The Impact of Cyclone Idai on Retail Credit in Mozambique

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Abstract

Climate change has presented several risks to financial institutions. Physical risk, arising from the higher occurrences and severity of extreme weather events has a direct impact on credit risk. Banks need to be agile and dynamic by creating playbooks of 'what if' scenarios for climate risk events by learning from previous events through analytics.

In March 2019, Cyclone Idai caused a humanitarian crisis in Mozambique, Zimbabwe, and Malawi, and was named the deadliest cyclone in the southwest Indian Ocean taking the lives of 1500 people.

This paper suggests an analysis of retail credit repayment behavior following the Idai cyclone in Mozambique. The analysis will help banks to understand different customer credit behaviors after extreme weather events. The better understanding will hopefully lead to better strategies to help customers become more resilient to such events, and how banks can adjust their lending strategies to help manage their risk.

Introduction

Mozambique is divided into 10 provinces with a local bank observed having its largest footprint in Maputo province in the south, which has the capital of the country, and the second largest in Sofala province based in central Mozambique.

The economy of Mozambique is mainly driven by natural resources (liquefied natural gas, coal, gold, aluminum), and agriculture (sugar, tobacco, nuts & forestry).

Mozambique is located on the southeastern region of the Indian Ocean in southern Africa and has had a history of cyclones. The cyclones mostly form in central Mozambique and then either move south or north.

Cyclone Idai formed in central Mozambique (refer to Figure 1) affecting provinces Sofala[7] and Manica[6], then moved north affecting Zambezia[5] and Tete[4]. Cyclone Idai caused a humanitarian crisis in Mozambique, Zimbabwe, and Malawi, and was the second deadliest cyclone on record in the region.

Credit risk is affected by two climate-related risks: physical and transition risk. Physical risk is caused by the increased frequency and severity of adverse weather events such as droughts, fires, cyclones, and floods. Transition risks arise from changes in policies related to transitioning to a low fossil fuel economy. These would include carbon taxes, consumer sentiments, regulations, and investor pressure.

This paper aims to analyze retail customer loan repayment patterns before and after Cyclone Idai to better understand behaviours during cyclones, and to better strategize a banking credit book in the event of adverse weather conditions.

North Mozambique
1. Niassa
2. Cabo Delgado
3. Nampula

Central Mozambique
4. Tete
5. Zambezia
6. Manica
7. Sofala

South Mozambique
8. Gaza
9. Inhambane
10. Maputo

Figure 1: Map of Mozambique

Management Actions

During the cyclone period, the bank decided to support its customers through two initiatives. Firstly, by offering payment holidays to customers in affected areas, and secondly, by providing top-up loans for customers to help rebuild after the cyclone.

Payment Holidays

As the cyclone disrupted most economic activity in the affected areas, the government asked banks to support customers during this difficult time by offering payment relief. The government, however, continued to pay salaries to its employees during this distress period.

The approach followed by the bank was to segment customers by branch locations and to automatically assign payment holidays to all qualifying customers in the affected areas. The automatic assignment of payment holidays was based on the assumption that the bank would be unable to reach customers during the storm period and getting responses would be very difficult. Customers had no access to roads, electricity, or internet, and overall limited communication during this period.

After the cyclone, customers signed updated agreements where loan maturity dates increased by 3 months to reflect the time lost due to the cyclone. During this period the business team also allowed customers to opt out of the payment holiday if they would wish to do so as there were some complaints about the automatic assignment of payment holidays. A small portion of customers opted out of payment holidays. It was observed that customers that had no prior delinquency mostly continued to pay without defaults. However, most of those who didn't have a clean record rolled into delinquency. This indicates

some self-selection as customers opting out were not in trouble whereas those who didn't opt out anticipated payment problems. It can further be speculated that some customers who opted out of payment holidays did not believe that their employers would retrench them during this time as a secondary measure.

Payment holidays were offered to customers across early delinquency buckets but the majority of customers were up-to-date as of February 2019. Defaulted and written-off customers were not eligible for payment holidays.

The payment holidays were offered for 3 months with a small portion of extensions granted after this period. Approximately 25% of the portfolio was offered payment holidays. This meant that for 3 months customers did not pay any installments, and after the end of the payment holiday, the accrued interest was capitalized and they resumed normal payments until the new maturity date.

Top-up Loans

While this paper's focus is on the risks associated with cyclones, there are opportunities to lend during adverse weather events. Post the cyclone, the bank offered top-ups to support customers in recovery and rebuilding. This support helped create a deeper relationship with the bank.

Top-up loans increased the loan amount, and new maturity dates and installments were agreed upon.

The performance of these customers was good post cyclone.

Methodology

Data

Loans data from December 2017 to March 2020 was used to observe payment behaviour before and after the cyclone. The performance of loans in 2017 and 2018, representing 'business as usual', was compared to loans from March 2019 (start of cyclone) to March 2020. Observation stopped in March 2020 to avoid the impact of the covid pandemic.

Segmentation

The product and "industry employed in" fields were used from customer records to track the difference in performance by different product and industry segments.

The geography flag was used to track performance based on customers in affected and non-affected areas. This is important as the impact of cyclones, specifically physical risk, is very much associated with location.

Bad definition

The bad definition used for this exercise was based on 2 missed payments (30+ days in arrears) to make sure there were an adequate number of 'bads' available. An ever-bad definition was used to create a cumulative default curve.

Exclusions

Ex-staff accounts were excluded as they were granted a loan as a staff member and then subsequently moved to another industry.

Analysis

The following steps were followed to complete the analysis.

1. Selecting a benchmark period representing 'business as usual'
2. Comparing the benchmark period with the cyclone period
3. Comparing benchmark vs cyclone performance by selected industries

1. <u>Selecting a benchmark period representing 'business as usual'</u>

1 month delinquent accounts were observed from multiple observation months to reveal an appropriate 'business as usual' period. This means that for example all accounts that were up-to-date as of the observation months were tracked for 1 month to check for spikes in delinquency (unstable periods). The curve was straight averaged to clearly illustrate the peaks and troughs throughout observation periods.

