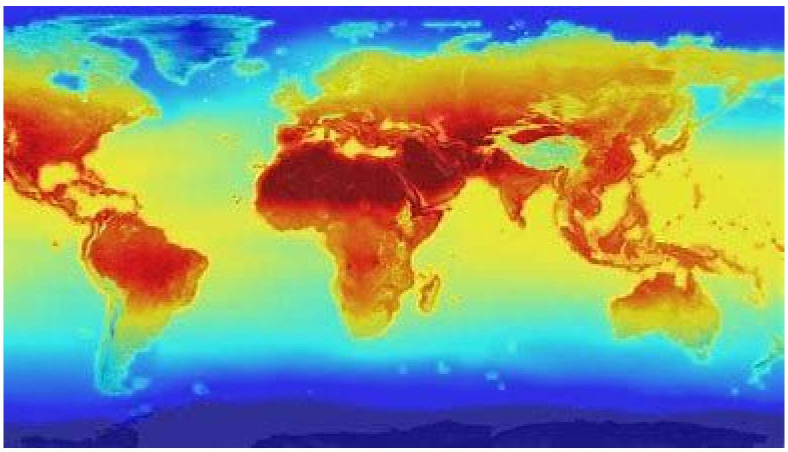

Building Climate Resilience for the Urban Poor: Disaster Risk Financing (DRF) Solutions used by Microfinance Institutions

ABSTRACT

Climate change will increase poverty, particularly among the urban poor in emerging economies. Innovative financial solutions are needed to build resiliency and enable the urban poor to rebuild livelihood strategies immediately after a geophysical shock. To that end, this report focuses on the role of microfinance institutions and innovations in disaster risk financing (DRF) solutions to spur recovery lending.

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Preface

The author is grateful for the opportunity from ACliFF to develop this document. Josh Ling of ACliFF provided invaluable assistance and guidance. Others across the ADB organization were also very helpful. Experience in working on these issues is credited to numerous development agencies and foundations and the many individuals that contributed to these projects. Knowledge gained from various projects that were implemented by GlobalAgRisk and Global Parametrics provide context and core material for many parts of this report. In many cases, this experience is drawn upon to reach conclusions and recommendations. The history of involvement in parametric insurance projects from this author and his colleagues is captured in many reports and academic papers that are available at this LINK.

The Gates Foundation supported some of the first work involving use of parametric insurance to protect microfinance institutions in Peru. This project started in 2009. Additionally, the Gates grant supported deeper analysis regarding the legal and regulatory environment needed to support these types of innovation as well as the data and market conditions. In the Peru project, a major financial institution used the El Nino insurance product to expand their operations in the risk prone regions in the North. The Ford Foundation provided a grant to expand these efforts into Indonesia which supported investigation of earthquake and microfinance. This project contributed to a deeper understanding of the potential value of an intermediary bank supporting index-based earthquake insurance for the MFI that they supported with loans. IFC and Mercy Corps picked up this work in Indonesia.

Leading up to the start of Global Parametrics, the Rockefeller Foundation provided a grant to GlobalAgRisk, VisionFund, and BlueOrchard. This grant extended the discovery in Indonesia by investigating how a microfinance network and a microfinance investment vehicle could serve as intermediaries in providing risk protection to the microfinance institutions that they serve. Other stakeholders supported more discovery for VisionFund and GlobalAgRisk to organize the evidence and prepare for using risk transfer for geophysical hazards to support recovery lending. Those included DFID and FMO.

Given these various projects, Global Parametrics was founded in 2016 and VisionFund International entered a first contract to support their MFIs in 2018. That contract protected six countries. Today, VFI protects 28 countries using the Geophysical shocks Fund that Global Parametrics manages. Given that VisionFund owns the MFIs, it was possible to build a single contract that bundled the countries and hazards. This added considerable efficiencies. Another extension of the Rockefeller Foundation effort has involved Enabling Qapital as a microfinance investment vehicle that provides debt to MFIs but does not have ownership of the MFIs. In this case, several financing options are embedded in a single debt structure.

