality implies that most firms are not traceable through official (government) lists, so it is challenging to locate all existing firms in the country. Thus, to create a representative sample of the manufacturing sector, we applied a stratified adaptive cluster sampling approach as described by Thompson (1990, 1991) and implemented in a similar way in Mozambique more recently by Jolevski and Ayana Aga (2019). We divided the cities of Beira and Chimoio into squares of 115 $\times$ 115 m, as depicted in 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 structure density in each cell, following Fisker et al. (2019). We located all enterprises operating in the selected squares and when one or more firms were found in one square, its neighbouring squares (i.e. the squares north, south, east and west of the square) were also inspected for businesses. We also interviewed 80 enterprises from the 2017 IIM survey, a process outlined in the next paragraph. In order to obtain a more complete sample of manufacturing firms with ten or more employees, we systematically inspected high-resolution satellite images of all areas of the two cities in search of buildings that could potentially host larger production units following the methods described in Fisker and Schou (2018). Each of these 'potential production units' then received a visit from a team of enumerators, who checked if it was indeed a manufacturing enterprise. With this approach, we located 51 SMEs that had not been part of our previous surveys.

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



Note: darker blue cells indicate areas with a higher density of buildings

Source: authors' illustration using ArcMap and Google Earth.

Lastly, to test the parallel trends assumption, a third sample combines the cyclone data set and data gathered in 2017, namely the Survey of Mozambican Manufacturing Firms (IIM 2017).[1] The IIM's objective is to investigate the development of the country's manufacturing sector over time. The IIM project interviewed manufacturing enterprises in seven of Mozambique's 11 provinces, but for our purposes we restrict the data set to firms in Beira and Chimoio. Sample 3 includes information on five points in time: (1) 2016; (2) February 2019 (the pre-cyclone month); (3) April 2019 (the post-cyclone month); (4) August 2019 (five months after the cyclone); and (5) February 2020 (11 months after the cyclone). The IIM project is based on Mozambique's enterprise census from 2002 (CEMPRE), and therefore it mostly includes firms formally registered with government authorities and which started operating before 2009. Nevertheless, during the interview process in 2012, additional firms were included with the help of snowballing techniques, and some of these are informal. Overall, the third sample includes 80 enterprises.

[1] IIM is an abbreviation of the questionnaire's Portuguese name: Inquérito às Indústrias Manufactureiras.

Firms in the third sample are unlikely to be representative of Mozambique's manufacturing sector. They are significantly different from the more representative first and second samples (see Appendix Table A2). They had significantly higher savings immediately before the cyclone occurred (MZN35,000 vs MZN15,000 and MZN24,000), and their firm owners are significantly older (49 vs 40 years). Moreover, the firms themselves are older as well (20 vs 12 years), a statistically significant smaller share operates informally (43 vs 71 and 66 per cent), they are significantly more likely to borrow money from a bank (13 vs 5 and 6 per cent), and are operative in different manufacturing industries than Samples 1 and 2 (9 per cent are tailors vs 21 and 20 per cent). Furthermore, firms in Sample 3 differ in a few more features, but these differences are statistically insignificant. For example, they spent more of their savings after the disaster because they reported smaller savings in the month following Idai (MZN4,000) than the other two samples (MZN7000 vs MZN12,000). Moreover, they seem to recover their pre-cyclone size at a slower pace because five months after the cyclone they only had 77 per cent of their pre-cyclone employees. In contrast, the other two samples had almost recovered their original size (96 and 97 per cent). Firm owners are also slightly better educated as 31 per cent have an education related to their business activity, while this is only the case for 25 per cent of Samples 1 and 2. Lastly, Sample 3 is slightly less risk-averse, and more likely to have electricity and internet access. Overall, we are interested in examining whether these more formal and experienced enterprises were affected by and coped with the cyclone differently from the first two samples, which are more representative of an average Mozambican manufacturing firm.

2.1 Descriptive statistics

In Table 1 we provide summary statistics by location (Beira, Chimoio) and firm size (micro enterprises and SMEs). About half of the sample's micro enterprises and two-thirds of the SMEs are located in Beira. Enterprises in Beira and Chimoio have statistically similar incomes, savings, and sizes. Prior to the disaster, micro enterprises in Beira earned MZN42,000 per month and micro business in Chimoio MZN39,000. SMEs had a much higher income than micro enterprises and sold on average around MZN1.7 million in Beira and MZN1.8 million per month in Chimoio. Firm income dropped sharply in April 2019, the month following Idai. In that month, income differences between the two cities were largest, indicating that the disaster had a stronger impact on Beira than on Chimoio. In Beira, the income of an average micro enterprise dropped to MZN15,000 (36 per cent of the pre-cyclone level) and in Chimoio only to MZN21,000 (54 per cent of the pre-cyclone income). Five months after the disaster, micro enterprises in both cities had recovered around 80 per cent of their pre-cyclone income, while SMEs earned even more than before the cyclone (112 per cent of pre-cyclone income). However, 11 months after the cyclone, incomes had dropped again, especially among SMEs, to a level that was even lower than in the month following Idai.