Figure 2 clearly shows the impact of the cyclone in March 2019, muted delinquencies during the payment holiday period, and then stabilization.

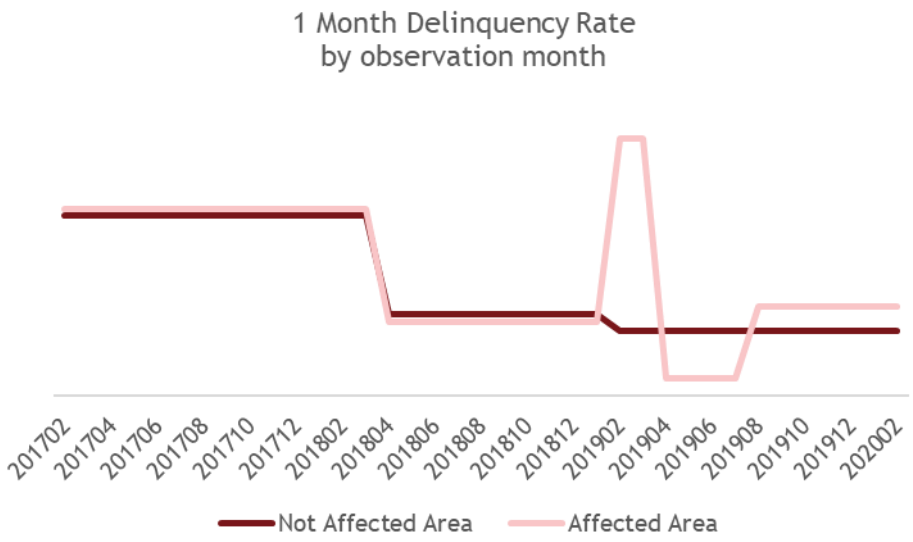

Figure 2: 1 month Delinquency rate by observation month

2017 to mid-2018 was an adverse period where the country had significant interest rate challenges due to high inflation. The decision was made to take up-to-date accounts as of April 2018 and monitor their subsequent performance as the benchmark period as this was a relatively stable time.

The periods used were therefore accounts as of April 2018 observed for 10 months as a benchmark period, and up-to-date accounts as of February 2019 observed for 10 months as the period affected by the cyclone. These two were compared to isolate the effect of the cyclone that hit the country in March 2019.

Historically, the areas not affected and affected by the cyclone had similar performances. After the cyclone, the non-affected area performed better by a slight margin. This will be further investigated in the causality section.

2. Compare the benchmark period with the cyclone period

Figure 3 shows cumulative delinquencies over 10 months for the entire portfolio. The orange line represents accounts as of February 2019 i.e. the cyclone affected cohort. The cyclone period had an initial significant impact on the delinquency of the overall portfolio. Payment holidays then seem to stabilize the impact during months 2 through 6. After that period the delinquencies seem to follow a similar trajectory to the pre-cyclone cohort, with an overall marginally lower delinquency rate.

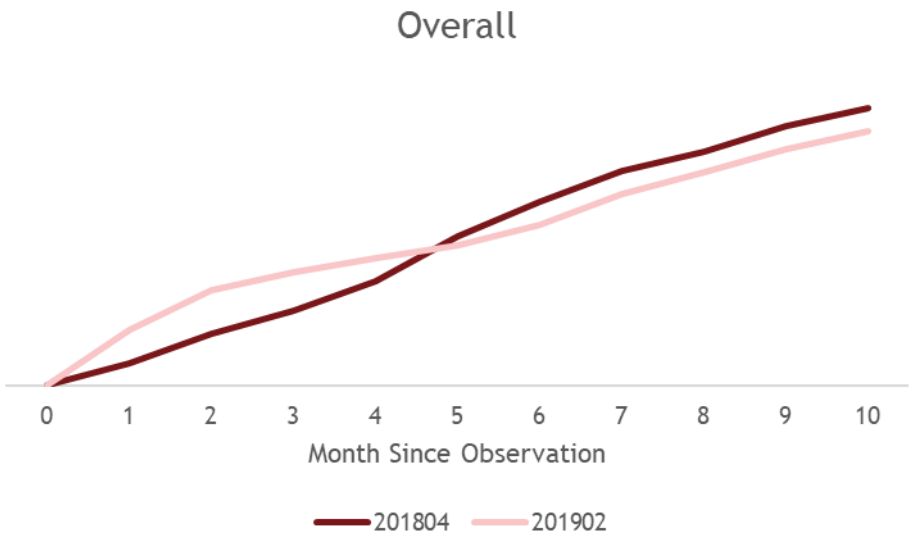

Figure 3: Overall Portfolio Comparing Benchmark (201804) and Cyclone (201902) periods

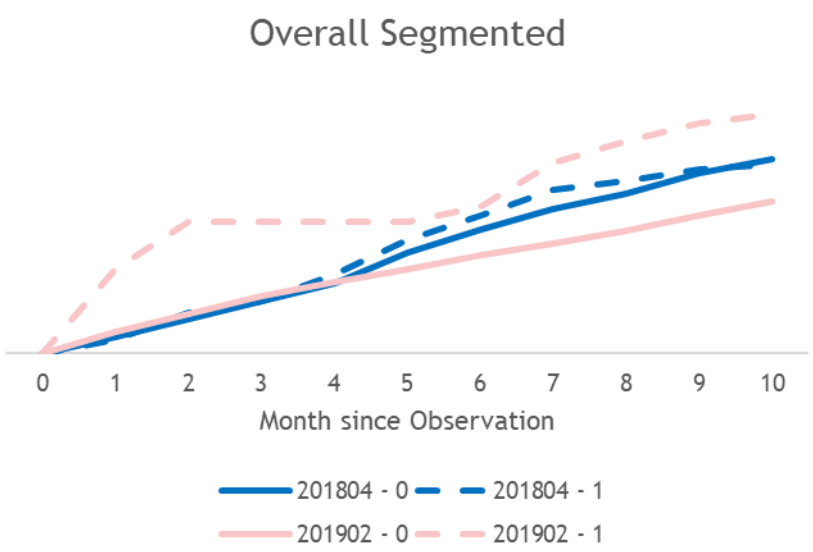

Figure 4: Overall Portfolio Comparing Benchmark (201804) and Cyclone (201902) periods split between affected areas(1) and non affected areas (0)