As with any innovation, daunting challenges remain in changing thinking and operations needed to spur adoption. The idea of protecting the balance sheet with disaster risk financing remains relatively new. Few MFI managers have been exposed to these innovations. But even when managers are exposed, the ideas do not fit neatly into the operations of many financing institutions. These frictions thwart demand. On the supply side, many advances have been made in parametric structures and products for a wide range of weather and geophysical hazards. Nonetheless, when introducing cost-effective risk transfer solutions, there is a need for global capital markets to transfer highly correlated risk out of the country and global capital markets require some minimum scale to cover the transaction costs. Highly concentrated MFIs generally do not offer the scale to get direct access to global markets.

Given the economic logic for using disaster risk financing via MFIs to support clients and communities in building resiliency against climate change, the market failures mentioned above merit public policy interventions. As ACLiFF is in a good position to implement and facilitate certain actions to address these market failures, many of the recommendations presented in this report are provided for ACLiFF but also for development financial institutions supporting financial institutions and are becoming increasingly more focused on how to build resiliency for climate change in the investments and emerging economies that they support.

Executive Summary

The urban poor are notably vulnerable to climate change and geophysical shocks[1]. Geophysical shocks push the working poor into poverty traps. Rapid urban growth places cities in low- and middle-income countries in a particularly difficult position given limited resources to improve planning, infrastructure, and services to respond to geophysical shocks. In all, the urban poor lack access to many basic services such as clean water, sanitation, good infrastructure, and safe-resilient housing. Next to this backdrop, resiliency against climate change will become increasingly difficult as urban areas face increasing flooding events, more frequent, and longer heat waves, and stronger tropical cyclones accompanied by stronger wind, more flooding, and sea surge.[2].

The pandemic and climate change have added 100 million to the ranks of the world's extremely poor and climate change will add another 68 to 132 million by 2030[3]. Urban populations will be 68 percent of the world's population by 2050[4] In Asia and the Pacific region this means 3.3 billion people will live in urban areas. Countries like Bangladesh (40 percent urban) and Indonesia (57 percent urban) are experiencing this rapid growth. And these countries are already experiencing a shift in poverty trends. For example, the Jakarta Post reports that urban poverty increased from 9.86 million (September 2019) to 11.16 million (March 2020). This was a 13.2 percent increase as opposed to rural poverty which increased about 2.2 percent over the same time.[5] Geophysical shocks compound the increase in urban poverty in Asian countries like Bangladesh and Indonesia.

Geophysical Hazards in Indonesia and Bangladesh as reported by Statista Risk Index (10 being highest risk)

Hazard	*Indonesia*	*Bangladesh*
Tsunami	*9.7*	*8.2*
Earthquake	*8.9*	*9.2*
Flood	*8.1*	*10*
Epidemic	*7.0*	*7.6*
Tropical Cyclone	*6.1*	*6.9*
Drought	*3.4*	*4.7*

Building Resiliency Against Climate Change and Geophysical Shocks

Economic development supporting small and medium enterprise contributes to the resiliency of the poor and vulnerable in urban areas. Building resiliency against climate change and geophysical shocks is critical for economic development and poverty reduction. Microfinance institutions (MFIs) operating in countries like Bangladesh[6] and Indonesia[7] must play a role. These MFIs like many in the region have a good history in serving woman. Recent studies for urban MFIs operating in Bangladesh show

[1]Geophysical hazards include extreme weather events, seismic events, and pandemics.
[2] What does it mean to leave no one behind? (undp.org)
[3] World Bank Poverty Overview
[4] 68 percent of the world population projected to live in urban areas by 2050, says| UN DESA
[5] The disparity of gig economy and rural-urban poverty
[6] Beyond Ending Poverty: The Dynamics of Microfinance in Bangladesh (worldbank.org)
[7] The Effect of Islamic Microfinance on Poverty Alleviation: Study in Indonesia (repec.org)

contributions to 'savings, educational expenditure, and transportation expenditure' increasing labor mobility. Additionally, there are improvements in 'housing, utility usages, water and sanitation' all having the potential to increase resiliency[8]. MFIs in Bangladesh and Indonesia by and large focus their lending in Urban areas. Some of the MFIs are totally concentrated in a single Urban area. These concentrations compound the problems created by a geophysical shock.