In terms of other firm and owner characteristics, enterprises in Beira and Chimoio are similar in the share of female owners/managers, smartphone usage, and levels of secondary education. However, we also found several statistically significant differences between the two cities: Beira had a larger share of firm owners with primary education (45 per cent) than Chimoio (31 per cent) because entrepreneurs in Chimoio are more likely to have pursued a technical education. For SMEs it is the other way around, with firm owners in Beira being less likely to only hold a primary degree (4 per cent) and more likely to have attended university (36 per cent) than business owners in Chimoio (25 and 8 per cent). Further, micro firms and their owners in Beira are older (14 and 43 years vs 10 and 38 years), more risk-averse (3.12 vs 3.44 on a scale from 0 (risk-loving) to 5 (risk-averse)), less likely to have heard of climate change (60 vs 70 per cent), more likely to have a bank loan (6 vs 2 per cent), more likely to be tailors (27 vs 18 per cent), and less likely to produce food or beverages (6 vs 15 per cent) than micro enterprises in Chimoio. Regarding Beira's SMEs and owners, they are younger than Chimoio's SMEs (9 and 36 years vs 14 and 43 years), more likely to be registered at the one-stop shop (BAÚ) (88 vs 42 per cent), to have their workers registered for social insurance (100 vs 83 per cent), and are much less likely to borrow money from a bank (8 vs 50 per cent).

For Chimoio to be a valid counterfactual, its firms should be comparable to Beira's enterprises. While firms in Beira and Chimoio do not differ significantly in our dependent variables, they do, however, showcase discrepancies in several firm characteristics. Therefore, we control for these characteristics in the regression analysis.

Table 1: Summary statistics

	Micro firms				SMEs			
	Beira [1]	Chim [2]	Diff. [1] – [2]	*p*-value	Beira [5]	Chim [6]	Diff. [5] – [6]	*p*-value
Dependent variables								
Income before Idai (in MZN1000)	41.56	38.81	2.75	0.69	1705.73	1787.42	–81.69	0.93
Income after Idai	14.54	20.76	–6.22	0.12	1455.21	1058.88	396.32	0.64
Income 6 months after Idai	32.99	30.18	2.81	0.62	2026.15	1741.74	284.40	0.78
Income 11 months after Idai	27.11	26.81	0.31	0.94	651.13	662.21	–11.09	0.97
Savings before Idai (in MZN1000)	4.50	4.09	0.41	0.73	100.18	201.44	–101.26	0.22
Savings after Idai	0.84	1.27	–0.43	0.29	83.74	63.61	20.12	0.76
Savings 6 months after Idai	3.23	2.66	0.58	0.56	98.18	146.71	–48.53	0.49
Savings 11 months after Idai	3.75	3.96	0.21	0.89	63.74	53.41	10.33	0.64
Firm size before Idai	3.54	3.31	0.23	0.39	50.64	26.92	23.72	0.43
Firm size after Idai	2.95	2.91	0.04	0.84	49.92	22.58	27.34	0.36
Firm size 6 months after Idai	3.18	3.01	0.17	0.46	53.12	23.42	29.71	0.33
Firm size 11 months after Idai	3.22	3.23	–0.01	0.98	56.36	23.67	32.69	0.36
Baseline owner characteristics								
Primary education	0.45	0.31	0.14	0.00	0.04	0.25	–0.21	0.06
Secondary education or above	0.29	0.29	0.00	0.99	0.64	0.67	–0.03	0.88
University degree	0.01	0.01	0.00	0.99	0.36	0.08	0.28	0.08
Business-related education	0.28	0.23	0.05	0.26	0.24	0.25	–0.01	0.95
Female	0.12	0.08	0.04	0.21	0.00	0.00	0.00	N/A
Smartphone	0.36	0.41	–0.05	0.27	0.84	0.83	0.01	0.96
Owner age	42.59	37.81	4.70	0.00	35.92	43.08	–7.16	0.12
Risk-loving (scale from 1 to 5)	3.12	3.44	–0.32	0.05	3.40	3.92	–0.52	0.41
Has heard of climate change	0.60	0.70	–0.10	0.03	0.92	0.92	–0.00	0.97
Baseline firm characteristics								
Firm age	13.98	9.51	4.47	0.00	9.44	13.92	–4.48	0.08
Informal	0.77	0.77	–0.00	0.97	0.00	0.00	0.00	N/A
BAÚ-registration	0.08	0.09	–0.02	0.58	0.88	0.42	0.46	0.00
Social security registration (INSS)	0.05	0.06	–0.02	0.50	1.00	0.83	0.17	0.04
Electricity access	0.80	0.78	0.01	0.76	1.00	1.00	0.00	N/A
Internet access	0.06	0.04	0.02	0.40	0.64	0.50	0.14	0.43
Bank loan	0.06	0.02	0.04	0.03	0.08	0.50	–0.42	0.00
Carpenter	0.39	0.32	0.07	0.13	0.12	0.25	–0.13	0.33
Tailor	0.27	0.18	0.08	0.03	0.04	0.00	0.04	0.50
Metal work	0.13	0.18	–0.06	0.10	0.08	0.08	0.00	0.97
Food and beverages	0.06	0.15	–0.09	0.00	0.36	0.42	0.06	0.75
Observations	215	212			25	12		

Note: mean estimates by city, their respective differences, and p-values of *t*-tests. Baseline characteristics are retrieved from the month immediately before Cyclone Idai (February 2019).
Source: authors' calculations based on Sample 1.