Figure 4 isolates the accounts in the affected areas (201902 – 1, 201804-1) and non-affected areas (201902 – 0, 201804 - 0). Several phenomena can be observed: The periods between months 2 to 6 are flat reflecting the payment holiday in the affected areas. This was preceded by a sharp increase in delinquencies as an immediate aftermath of the cyclone. Delinquency rates in the unaffected areas are slightly lower post cyclone. Loans in the affected area had higher bad rates than those that did not take a payment holiday as they were likely those customers directly impacted by the cyclone.

This is an overall portfolio view that tells part of the story. The next step was to analyze the portfolio by various segments to get a deeper understanding of delinquency behaviour.

3. <u>Comparing benchmark vs cyclone performance by selected industries</u>

5 industries that employed a significant portion of retail loan customers were selected for observation:

1. Government & Staff
2. Agriculture
3. Construction & Manufacturing
4. Hotels & Restaurants
5. Financial Intermediation

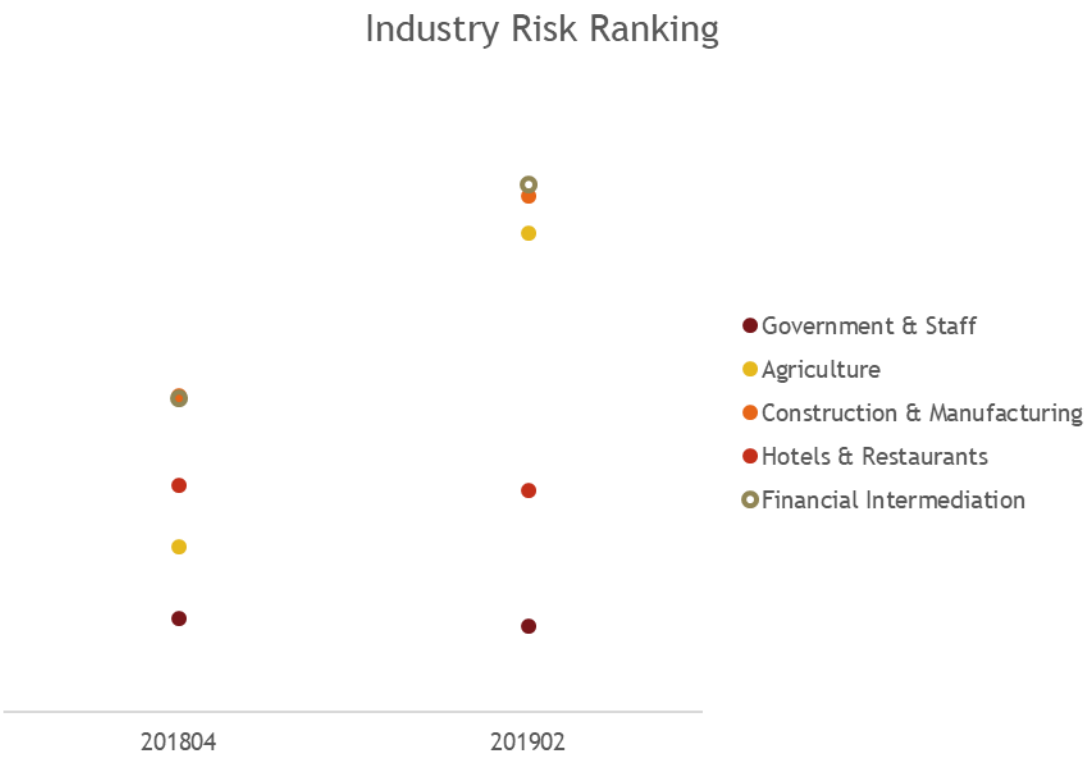

Figure 5: Industry risk ranking by delinquency

Figure 5 above represents the relative delinquency rates of the benchmark and cyclone cohorts for the different industries that employed loan accounts. The numbers can justifiably be taken as indicative of the stability of income or employment for people employed in various industries due to physical risk. Government & staff, as well as Hotels & Restaurants, remained flat, whereas Construction & Manufacturing, Financial Intermediation, and Agriculture had a significant increase in delinquencies. One surprise here was the Hotel & Restaurant industry, as there was an expectation that the cyclone would have an adverse impact on this sector. This will be investigated further in the section 'causality assessment' that will take into account geographical data as well.

To quantify the shift from 2018 to 2019 a risk scalar was calculated to standardize measures

A scalar was calculated for 10 months

$$\frac{average\ Cyclone\ delinquency\ rate\ over\ 10\ months}{average\ Benchmark\ delinquency\ rate\ over\ 10\ months}$$

The average delinquency rate was calculated over 10 months for 2019 and 2018 and divided to create a scalar to compare which industries were most impacted by the cyclone.

Industry	Scalar
Agriculture	2.9
Financial Intermediation	1.7
Construction & Manufacturing	1.6
Hotels & Restaurants	1.0
Government & Staff	0.9

Figure 6: Overall Bank Cyclone Impact Scalars

Figure 6 confirms our visual comparison, but further insights are gained with respect to scale. Agriculture, a usually low-risk sector jumped up by 200%, greatly increasing the risk during the cyclone period. Financial Intermediation had a 100% increase. Construction & Manufacturing had a 50% increase. Government & Staff as well as Hotels & Restaurants remained flat. Customers employed in Financial Intermediation sectors had higher than average delinquency increases, even though they were almost all located in the unaffected areas – indirectly impacted by their own industry's exposure to climate risk.