Climate change and geophysical shocks are creating an unresolved conundrum whereby the very financial institutions (MFIs) relied upon by the poor are also especially vulnerable to geophysical shocks meaning that they are in a poor position to help their community when they are needed the most. The balance sheet of the MFIs suffers meaning that they can't respond to the community – either through recovery lending or in offering other forms of response immediately after the shock. This is particularly true for smaller and geographically concentrated MFIs operating in urban areas. A key to resolving the conundrum mentioned above must include ex-ante financing to rebuild the balance sheet quickly. Disaster Risk Financing (DRF) solutions are designed to do that.

Disaster Risk Financing (DRF) solutions are designed to provide rapid financing to an MFI when there is a geophysical shock. They comprise a comprehensive approach using event-based products and statistical methods for risk analysis to predetermine the return period of a geophysical shock. Return period analysis for the risk exposure is used to organize efficient ex ante triggers using a risk layering approach for financing from reserves, contingent credit, and risk transfer. More infrequent events are more severe and require greater financing.

Efficient DRF solutions can be used to facilitate MFI recovery lending as an essential facet of building resiliency of the poor and vulnerable and, in turn, their communities. Successful investments immediately after extreme geophysical events that destroy productive assets is an important risk mitigation strategy. Fresh experience with how a geophysical shock challenges the livelihood strategies of the poor can result in new and more resilient strategies.

Due to the highly correlated characteristic of geophysical shocks, many MFI clients suffer at the same time. For clients with loans, their livelihood strategy is disrupted, and they may lack the cash to service the loan payments. For clients having deposits in the MFI, the geophysical shock creates the conditions to withdraw savings. Thus, unlike deaths of clients which are largely independent and can be managed by the MFI with credit-life insurance, geophysical risk must be managed by diversifying risk via more sophisticated solutions which include accessing global capital markets for the risk-transfer component of DRF solutions.

[8] Impact of urban microfinance on the livelihood strategies of borrower slum dwellers in the Dhaka city, Bangladesh - ScienceDirect

There is experience of MFIs using DRF solutions to either expand lending into vulnerable regions or to pre-plan recovery lending programs. In Peru, Caja Nuestra Gente purchased an ENSO insurance product with the explicit goal of expanding lending in the impacted regions[9]. VisionFund International (VFI) developed a more comprehensive DRF program named ARDIS[10] supporting balance sheet protection to spur recovery lending in 26 of the MFIs in their microfinance network as of 2021. Enabling Qapital as a microfinance investment vehicle has developed a Climate Resilience Enhanced Debt (CRED) product that follow some of the structures used by VFI[11]. Both VFI and Enabling Qapital work with Global Parametrics on event-based risk transfer structures for geophysical shocks but that also use the parametric structures to trigger internal reserves and options on contingent credit.

> A significant financial innovation is use of a single debt instrument to wrap normal credit with contingent credit and contingent capital together into one loan agreement. Contingent credit rebuilds liquidity and contingent capital flows with risk transfer (insurance-like) instruments that are treated as subordinate debt and can be quickly converted to capital under Basel. The risk transfer goes to the global capital markets (reinsurance and ILS).

While the progress being made by programs like VFI and Enabling Qapital is promising, the novelty of these programs remains a serious impediment to their adoption. As with any innovation, it takes time and experience to gain traction. And while a good case can be made that maintaining a strong balance sheet after a geophysical shock increases the likelihood that the MFI will continue to grow and that this alone may represent enough benefit to incur the cost of DRF solutions, the evidence will take years to build when this primary benefit is hidden and can be experienced only when there is an infrequent geophysical shock (e.g., a shock that occur maybe every 25 or 50 years). Insurance markets for property and casualty losses fit this profile in developed countries where without a combination of regulations and subsidies the public good of development of insurance markets would be suboptimal. Certainly, without some stronger institutional support, DRF solutions which typically require scale for a one-off transaction, will only be available to larger financial institutions – by passing MFIs that are geographically concentrated in urban settings.