3 Methodology

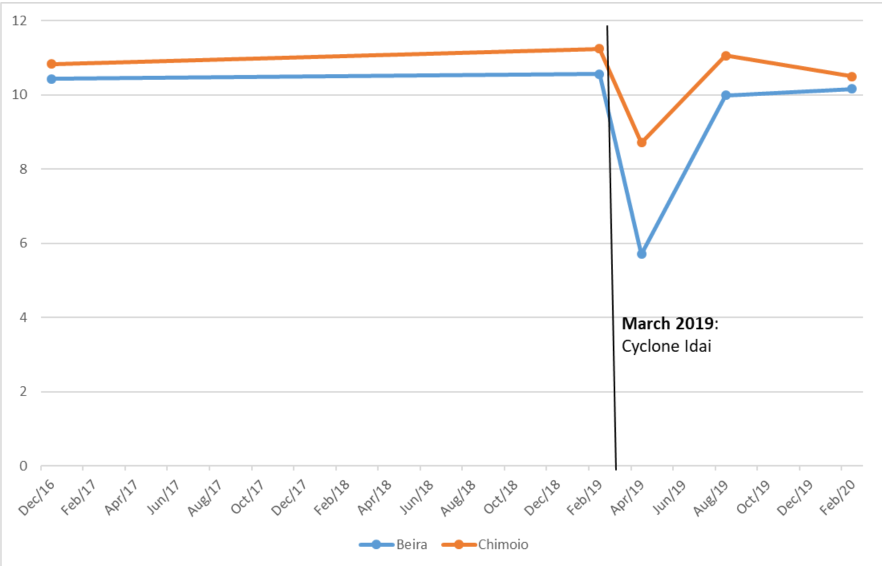
Our empirical approach exploits Cyclone Idai as an exogenous shock and the fact that the disaster hit the city of Beira and to a much smaller extent the city of Chimoio. Specifically, we count the cyclone as the treatment, and all firms located in Beira are classified as affected by the disaster, whereas Chimoio's enterprises are regarded as unaffected. We have one or several pre- and post-treatment periods depending on the sample. Our main sample involves one pre-treatment point in time (February 2019) and covers three post-treatment points (April 2019, August 2019, February 2020).

3.1 Parallel trends

Firm recovery does not only imply that firms manage to get back to their pre-cyclone levels. It also requires they reach the level at which they would have been had the cyclone not occurred. In the ideal world, we would be able to observe the same firm's outcome affected by the cyclone and in the absence of the cyclone. The difference between the affected and unaffected outcome would be the causal impact of the disaster. Unfortunately, it is impossible to know what would have happened to the same enterprise in the absence of Idai. Therefore, we need a reasonable counterfactual enterprise that was not hit by the cyclone and followed the same economic trends as the affected firm. We use the city of Chimoio as a counterfactual location. Chimoio is about 200 km away from Beira and was much less affected by Idai (COM 2019b). As Chimoio was affected to a smaller extent, it is unlikely that the city experienced an unobserved positive development.

The econometric analysis consists of a difference-in-differences (DD) approach, which estimates the causal impact of Cyclone Idai on firm income from sales, savings, and the number of employees. For a DD model to obtain valid estimates, it has to fulfil the parallel trends assumption. This implies that in the absence of Idai, the difference between Beira (the treatment group) and Chimoio (the control group), would have been constant over time. We do not have information of more than one pre-treatment point for all enterprises in the main data set. However, we can use Sample 3 to examine the development of 80 firms' incomes in Beira and Chimoio over a longer period of time. Figure 3 illustrates enterprises' average incomes over time. In 2016, the average income level in both cities was similar and the difference statistically insignificant. In February 2019, immediately before Cyclone Idai occurred, the income level in both locations was almost the same as in 2016. Following the disaster, in April 2019, the decline in mean income in Beira was statistically and significantly larger than that in Chimoio. Next, both locations experienced an increase in income some five months after the cyclone; in August 2019, it had not recovered to pre-disaster levels and continued to be significantly lower in Beira than in Chimoio. About one year following Cyclone Idai, the income had not continued on the recovery pathway, but had slightly declined. However, the difference between the treatment and control location was statistically insignificant again, as in pre-cyclone times. Overall, firms in the two cities seem to follow the same trends over time and, therefore, our estimates are likely to be valid.

Figure 3: Mean of log income over time (Sample 3)



Source: authors' illustration using Sample 3.

3.2 Estimation models

We aim at estimating the causal impact of Cyclone Idai on firm outcomes by applying a DD approach:

$$Y_{i,t} = \alpha_i + \beta_1 Beira_i \times PC_t + \beta_2 Beira_i + \beta_3 PC_t + \beta_4 X_{i,t} + \varepsilon_{i,t} \tag{1}$$

in which $Y_{i,t}$ represents the outcome of interest for firm i at time t. *Beira* is a dummy variable indicating whether a firm is located in Beira (1) or in Chimoio (0). PC (post-cyclone) equals 0 when the observation is from before the cyclone and switches to 1 for all observations after the disaster. The estimate of interest is β_1, an interaction term representing all firms in Beira in the post-cyclone period. Firm-level fixed effects are captured by α_i, while $X_{i,t}$ represents a set of firm-specific controls that differ between Beira and Chimoio.