These numbers, as well as the regional ones, show how climate risk will disparately impact different regions and sectors. Once stable industries will no longer have that simply by existing in a particular region, or by having secondary exposure in particular regions

This also brings up other issues beyond the scope of this paper – for example, the availability and increased cost of insurance for crops and physical assets will make lending more risky in the future as adverse weather events increase. The minister of agriculture has been on a drive to encourage insurers to improve crop cover which means there may be less severe impact from future cyclones. During Cyclone Idai most insurers stated that they will not cover weather-related damage.

Causality assessment

To lend weight to any causality assignment, experienced risk and business staff were consulted at a local bank. Business data with granular details of companies were used to aid conversations. In this analysis, wherever retrenchment is referenced it indicates collector reports stating a retrenchment letter received from the employer. This is not necessarily based on public reports of retrenchments by these companies due to the cyclone.

In the graphs in this section, '*date-0*' depicts accounts not in the affected area, and *'date-1'* the accounts in the affected area. In addition, recall 201804 is the start of the 'business as usual' period, and 201902 that of the cyclone affected period.

Since payment holidays were only offered to customers in the location affected by the cyclone the flattening of the curve due to payment holidays is clear in the affected area lines.

In the next section, each industry is discussed in detail.

Agriculture

The agricultural sector in the area impacted by the cyclone mostly consists of sugar, nuts, forestry, maize & tobacco companies.

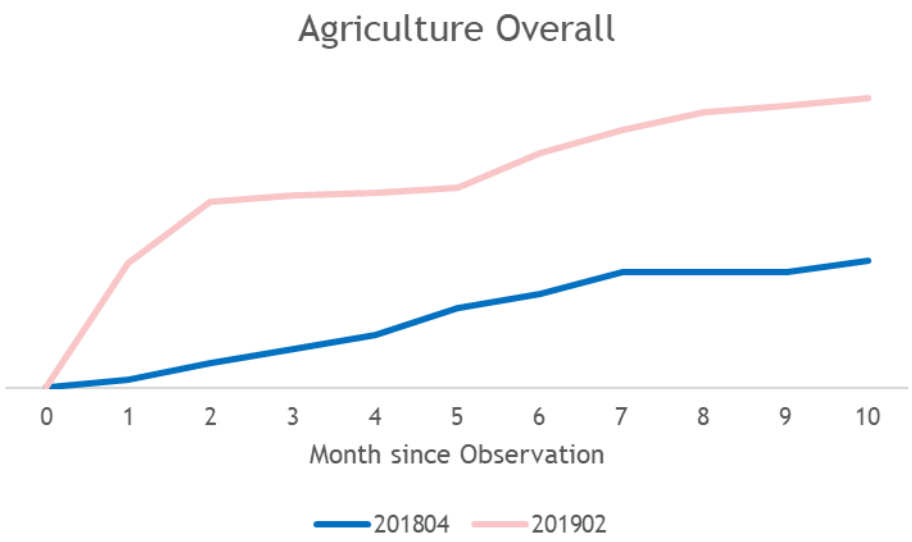

Figure 7: Agriculture Overall Comparing Benchmark (201804) and Cyclone (201902) periods

From Figure 7, the severe effect of the cyclone can be seen clearly – the delinquencies of accounts employed in this sector were 200% higher than the historical benchmark, representing the worst-hit sector. If payment holidays were not given, the sector might have performed even worse. This highlights the role banks, governments, and regulators can play in steadying at least the short-term impacts of physical risk (similar to the payment holidays observed during the early days of the Covid pandemic).

The sector had damage to crops and equipment. Agricultural insurance companies paid out for the equipment damage, but not the loss of crops. This created financial constraints in the companies and retrenchment programs were initiated affecting retail customers.

Approximately 20% of customers in the affected areas opted out of payment holidays when initially offered for agriculture. Customers that opted out were tracked and some delinquencies were observed where customers lost their jobs.

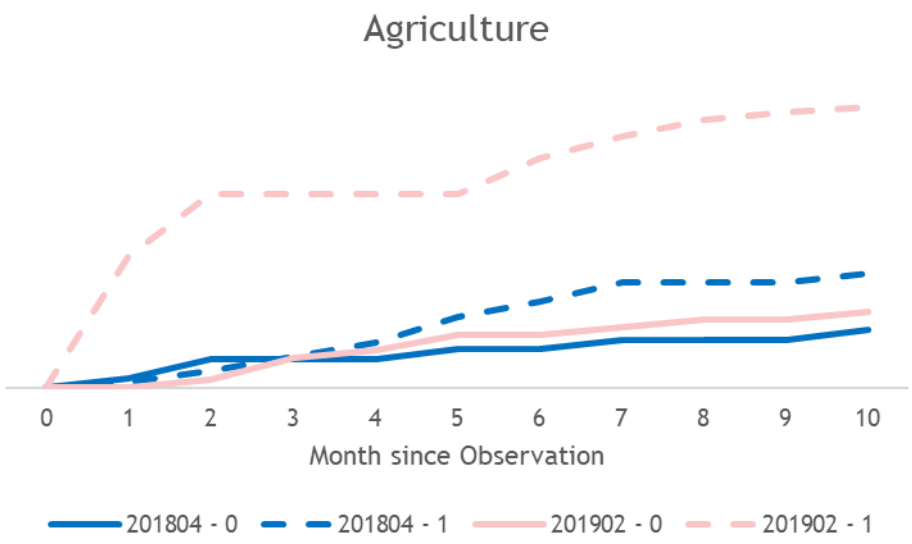

Figure 8: Agriculture Comparing Benchmark (201804) and Cyclone (201902) periods split between affected areas(1) and non affected areas (0)

From Figure 8 it is observed that the affected areas had higher delinquencies compared to unaffected irrespective of period. However, the difference in delinquencies in the unaffected areas pre and post are quite small when compared to the differences in the cyclone affected areas. This shows the very high localized impact on the agriculture industry and the relatively low secondary impact outside of immediate areas. This may not be true universally, for example in situations where raw material is shipped out for manufacturing or distribution plants that will suffer due to lower production. In that case, the impact outside of immediate areas may well be higher.