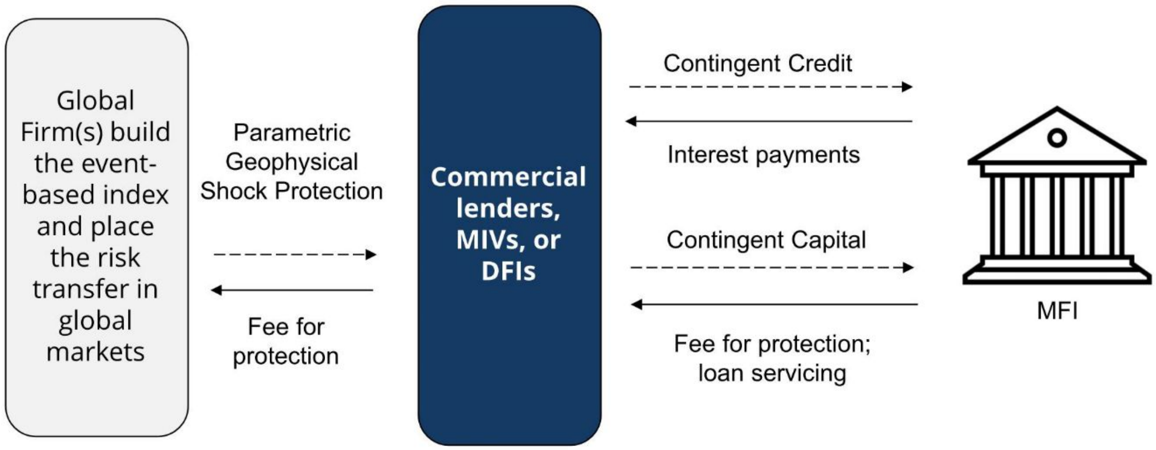
Efficient DRF Solutions that Crowd in Private Capital

To implement efficient DRF solutions, three primary parties are needed. A commercial lender (private capital) will serve as the intermediary between the global risk transfer markets and the MFI using a debt agreement that has contingent credit and contingent capital as depicted in the figure below.

[9] Strengthening Local Credit Markets Through Lender-Level Index Insurance - Collier - 2020 - Journal of Risk and Insurance - Wiley Online Library

[10] The African and Asian Resilience in Disaster Insurance Scheme (ARDIS) by VisionFund International

[11] Launch of Climate Resilience Enhanced Debt Product by Enabling Qapital



This structure facilitates:

- ✓ **Parametric Geophysical Shock Protection**: Geophysical shock risk protection per tailored index; payouts based solely on index trigger.
- ✓ **Contingent Credit:** Senior loan at pre-agreed terms that can be drawn down at different amounts depending on the severity of the geophysical event as defined by the parametric index
- ✓ **Contingent Capital:** Tier 2 capital or Tier 1 capital at pre-agreed terms based on the severity of the geophysical shock as defined by the parametric index; possible mechanisms could include senior loan conversion to sub-debt, loan forgiveness, or distressed debt purchase. For the example presented below, the focus is on Tier 2 capital via subordinated debt.

As an example, consider an MFI operating in an urban market in Bangladesh wishing to structure DRF solutions for tropical cyclones. The MFI has a loan portfolio of $100 million with an average NPL ratio of 5 percent (loans >30 days in arrears). They are very conservative and maintain a loan loss reserve of 100 percent of the average NPL or 5 percent times 100 million ($5 million). For this MFI, the commercial lender is willing to provide contingent credit only if the MFI maintains a capital adequacy ratio of 15.5 percent (above the regulatory requirement) and if the MFI purchased risk transfer that will protect recovery loans that follow a shock for up to 20 percent default rate. Recovery loans have been shown to perform as well as normal loans meaning that the 20 percent default rate is highly conservative.

In this stylized case, the risk transfer amounts will be equally divided so that 50 percent of payments go to the MFI in the form of subordinated debt that will be forgiven and counted as capital on the MFI balance sheet. The other 50 percent will go to the commercial lender to protect the contingent credit for the potential 20 percent default rate. The latter amount crowds in the contingent credit (in this case at a ratio of 1 to 5). The structure appears below where only the category of the tropical cyclone (TC) as it crosses into the zone of lending for the MFI is used to trigger the financing.