Equation 1 estimates the average effect of Cyclone Idai over the entire post-cyclone period covered by our data set. However, the cyclone's impact is likely to vary over time. We expect the impact to be biggest directly after the disaster. To explore the differential impact of Cyclone Idai over time, we create interaction terms of Beira and each post-cyclone point in time:

$$\begin{aligned} Y_{i,t} = \alpha_i &+ \beta_1 Beira_i \times Apr19_t + \beta_2 Beira_i \times Aug19_t + \beta_3 Beira_i \times Feb20_t \\ &+ \beta_4 Beira_i + \beta_5 Apr19_t + \beta_6 Aug19_t + \beta_6 Feb20_t + \beta_4 X_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{2}$$

where *Beira* is interacted with dummy variables for each of the data points after the cyclone. Additionally, in order to differentiate the effects between types of firms, we introduce a model with heterogeneous effects, and we separate the sample into sub-samples and apply ordinary least squares (OLS) to Equation 1 for each group. Finally, as a test to the robustness of our results, we further estimate Equation 1 (all firms and sub-groups) and Equation 2 on a sample that contains more observations but fewer time periods (Sample 2), as well as for the small sample of firms that are part of the IIM survey and thus contain data points from 2017 as well (Sample 3).

4 Results

This section outlines how the manufacturing sector in Mozambique reacted to the impacts of Cyclone Idai. First, we report general results, then separate the findings by time and sub-group, and finally we check the robustness by using different samples.

4.1 Cyclone impacts on manufacturing firms

The main aim of our paper is to investigate Cyclone Idai's impact on manufacturing enterprises. To meet this goal, we first illustrate the cyclone's average causal effect on firm income in Table 2. Column 1 illustrates that firms located in Beira generally have a lower income than Chimoio's enterprises. Similarly, the post-cyclone period is negatively associated with the outcome variable. In column 2, we add our estimate of interest, the interaction term of being located in Beira in the post-cyclone period, as well as a few control variables. We find that the effect of being exposed to the cyclone is a reduction of an average firm's income by 111 per cent. We obtain exactly the same magnitude when including random effects instead of OLS.

Next, we implement the same DD analysis, but with alternative outcome variables in Table 3. We find that the cyclone reduced firms' profits and savings within the margin of statistical significance. Specifically, an average firm's profits were reduced by 94 per cent and its savings by 97 per cent. We also find that Cyclone Idai did not have a statistically significant effect on firm size and the enterprises' likelihood to invest. It is surprising to find that Idai did not lead to a measurable reduction in employment as newspapers reported a loss of 12,000 jobs in large companies alone during the months following the disaster (COM 2019a). On the other hand, studies from other countries have even shown a positive effect of disasters on employment (Elliott et al. 2019; Leiter et al. 2009), such that an insignificant impact of the cyclone on the number of jobs is not out of line.

Table 2: Cyclone Idai and firm income

	[1] OLS Income	[2] OLS Income	[3] RE Income
Beira	–0.6391***	0.2850**	0.2790*
	(0.1371)	(0.1417)	(0.1476)
Post-cyclone (PC)	–1.3717***	–0.8129***	–0.8096***
	(0.1163)	(0.1289)	(0.0801)
Beira × PC		–1.1076***	–1.1109***
		(0.2231)	(0.1424)
Primary education		–0.7025***	–0.6409***
		(0.1469)	(0.1592)
Owner age		–0.0063	–0.0053
		(0.0055)	(0.0068)
Bank loan		0.7746**	0.5700
		(0.3479)	(0.3621)
Observations	1,856	1,856	1,856
Number of firms	464	464	464
Adjusted R^2	0.05	0.07	0.06

Note: the dependent variable is logged. Robust standard errors are reported in parentheses. *** $p < < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: authors' calculations based on Sample 1.

Table 3: Cyclone Idai and other firm outcomes

	[1] Profits	[2] Savings	[3] Firm size	[4] Investments
Beira	0.371**	0.646	0.219**	0.112**
	(0.155)	(0.405)	(0.085)	(0.044)
Post-cyclone (PC)	–0.828***	–0.880***	–0.054	–0.153***
	(0.137)	(0.329)	(0.062)	(0.035)
Beira × PC	–0.942***	–0.969**	–0.009	–0.027
	(0.230)	(0.464)	(0.097)	(0.050)
Primary education	–0.628***	–1.389***	–0.346***	–0.096***
	(0.142)	(0.209)	(0.042)	(0.022)
Owner age	–0.008	0.005	–0.004***	–0.001
	(0.005)	(0.008)	(0.002)	(0.001)
Bank loan	0.792**	1.737***	0.628***	0.245***
	(0.367)	(0.483)	(0.109)	(0.057)
Observations	1,704	1,856	1,677	1,429
Number of firms	426	464	444	464
Adjusted R^2	0.07	0.04	0.01	0.05

Note: profits, savings, and firm size are logged. Robust standard errors are reported in parentheses. We have fewer observations for profits because it is not possible to take the log of negative profits. All firms that were excluded from the regression in column 1 reported negative profits in at least one of the observed time periods. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: authors' calculations based on Sample 1.

4.2 Heterogeneous effects

Besides estimating the average effect over the post-cyclone period, we look into the dynamic evolution of the DD effect and estimate our model for different periods after Cyclone Idai occurred. Table 4 shows that the cyclone had a large negative effect on income, profits, and savings in April 2019, the month immediately following the cyclone. Despite this, not even in that month did the number of workers decrease significantly. While the cyclone did not seem to have any effect on profits five months after its occurrence, it had a significantly negative impact again in February 2020. However, we cannot detect any significant impact on the other outcome variables five months (August 2019) or 11 months (February 2020) after the shock. Hence, the cyclone's impact seemed to level off quickly. This is comparable to what has been found in China, where a typhoon did not impact manufacturing firms for more than one year (Elliott et al. 2019).