The reverse is also true for a small portion of affected companies. Based on more granular company data some performed better than in the benchmark period – for example, those supplying material to the rebuilding effort. One example is forestry farms which had a high demand for their products after the cyclone period for rebuilding and a more resilient crop. They perhaps were able to maintain staff better than in non-cyclone times, at least for the short term during re-building.

Sugar companies that were not in the affected area had a stable performance from a retail perspective as the customer's jobs remained stable. The expectation was that plantations not in the area would see a boom in economic activity as they would be covering the losses from plantations in the affected area, thus seeing a demand increase. This would then be reflected in the delinquency records of loan customers.

Agriculture also had a secondary impact on the economy of the country. The shortage of food caused prices to increase and inflation to rise which caused additional financial distress in customers. This could be a reason for an increase in customers removing their salary deposits from the bank to seek additional financing from microfinance.

Finance Intermediation

The loan customers who work in the financial intermediation sector include micro finance institutions and insurance companies. However, the bulk of this sector consists of insurance related firms.

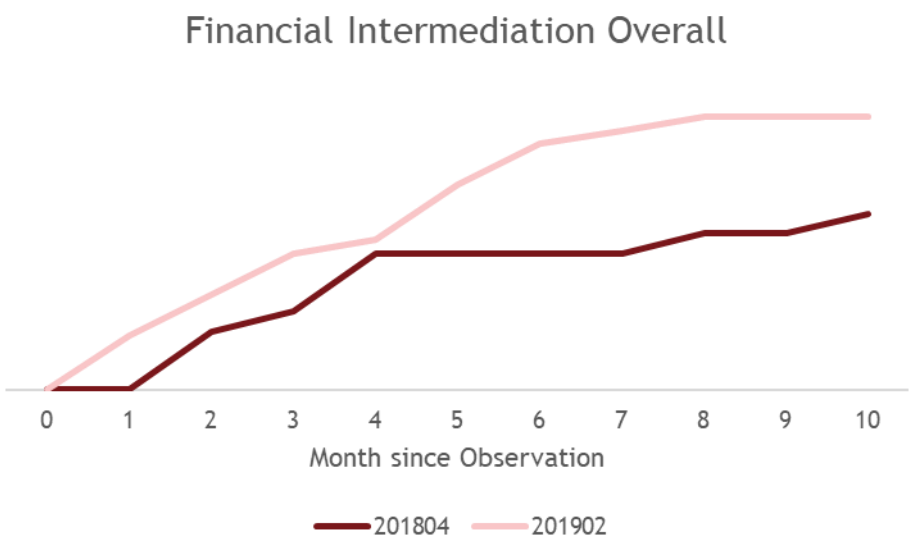

Figure 9: Financial Overall Comparing Benchmark (201804) and Cyclone (201902) periods

From Figure 9, the severe effect of the cyclone can be seen clearly. This was, however, mostly a secondary impact as the financial sector is based mainly in Maputo which was not directly affected by the cyclone, and no buildings of these institutions were directly damaged.

However, financial intermediation is exposed to credit risk as their clients are affected by the cyclone, thereby affecting loan payment behaviour. These financial companies had retrenchments post cyclone that affected the delinquency rates of their (former) employees.

The financial intermediaries that were more impacted consisted of micro finance lenders, who traditionally have lower asset quality than commercial banks and therefore could be more sensitive to severe events.

Insurance companies had to pay out claims for life as well as for damages to transportation, logistics, commercial, and manufacturing sectors that had a severe or partial impact on their buildings and equipment.

One of the local insurers indicated that Idai was the largest payout to date and that they relied on external funding from The World Bank. They further stated that the agriculture insurance industry may not be prepared for severe weather events as these are usually subsidized insurance. These companies are in the process of creating better agricultural insurance for adverse weather events to cater to small and big farmers.

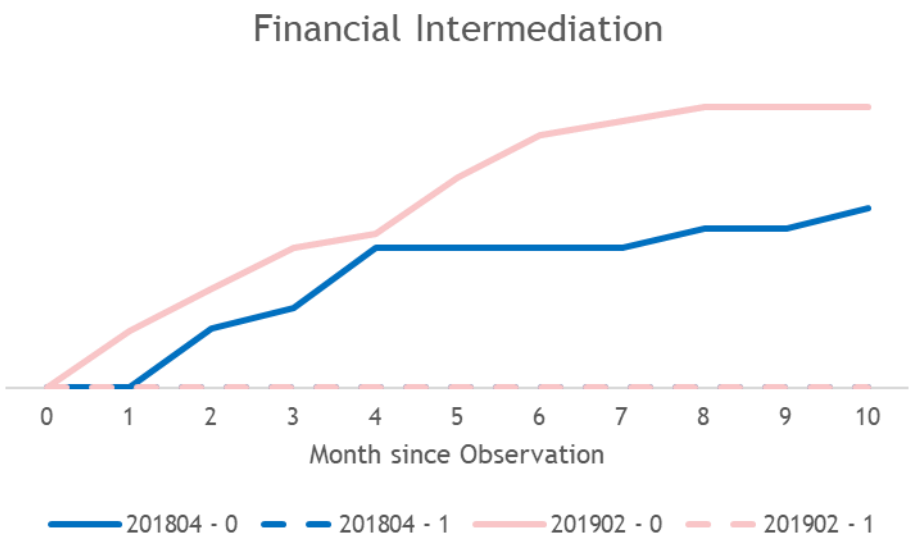

Figure 10: Financial Comparing Benchmark (201804) and Cyclone (201902) periods split between affected areas(1) and non affected areas (0)

The flat delinquency curves for the affected areas in Figure 10 are because almost all of the Financial Intermediation industry is located outside the immediate affected area.

Closer analysis revealed those who worked in the micro finance sector saw a significant and immediate increase in missed payments, which drove the increased delinquency in the Financial Intermediation sector. The micro finance lenders give short term loans to higher risk customers which may explain the immediate impact on delinquencies. In the insurance industry, a small number of retrenchments were observed. However, these cannot be conclusively linked to the cyclone due to the small numbers, the usual long lead times to deal with payouts, and that the industry normally increases premiums to cover losses.