Tropical Cyclone (TC)	Loan Loss Reserve	Contingent Credit	Risk Transfer Contingent Capital Paid by MFI	Risk Transfer Paid by Commercial Bank
Cat 1	Up to $5M	$0	$0	$0
Cat 2	Up to $5M	$0	$0	$0
Cat 3	Up to $5M	Up to $4M	$0.8M	$0.8M
Cat 4	Up to $5M	Up to $8M	$1.6M	$1.6M
Cat 5	Up to $5M	Up to $10M	$2.0M	$2.0M

As a reminder, the loan loss reserve and contingent credit can be used at the discretion of the MFI; meaning that the MFI can use any amount up to the maximum values matching the specific category of a TC. However, the commercial lender may have some minimum requirements for use of the loan reserve as a condition for providing contingent credit. The commercial lender has a legal obligation to provide the amount of contingent credit requested from the MFI up to the amount that matches the shock and the level the table above.

The risk transfer is also a legal obligation from a global risk provider who must pay the full amount in each category. Of note, blending financing in this way also mitigates basis risk from the risk transfer contract. For example, it the risk transfer does not pay what is needed, there are two other forms of financing (reserves and contingent credit) that can be more fully used. If the needs are less than anticipated (i.e., risk transfer pays more than needed), the MFI would use less of the reserves and contingent credit.

The benefits from this DRF solution flows to the key stakeholders as follows:

1. The commercial lender is securely increasing their lending when there is a shock.
2. The MFI is getting access to contingent credit and contingent capital to quickly rebuild the balance sheet and continue business largely uninterrupted meaning their growth continues.
3. MFI clients benefit by using recovery lending to rebuild their livelihoods despite the geophysical shock.
4. Society benefits by building resiliency of the MFIs and their clients

Importantly, given the composition of MFI clients, most of these benefits will flow to women.

Public Investment in a Contingent Credit and Premium Support Fund (CCPSF)

To accelerate the adoption of DRF solutions for MFIs in Bangladesh, Indonesia, and other Asian markets, it is recommended that ADB could create a dedicated facility to address what are likely the two largest obstacles for using DRF solutions as presented above – 1) reluctance to pay for largely untested DRF solutions; and 2) reluctance from commercial lenders to offer contingent credit. The challenge for any commercial lender offering contingent credit for shocks that happen infrequently is that, if not managed properly, they will have large amounts of idle capital. The commercial lender will need the services of the risk provider (e.g., a global reinsurer) to optimally manage a portfolio of contingent debt.

The facility could be named the Contingent Credit and Premium Support Fund (CCPSF). Such a facility would be capitalized by ACLIFF with donor support or even with a commercial lender and managed as Microfinance Investment Vehicle (MIV) that works across the region. The CCPSF would be serviced by a risk-modeling firm with experience in evaluating event-based products. There are numerous global companies who can be utilized to build the parametric structures and to place the risk in global markets. The CCPSF would have a special purpose and strong governance to assure that the dedicated funds were being used to spur DRF solutions. Premium support would have a limited life and represent a large share of the use of funds in the early years but would be eliminated at some stage (e.g., 5 to 10 years). When the premium support is fully used, the CCPSF would be fully dedicated and sustainable fund providing contingent credit and supporting DRF solutions.

Governance would manage how a commercial lender and MFIs obtain premium support for the risk transfer. The commercial lender and the MFI should pay some share even in the first year (e.g., 25 percent). But these shares would increase over a defined period until the full cost is paid (e.g., 5 to 7 years). The core idea is that the commercial lender and the MFI follow structures like presented above where both are using the same structure in equal portions. In this type of structure, the risk transfer acts as a loan guarantee. In the table above the risk transfer crowds in contingent credit at a ratio of 1 to 5. The contingent credit is returnable capital with profits.