When comparing our results to theoretical predictions about the economic effects of disasters, they fit best with the 'recovery to trend' hypothesis, which claims an immediate negative impact following the shock but a recovery afterwards, implying that the disaster's effects vanish over time. Accordingly, the effects disappear because more investments than usual are made to recover pre-cyclone levels. Once the pre-cyclone state is recovered, the economy's steady state is reached again. In Beira, large amounts of aid were delivered in the three months following the cyclone, which might have stimulated demand for manufactured goods. Half a year later, at the time of our data collection, Beira's manufacturing enterprises had already recovered 95 per cent of the pre-cyclone levels. While such a quick recovery may seem surprising, it is not unusual as other studies have also found that businesses in a developing-country context recovered in a short period by using their own savings and help from family and friends (de Mel et al. 2012). Furthermore, when our survey started in September 2019, Beira already appeared quite organized, with the main remnant of the cyclone being that many roofs were still missing or undergoing reconstruction.

Table 4: Cyclone Idai and differential effects over time

	[1] Income	[2] Profits	[3] Savings	[4] Firm zize
Beira × Apr 19	–3.234***	–2.793***	–1.469***	–0.055
	(0.432)	(0.424)	(0.523)	(0.118)
Beira × Aug 19	–0.119	–0.087	–0.847	–0.008
	(0.214)	(0.228)	(0.565)	(0.118)
Beira × Feb 20	–0.029	–0.750***	–0.596	0.039
	(0.194)	(0.165)	(0.576)	(0.122)
Observations	1,856	1,704	1,856	1,677
Number of firms	464	426	464	444
Adjusted R^2	0.28	0.22	0.11	0.09

Note: robust standard errors are reported in parentheses. We have fewer observations for profits because it is not possible to take the log of negative profits. All firms that were excluded from the regression in column 2 reported negative profits in at least one of the observed time periods. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: authors' calculations based on Sample 1.

Lastly, Table 5 investigates the cyclone's impact on sub-groups. The disaster's effect was particularly negative for blacksmiths and tailors, as they experienced an income reduction of 134 and 132 per cent, respectively. However, relative to the remaining sectors, the difference is not statistically significant, as shown by Appendix Table A3. Another outstanding result is that Idai did not seem to have a statistically significant negative impact on carpenters or brick makers, perhaps because firms in these sub-groups experienced higher demand as they were involved in immediate reconstruction works. Businesses owned or managed by women and micro businesses faced an income decline that was slightly larger than, but not statistically different from, the sample's average enterprise. On the other hand, informal firms and firms with owners or managers who are at least 51 years old had a lower than average income reduction.

Table 5: Cyclone Idai and sub-groups' income

	[1] All	[2] Micro	[3] Informal	[4] Old owner	[5] Female	[6] Carpenter	[7] Tailor	[8] Blacksmith	[9] Brick maker
Beira	0.285**	0.035	–0.030	0.183	0.175	–0.370	0.357	0.413	1.340**
	(0.142)	(0.118)	(0.154)	(0.321)	(0.217)	(0.449)	(0.262)	(0.311)	(0.496)
Post-cyclone (PC)	–0.813***	–0.822***	–0.879***	–0.948***	1.075***	–0.972**	–0.490**	–0.678***	–0.465
	(0.129)	(0.119)	(0.154)	(0.350)	(0.209)	(0.455)	(0.243)	(0.248)	(0.474)
Beira × PC	–1.108***	–1.134***	–0.987***	–0.844*	–1.175***	–0.972	–1.316***	–1.342**	–0.551
	(0.223)	(0.207)	(0.268)	(0.457)	(0.368)	(0.707)	(0.387)	(0.530)	(0.694)
Observations	1,856	1,708	977	493	647	165	392	282	146
Number of firms	464	427	242–251	119–136	162	39–42	98	69–71	36–38
Adjusted R^2	0.07	0.08	0.09	0.08	0.08	0.13	0.09	0.07	0.08

Note: the dependent variable is logged. Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: authors' calculations based on Sample 1.

4.3 Robustness

In this section we explore the robustness of our results, running the same regressions as in the previous section and using Sample 2 instead—that is, a sample with fewer time periods but more observations. It is especially interesting to explore this sample with more observations due to the high exit rate between our baseline and follow-up survey rounds. If enterprises dropped out of the survey between the two rounds because they closed down their operations as a result of the cyclone, our results of Sample 1 will be biased, as they will only focus on the firms that survived the disaster. However, when asked, most of the exit enterprises rather stopped their survey participation because they were unwilling to be interviewed over the phone or were partly closed due to the COVID-19 pandemic. These exit firms are statistically different from Sample 1 because they earn higher incomes, are bigger, and are more formal.

Table A4 shows that Cyclone Idai had significantly negative effects on income, profits, and savings. The effect magnitudes are stronger than in the case of Sample 1, which is probably driven by the fact that we are looking at a shorter time period (April–August 2019) than when using Sample 1 (April 2019–February 2020). Yet, just like in the case of Sample 1, we do not find any statistically significant impact of the cyclone on firm size and the likelihood to invest.