That being said, customers' behaviour did change as the bank observed the removal of salary deposits for numerous customers (most probably because they obtained loans elsewhere for additional funding or willfully moved their salaries with no intention to pay the bank back). Collections reports confirmed the fact that they were facing financial difficulties. While these customers were not directly impacted by the cyclone, their employment was still negatively affected. This illustrates the potential widespread impacts of physical risk in the years to come – when an area gets hit with destructive weather events, it will result in a reduction of overall economic activity that will affect many industries including banking.

Construction and Manufacturing

The loan customers who work in the manufacturing sector include the manufacturing of cement, cables, aluminum, iron, copper, cobalt, and other mining output. Construction is all types of construction.

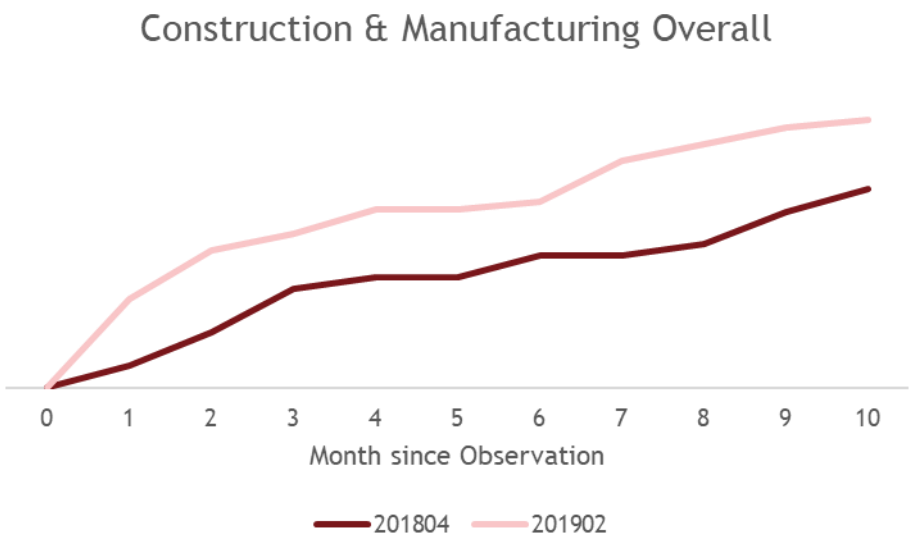

Figure 11: Construction & Manufacturing Overall Comparing Benchmark (201804) and Cyclone (201902) periods

From Figure 11, the severe effect of the cyclone can be seen clearly. Companies' equipment got damaged during the cyclone. Some damage was not fully covered by insurance, output was reduced resulting in less demand for labour, and as a result, the companies had to offer reduced hours (resulting in lower income) or go on retrenchment drives.

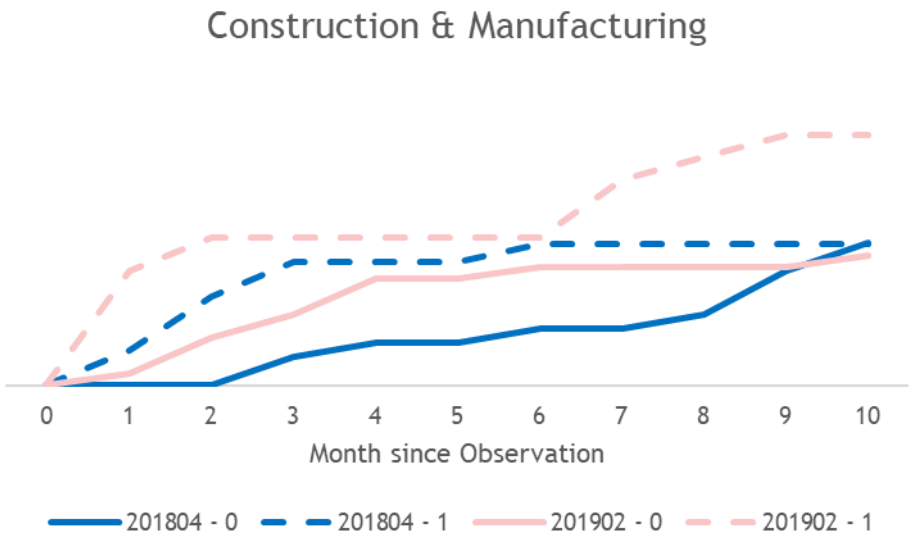

Figure 12: Construction & Manufacturing Comparing Benchmark (201804) and Cyclone (201902) periods split between affected areas(1) and non affected areas (0)

Figure 12 shows several phenomena. The delinquency rates in the affected areas post cyclone were kept flat in months 2 to 6 due to payment holidays but increased significantly afterward. This may indicate the longer term impact on the manufacturing sector due to the unavailability of raw materials, damages to critical infrastructure, and disrupted supply chains. In the nonimpacted areas, while the delinquencies do

go up in the short term, perhaps due to impacted customers who were not offered payment holidays, they stabilize after 4 months.

Closer analysis also revealed that some construction companies that did better during the cyclone period were based in Maputo, which was not affected by the cyclone. However, other companies based in Matola which were also not affected by the cyclone directly, performed worse due to customers' removing their salary deposits. This may be an indication of the different areas of activity of the construction companies – some benefited from the post cyclone construction activities and some did not. Similar behaviour was observed in the manufacturing sector with some individual firms doing well, and others facing problems.

It became clear that the impact on both the construction and manufacturing sectors was nuanced, and not easily generalized. Further analysis will help in identifying specific factors such as dependence on specific raw materials, location, nature of the business, and the disruption in their supply chains to identify types of firms that may be more resilient to such adverse weather events.