While the CCPSF is an ambitious program it should be viewed as a unique model to address the market failures slowing adoption of DRF solutions like those presented above. It would open the way for increasing liquidity (contingent credit) and capital (contingent capital) immediately when there is a geophysical shock. The CCPSF also offers the best option for reaching smaller MFIs that need DRF solutions the greatest. The entire system would address the greater needs in making MFIs an essential agent in building resiliency against climate change for the livelihoods of the poor, businesses, and communities – all of which lead to poverty reduction, economic growth, and conflict mitigation.

Section 1: Introduction

The pandemic and climate change have added 100 million to the ranks of the world's extremely poor, and climate change will add another 68 to 132 million by 2030[12]. Poverty and vulnerability are strongly linked. Geophysical shocks push the poor into poverty traps (Carter et al. 2007). Given the high vulnerability of Bangladesh and Indonesia to geophysical hazards[13] and the adverse effects of climate change, recent trends in poverty are likely to continue – Bangladesh poverty rates went from 14.4 to 18.1 percent[14] and Indonesia rates went from 9.2 to 10.4 percent[15] during the first year of the pandemic. These setbacks were greater in urban areas.

As will be more fully developed, the multiple balance sheet issues tied to a geophysical shock result in a credit crunch where microfinance institutions (MFIs) slow or stop lending to the community when the needs are the greatest. This market failure merits attention from policy makers and the developmental community. This was the motivation for the Asia-Pacific Climate Finance Fund (ACliFF) to commission this paper.

Innovative financing solutions to build resiliency against geophysical shocks are needed to reverse recent and impede future setbacks in poverty reduction. To this end, the focus of this report is the role for Disaster Risk Financing (DRF)[16] solutions targeted at microfinance institutions (MFIs) serving the urban poor in Bangladesh and Indonesia. As will be developed within, the urban poor are most vulnerable to geophysical shocks. Three core issues are addressed in this report:

> *Disaster Risk Financing (DRF) solutions comprise a comprehensive approach using event-based products and statistical methods for risk analysis to predetermine the return period of a geophysical shock. Return period analysis for the risk exposure is used to organize efficient ex ante triggers using a risk layering approach for financing from reserves, contingent credit, and risk transfer. More infrequent events are more severe and require greater financing. Vulnerability can also be built into DRF solutions so that more vulnerable sectors or geographies are provided with greater ex ante financing*

1. The role of the microfinance sector in promoting climate resilience of the urban poor,
2. DRF products and structures that can support the microfinance sector, and
3. Policy recommendations to accelerate the use of DRF solutions in recovery lending.

Currently nearly all MFIs and their investors operating in low- and middle-income countries are making decisions and managing operations with very limited knowledge regarding how geophysical shocks will impact their business. When a shock occurs, there is a spike in non-performing loans (NPL) which results in capital erosion. In response, lending either stops or slows significantly and the cost of lending increases. Being unable to lend when the community needs it the most misses the opportunity to reinforce existing clients and acquire new clients.

[12] World Bank Poverty Overview
[13] The term geophysical hazards include extreme weather events, seismic events, and pandemics.
[14] Bangladesh Overview: Development news, research, data | World Bank
[15] Indonesia Overview: World Bank October 29, 2021
[16] Disaster risk financing - OECD

The current practices push the burden of geophysical shocks to local borrowers and their communities.

The process for adoption of DRF solutions begins with understanding how geophysical shocks will impact MFI business. Regulators should require stress testing for the most extreme shocks so that MFI managers will have a view of the consequences. Once managers understand the risks, they must take ownership. Finally, with ownership, managers should be seeking means to manage the risks. It is no longer acceptable to go the owners of an MFI and indicate that problems created by geophysical shocks are a *force de jure* or *an act of God*.

Much of what is developed within this report is meant to address the conundrum presented above whereby the very financial institutions (MFIs) relied upon by the poor are also especially vulnerable to geophysical shocks meaning that they are in a poor position to help their community when they are needed the most – with capital needs to rebuild immediately after a shock. Efficient DRF solutions can fit the triple bottom line – serving to build resiliency and mitigate poverty, facilitating investments in the environment, and strengthening the commercial position of MFIs. DRF products and structures facilitating MFI recovery lending can be an essential facet of building resiliency of the poor and vulnerable. Successful investments immediately after extreme geophysical events that destroy productive assets is an important risk mitigation strategy. Additionally, this is an ideal time for new investments as the harsh reminder of how certain livelihood strategies failed can spur new and more resilient strategies.