Now we turn to explore differential effects over time in Table A5. We find that Sample 2's average income decreased by 294 per cent and its profits by 257 per cent in the month following the cyclone. This effect is slightly smaller than for Sample 1, which experienced a decrease of 323 per cent in income and of 279 per cent in profits. The smaller effect of Sample 2 is likely to be driven by bigger enterprises being less vulnerable to the disaster, while also being less likely to participate in the follow-up survey round. Nevertheless, these findings confirm the robustness of our results. In the case of savings, the effect magnitude is exactly the same for both samples (i.e. savings dropped by 147 per cent).

Next, we compare the disaster's impact across sub-groups in Table 6. We find that the average effect is slightly stronger for the firms of Sample 1 relative to Sample 2 (168 vs 147 per cent income reduction). However, in both samples, micro-sized firms (163–173 per cent), businesses managed or owned by women (152–176 per cent), carpenters (159–182 per cent), tailors (150–173 per cent), and blacksmiths (150–184 per cent) are slightly more strongly affected than the average firm. Informal businesses (137–149 per cent) and firms with elderly owners are slightly less impacted than average. Moreover, firms that produce bricks were not affected by the cyclone in a statistical sense. Overall, Idai's impact on sub-groups does not seem to be biased by the choice of sample, implying that our main sample is representative despite the exit rate.

Lastly, we take a look at Sample 3, which is restricted to 80 so-called IIM firms that were already included in previous enterprise surveys. Appendix Tables A6 and A7 show that these firms, which are generally older and more formal than the remaining enterprises, experienced a smaller impact of the cyclone. Their income reduced by 244 per cent directly after the cyclone, whereas the mean reduction of Sample 1 was 323 per cent. Moreover, we cannot detect any statistically significant impact on profits, but this might be due to a small number of observations. Overall, these IIM firms, which have been operating in the manufacturing sector for a much longer time and are more formal than an average Mozambican manufacturing enterprise, were less strongly hit by Cyclone Idai.

Table 6: Cyclone Idai and sub-groups' income, Sample 2

	[1] All	[2] Micro	[3] Informal	[4] Old owner	[5] Female	[6] Carpenter	[7] Tailor	[8] Blacksmith	[9] Brick maker
Beira	0.431***	0.109	0.076	0.081	–0.321	0.146	0.530*	0.721**	0.789*
	(0.147)	(0.118)	(0.158)	(0.320)	(0.239)	(0.239)	(0.285)	(0.323)	(0.459)
Post-cyclone (PC)	–1.003***	–1.030***	–1.184***	–0.971**	0.952*	–1.420***	–0.783***	–1.061***	–0.380
	(0.163)	(0.146)	(0.194)	(0.407)	(0.531)	(0.269)	(0.299)	(0.325)	(0.553)
Beira × PC	–1.473***	–1.629***	–1.370***	–1.456***	–1.524*	–1.586***	–1.502***	–1.497**	–1.118
	(0.276)	(0.259)	(0.338)	(0.543)	(0.842)	(0.472)	(0.491)	(0.695)	(0.808)
Observations	1,614	1,389	783	423	132	534	315	228	138
Number of firms	538	463	261	141	44	179	105	76	46
Adjusted R^2	0.11	0.12	0.14	0.15	0.17	0.13	0.12	0.09	0.05
Sample 1	–1.677***	–1.726***	–1.492***	–1.471**	–1.760**	–1.816***	–1.727***	–1.842***	–0.862
Beira × PC	(0.282)	(0.269)	(0.350)	(0.582)	(0.856)	(0.478)	(0.490)	(0.670)	(0.865)
Observations	1,392	1,281	726	357	126	486	294	213	108
Number of firms	464	427	242	119	42	162	98	71	36
Adjusted R^2	0.11	0.13	0.15	0.14	0.19	0.14	0.14	0.12	0.08

Note: the dependent variable is logged. Robust standard errors are reported in parentheses. The last five rows report results of the same regression for Sample 1, excluding the period of February 2020. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: authors' calculations based on Sample 2.

5 Conclusion

In countries like Mozambique, cyclone disasters may induce large negative effects on the performance of manufacturing firms. When directly comparing firms in the city of Beira, which was strongly affected by Cyclone Idai, with a control group in Chimoio, 200 km inland, the post-cyclone DD was around 111 per cent for income and 94 per cent for profits. However, these numbers hide substantial heterogeneity across time and sub-groups. Almost all of the effect is attributable to a large decline in the month immediately after the cyclone. Five and 11 months after the shock, most firms had returned to their pre-cyclone trends.

Furthermore, some types of firms were harder hit by the destruction of the cyclone than others. For instance, manufacturing firms in the construction sector saw no significant decline or increase in income. Micro-sized firms, female owned firms, and tailors were among the most affected. Lastly, the so-called IIM firms, which have been included in previous enterprise surveys, seem to have suffered less damage than the average Mozambican manufacturing enterprise.

From a practical perspective, the most important findings in this study are that in the presence of a large-scale cyclone event, certain manufacturing firms face strong, but temporary, negative effects. This is an argument for governments and international aid organizations to provide temporary support for manufacturing firms until local demand for products has returned. For firm owners, the results underline the importance of having a secure stock of raw materials, especially firms operating in the construction industry, where demand for services might go up and supply of materials become limited.