Hotels and Restaurants

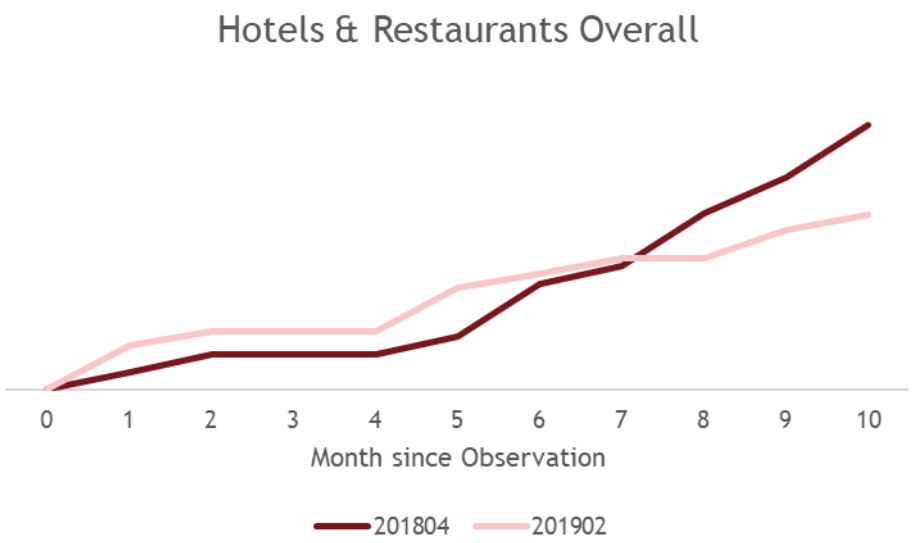

Figure 13: Hotel & Restaurants Overall Comparing Benchmark (201804) and Cyclone (201902) periods

From Figure 13, it is observed that the performance between the periods is similar with no major movement. There is a slight initial deterioration and then stabilization with better performance than the benchmark period explained below. While the impact seems visually large, the numbers were very small, and in overall terms, the impact was not significant.

In the initial industry discussion in Figure 5, the anticipation was that there would be a greater impact on the Hotels & Restaurants sector. However, from this analysis, it was observed that the tourism industry is more concentrated in the non affected areas.

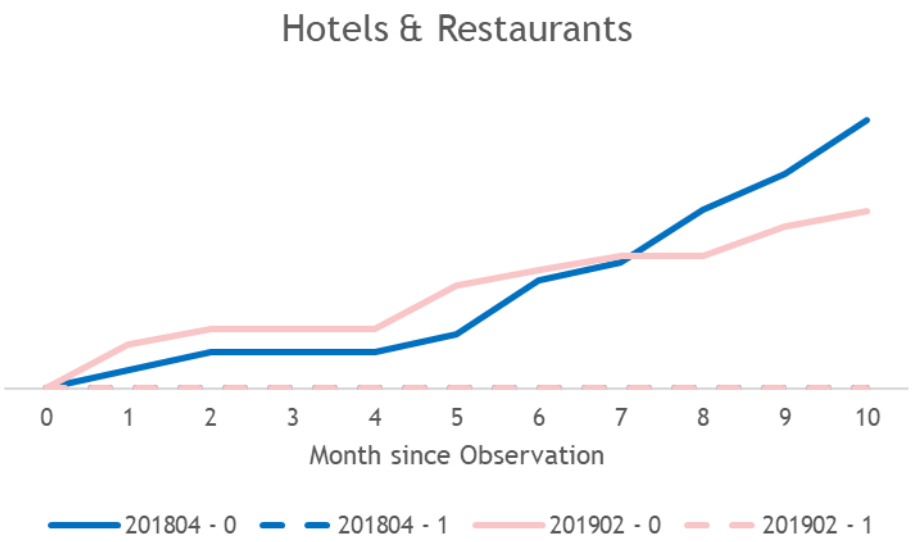

Figure 14: Hotel & Restaurants Comparing Benchmark (201804) and cyclone (201902) periods split between affected areas(1) and non affected areas (0)

From Figure 14 it is observed that the hotels in the affected areas did not have any delinquencies, because the majority of the hotels are based in the non affected areas. Hotels & restaurants in the affected area closed during the cyclone period and reopened for business as usual after. The affected area is not seen as a tourist hub in Mozambique and therefore catered to stable local demand.

However, hotels and restaurants not in the affected area during the cyclone period performed slightly worse for the first 6 months after the cyclone than in 2018, but still not a major deterioration. This can be due to lower tourist numbers during the cyclone as tourists had to move their travel dates to after the cyclone. 2018 was a record level of tourist in 2019 there is a slight drop but still higher than previous years. The hotels retrenched and customers were faced with job losses. Customers also removed their salary deposits which is a sign of stress as they could have faced some personal damage in the affected area.

The delinquency rate became better than in 2018 after 7 months. This is due to pent-up demand in non-affected areas as the country became open for business.

Government & Staff

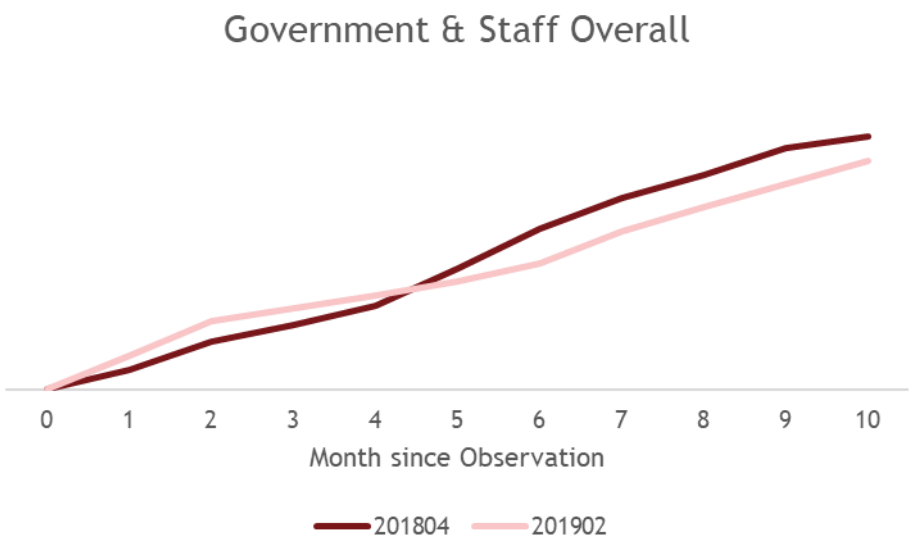

Figure 15: Government & Staff Overall Comparing Benchmark (201804) and Cyclone (201902) periods

Loan account holders employed in the Government & Staff categories were expected to be a low risk sector during a cyclone as the government & the local bank were expected to continue paying salaries. The local bank's staff could not remove salaries, as those are required to be received by the bank for any loan deductions.