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Appendix A

Table A1: Comparison of exit firms and Sample 1

	Exit [1]	Sample 1 [2]	Diff. [1] – [2]	*p*-value
Dependent variables				
Income before Idai	1010.12	175.12	835.00	0.00
Income after Idai	902.83	122.01	780.81	0.00
Income 6 months after Idai	1145.98	183.29	962.69	0.00
Savings before Idai	80.99	14.56	66.42	0.00
Savings after Idai	45.68	7.12	38.55	0.00
Savings 6 months after Idai	68.79	11.80	56.99	0.00
Firm size before Idai	34.68	6.58	28.10	0.00
Firm size after Idai	33.69	5.97	27.72	0.00
Firm size 6 months after Idai	33.85	6.32	27.53	0.00
Baseline owner characteristics				
Primary education	0.18	0.36	–0.18	0.00
Secondary education or above	0.68	0.32	0.36	0.00
University degree	0.32	0.03	0.29	0.00
Business-related education	0.20	0.25	0.05	0.34
Female	0.03	0.09	–0.06	0.06
Smartphone	0.69	0.42	0.27	0.00
Owner age	42.58	40.09	2.49	0.15
Risk-loving (scale from 1 to 5)	3.62	3.30	0.31	0.13
Has heard of climate change	0.78	0.67	0.11	0.06
Baseline firm characteristics				
Firm age	13.78	11.69	2.09	0.11
Informal	0.34	0.71	–0.37	0.00
BAÚ registration	0.49	0.14	0.35	0.00
INSS	0.61	0.13	0.48	0.00
Electricity access	0.85	0.81	0.05	0.35
Internet access	0.43	0.09	0.34	0.00
Bank loan	0.12	0.05	0.07	0.02
Carpenter	0.22	0.34	–0.12	0.03
Tailor	0.09	0.21	–0.12	0.02
Metal work	0.07	0.15	0.09	0.05
Food and beverages	0.16	0.12	0.04	0.35
Observations	74	464		

Note: mean estimates by city, their respective differences, and *p*-values of *t*-tests. Baseline characteristics are retrieved from the month immediately before Cyclone Idai (February 2019).
Source: authors' calculations based on the third IIM cyclone sample.

Table A2: Sample comparison

	Sample 1 [1]	Sample 2 [2]	Sample 3 [3]	Diff. [1] – [3]	*p*-value	Diff. [2] – [3]	*p*-value
Dependent variables							
Income before Idai (in MZN1000)	175.12	289.97	220.11	–44.99	0.66	69.86	0.59
Income after Idai	122.01	229.41	66.69	55.32	0.51	162.72	0.17
Income 6 months after Idai	183.29	315.70	207.70	–24.41	0.84	108.00	0.46
Savings before Idai (MZN1000)	14.56	23.70	34.83	–20.26	0.05	11.13	0.36
Savings after Idai	7.12	12.43	3.94	3.19	0.60	8.49	0.30
Savings 6 months after Idai	11.80	19.64	15.10	–3.30	0.67	4.54	0.66
Firm size before Idai	6.58	10.44	7.16	–0.58	0.84	3.28.	0.43
Firm size after Idai	5.97	9.78	5.21	0.76	0.79	4.57	0.26
Firm size 6 months after Idai	6.32	10.10	5.54	0.78	0.79	4.57	0.27
Baseline owner characteristics							
Primary education	0.36	0.33	0.35	0.01	0.86	–0.02	0.79
Secondary education or above	0.32	0.37	0.39	–0.07	0.21	–0.02	0.71
University degree	0.03	0.07	0.05	–0.02	0.50	0.02	0.43
Business-related education	0.25	0.25	0.31	–0.06	0.28	–0.07	0.21
Female	0.09	0.08	0.14	–0.05	0.19	–0.06	0.10
Smartphone	0.42	0.46	0.48	–0.05	0.36	–0.02	0.77
Owner age	40.09	40.44	49.08	–8.98	0.00	–8.64	0.00
Risk-loving (scale from 1 to 5)	3.30	3.34	3.59	–0.29	0.15	–0.24	0.22
Has heard of climate change	0.67	0.69	.70	–0.03	0.63	–0.01	0.82
Baseline firm characteristics							
Firm age	11.69	11.98	20.4	–8.71	0.00	–8.42	0.00
Informal	0.71	0.66	0.43	0.29	0.00	0.23	0.00
BAÚ registration	0.14	0.19	0.28	–0.14	0.00	–0.09	0.06
INSS	0.13	0.20	0.21	–0.08	0.06	–0.01	0.78
Electricity access	0.81	0.81	0.88	–0.07	0.14	–0.06	0.17
Internet access	0.09	0.14	0.18	–0.08	0.03	–0.03	0.43
Bank loan	0.05	0.06	0.13	–0.07	0.02	–0.06	0.05
Carpenter	0.34	0.32	0.38	–0.03	0.55	–0.05	0.36
Tailor	0.21	0.20	0.09	0.12	0.01	0.11	0.02
Metal work	0.15	0.14	0.14	0.02	0.72	0.00	0.93
Food and beverages	0.12	0.13	0.16	–0.04	0.33	–0.03	0.40
Observations	464	538	80				

Note: mean estimates by city, their respective differences and p-values of t-tests. Baseline characteristics are retrieved from the month immediately before cyclone Idai, i.e. February 2019.
Source: authors' calculations based on second cyclone sample.

Table A3: Cyclone Idai and heterogeneous income effects

	[1] Micro	[2] Informal	[3] Old	[4] Female	[5] Carpenter	[6] Tailor	[7] Blacksmith	[8] Brick maker
Beira × PC × sub-group	–0.074	0.252	–0.361	0.137	–0.080	–0.244	–0.246	0.845
	(0.755)	(0.426)	(0.527)	(0.718)	(0.459)	(0.461)	(0.579)	(0.751)
Beira	0.325	0.453**	0.327**	0.367**	0.338*	0.368**	0.222	0.234
	(0.510)	(0.208)	(0.162)	(0.150)	(0.186)	(0.152)	(0.158	(0.147))
Sub-group	–3.356***	–1.065***	0.222	0.256	0.410***	–1.399***	–0.626***	0.277
	(0.478)	(0.177)	(0.368)	(0.324)	(0.172)	(0.195)	(0.192)	(0.434)
Post-cyclone (PC)	–0.500	–0.680***	–0.781***	–0.801***	–0.682***	–0.879***	–0.839***	–0.825***
	(0.506)	(0.194)	(0.138)	(0.135)	(0.162)	(0.140)	(0.146)	(0.133)
Beira × PC	–1.069	–1.258***	–1.205***	–1.119***	–1.064***	–1.079***	–1.070***	–1.184***
	(0.726)	(0.331)	(0.270)	(0.236)	(0.280)	(0.255)	(0.245)	(0.234)
Beira × sub-group	–0.264	–0.474*	–0.176	–0.842*	–0.191	–0.012	0.245	0.532
	(0.531)	(0.255)	(0.352)	(0.440)	(0.268)	(0.285)	(0.323)	(0.528)
PC × sub-group	–0.316	–0.196	–0.164	–0.154	–0.394	0.395	0.140	0.190
	(0.520)	(0.248)	(0.374)	(0.453)	(0.262)	(0.279)	(0.293)	(0.548)
Observations	1,856	1,856	1,856	1,856	1,856	1,856	1,856	1,856
Number of firms	464	464	464	464	464	464	464	464
Adjusted R^2	0.18	0.12	0.07	0.07	0.10	0.10	0.08	0.08

Note: OLS regression. Dependent variable: logged income. Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: authors' calculations based on Sample 1.

Table A4: Cyclone Idai and firm outcomes, Sample 2

	[1] Income	[2] Profits	[3] Savings	[4] Firm size	[5] Investment
Beira	0.431***	0.519***	0.785**	0.268***	0.105**
	(0.147)	(0.160)	(0.389)	(0.094)	(0.041)
Post-cyclone (PC)	–1.003***	–0.898***	–1.418***	–0.070	–0.159***
	(0.163)	(0.166)	(0.334)	(0.076)	(0.032)
Beira × PC	–1.473***	–1.309***	–1.071*	–0.026	–0.010
	(0.276)	(0.277)	(0.466)	(0.113)	(0.047)
Observations	1,614	1,482	1,614	1,486	1,614
Number of firms	538	494	538	493–498	538
Adjusted R^2	0.11	0.10	0.09	0.13	0.08

Note: profits, savings, and firm size are logged. Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: authors' calculations based on Sample 2.

Table A5: Cyclone Idai and differential effects over time, Sample 2

	[1] Income	[2] Profits	[3] Savings	[4] Firm size
Beira × Apr 19	–2.936***	–2.568***	–1.465***	–0.043
	(0.420)	(0.414)	(0.512)	(0.131)
Beira × Aug 19	–0.010	–0.050	–0.677	–0.009
	(0.224)	(0.240)	(0.544)	(0.131)
Observations	1,614	1,482	1,614	1,486
Number of firms	538	426	538	493–498
Adjusted R^2	0.25	0.22	0.12	0.13

Note: income, profits, savings, and firm size are logged. Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: authors' calculations based on Sample 2.

Table A6: Cyclone Idai and firm outcomes, Sample 3

	[1] Income	[2] Profits	[3] Savings	[4] Firm size
Beira	–0.509**	–0.757*	–0.349	–0.267**
	(0.246)	(0.384)	(1.073)	(0.110)
Post-cyclone (PC)	–0.951***	–1.180***	–2.200**	–0.181*
	(0.339)	(0.446)	(0.976)	(0.108)
Beira × PC	–0.917*	–0.601	–0.690	0.164
	(0.499)	(0.585)	(1.225)	(0.131)
Observations	400	272	320	400
Number of firms	80	68	80	80
Adjusted R2	0.10	0.09	0.10	0.07

Note: profits, savings, and firm size are logged. Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: authors' calculations based on Sample 3.

Table A7: Cyclone Idai and differential effects over time, Sample 3

	[1] Income	[2] Profits	[3] Savings	[4] Firm size
Beira × Apr 19	–2.443**	–1.760	–0.417	0.092
	(1.115)	(1.174)	(1.434)	(0.164)
Beira × Aug 19	–0.504	–0.381	–1.185	0.179
	(0.445)	(0.593)	(1.520)	(0.163)
Beira × Feb 20	0.198	0.339	–0.475	0.221
	(0.368)	(0.528)	(1.463)	(0.174)
Observations	400	272	320	400
Number of firms	80	68	80	80
Adjusted R^2	0.29	0.23	0.16	0.07

Note: income, profits, savings, and firm size are logged. Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Source: authors' calculations based on Sample 3.