From Figure 15, there is a small deterioration in 2019 and then subsequently better performance than in 2018. However, the difference in numbers was small (less than 0.5%) and it did not significantly impact portfolio numbers.

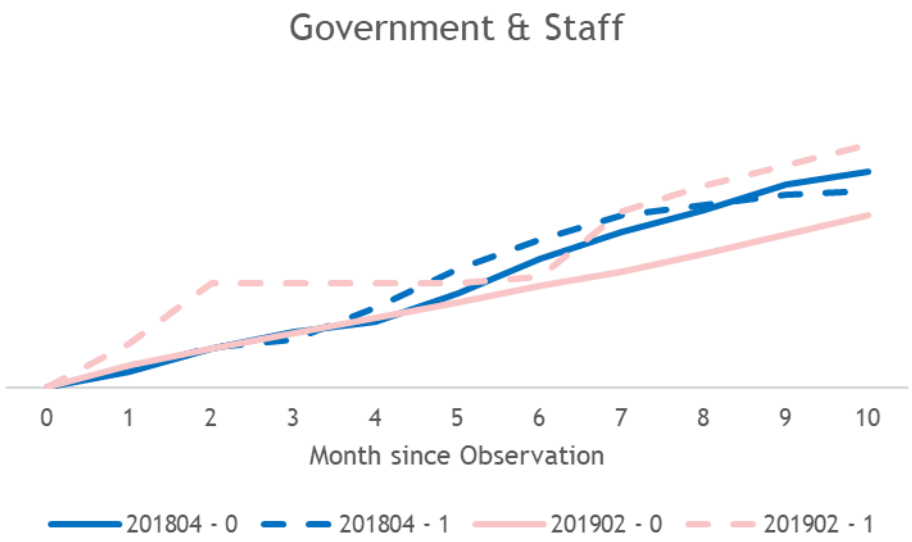

Figure 16: Government & Staff Comparing Benchmark (201804) and cyclone (201902) periods split between affected areas(1) and non affected areas (0)

In Figure 16, the difference between the lines is relatively small. A flattened curve is observed for affected areas due to payment holidays and an increase in delinquencies afterward.

However, there is an interesting phenomenon where government employees in the affected areas did end up having a slightly higher risk profile than those in unaffected areas. From this population, it was observed that government employees removed their salary deposits to other banks to obtain additional funding for rebuilding. These employees might have lost their homes and likely ended up with higher debt loads than their employment (although stable) could sustain.

The spike could also be due to unknown deaths that occurred in the period that only came to light after the accounts started to deteriorate.

Conclusion

This study aimed to get a better understanding of the impact of physical risk on a retail lending portfolio. Specifically, we looked at how Cyclone Idai in Mozambique impacted loan repayments across geographies and industries. It must be noted that while specific impacts of physical risks will be different globally due to the nuances of each local and regional economy, some generic lessons can be learned from this exercise.

Predictably, the cyclone had the most damage where direct physical impact was present. The retail loan customers were affected as their employers underwent damage to physical infrastructure, a reduction in economic activity, and disruptions to supply chains which led to retrenchment programs. This was most evident for those working in the Agriculture sector. It was also noted that the recovery period was different by industry. While some, like agriculture, had long term damage, others like Hotels & Restaurants bounced back.

For customers who were not in the affected areas, there was a secondary effect evident from them moving their salary deposits to other financial institutions as they faced financial difficulties. It can only be speculated that they had personal damage to their families.

Financial institutions and insurance firms were protected from direct physical damage as they are located in Maputo but had the secondary impact of being exposed to companies that did face disruptions. This is how banks will face most of the credit and market risk as a result of physical risks.

Agricultural insurers paid out for equipment damage but not for lost crops. General insurance did not pay out for some equipment or asset damage. These suggest there may be ways to mitigate risk for agriculture and other sectors as well as retrenchment cover via new insurance products or redesign of existing ones.

These analyses will help banks develop a better understanding of the impacts of physical risk on their portfolios. Firstly by identifying, and quantifying the potential losses from increasing adverse weather events. These will differ by product (for example, mortgages and credit cards), by region, and by industry as was shown in this study. Additionally, the impacts of physical risks are not limited to areas facing direct damage from floods, fires, droughts, and cyclones. Many industries and customers will face hardships due to secondary factors such as disrupted supply chains, crop failures, damages to infrastructure, and overall reduced economic activity. There will be some industries that will be severely adversely impacted while others may see short and long term benefits due to rebuilding, and as governments fund adaptation and

mitigation programmes. While this study was limited to retail loans, it is known that the impacts of physical risks will also affect almost all bank lending from corporate and commercial loans to municipal and sovereign exposures.

These will enable banks to develop more effective strategies, including how to better target payment holidays, diversify their lending books, adjust lending policies by industry and geography, design collections campaigns, fill data gaps, and of course, design better products and mitigation measures.

Future Research

The cyclone hit exactly a year before Covid and it would have been interesting to be able to observe the performance of these customers for a longer period.

This study relied on conversations with business practitioners to assign causality. It would be a natural next step to develop a statistical model to predict the behaviour of the customers affected by the cyclone, using a variety of data to predict resilience to physical risks.

This study focused on personal loans. A further next step would be to analyze other portfolios such as SME loans, mortgages, auto loans, and credit cards.

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