Due to the highly correlated characteristic of geophysical shocks, many MFI clients suffer at the same time. For clients with loans, their livelihood strategy is disrupted, and they may lack the cash to service the loan payments. For clients having deposits in the MFI, the geophysical shock creates the conditions for where they are more likely to withdraw their savings. Thus, unlike deaths of clients which are largely independent and can be managed by the MFI with credit-life insurance, geophysical risk must be managed by diversifying risk via more sophisticated solutions which include accessing global capital markets for the risk-transfer component of DRF solutions.

The needs of small urban-based MFIs are particularly acute. The urban poor are highly vulnerable to geophysical shocks given the increasing frequency of extreme geophysical shocks and the lack of adequate infrastructure and institutions in urban areas to help in coping with shocks. The urban poor generally live in high risk areas and have inadequate shelter. Rapid urban growth with little or no planning and mitigation systems compound the problems faced when there is a geophysical shock. Hazards such as earthquakes, tsunami, heatwaves, flooding are particularly problematic for urban populations as the exposure of the poor can be heavly concentrated with large numbers of the poor impacted at the same time. To the extent that the hazard distrupts the livelihood of the poor, concentrated urban MFIs will be placed at significant risk of failure.

Understanding the dynamics of geophysical shocks in creating a credit crunch

While MFIs are like any banking interest whereby, they attempt to diversify their exposures to a wide range of risks by operating in different locations and by working with different sectors, there are certain highly correlated risks that are difficult to manage in this fashion. Further since very few MFIs currently transfer the correlated geophysical risks into global markets, the dynamics of a geophysical shock will hurt the MFI balance sheet which, in turn, slows or stops future growth. This is particularly true for smaller and more geographically concentrated MFIs.

The balance sheet of MFIs suffers on the assets side as well as the liability side. On the asset side, the quality of loans deteriorates. Increased non-performing loans and even defaults on loans will erode the MFI's capital just as any income loss. On the liability side, clients stop saving and withdraw their savings creating a liquidity problem. Additionally, the cash needed to restructure loans and make other adjustments during the crisis also erodes liquidity. Seeing the erosion in liquidity, sources of borrowing for the MFI also dry up as commercial banks essentially halt lending when there is a geophysical event. These multiple balance sheet issues result in a credit crunch where MFIs slow or stop lending to the community when the needs are the greatest.

Financing After a Geophysical Shock

While the above description fits many MFIs, if the MFI has a large capital adequacy ratio (i.e., being overcapitalized in some cases), the impact of a geophysical shock on lending will be less pronounced. This seems to be the case for the larger MFIs operating in Bangladesh and Indonesia. It is beyond the scope of this study to explain the motivation for this behavior. Perhaps it is a result of regulatory policy which may be more focused on consumer protection issues using the most conservative approaches targeted at keeping the MFI solvent. It is also likely that concerns about the effect of geophysical shocks are responsible for this behavior. In either case, DRF solutions can provide an impetus for change. If MFIs can leverage more capital without undue risks, this has distinct and clear value to their clients and to society.

Collier and Babich (2017) explore the effects of geophysical shocks on credit supply in low- and middle-income countries. An important premise to this research is the assertion that in both developed and developing markets credit often provides a critical means for households and businesses to manage disaster losses. For example, earlier work by Collier[17] found that following Superstorm Sandy in New York 40 percent of negatively impacted businesses increased their debt following the disaster. In fact, more of the firms impacted by Sandy borrowed to finance recovery than received insurance payments. As Collier and Babich explain, credit provides much-needed cash in a crisis and can allow firms to replace lost assets, increasing their earnings opportunities after a severe event. Given the limited penetration of insurance markets in low- and middle-income economies, the potential role of credit in managing disaster losses is therefore particularly important.

Collier and Babich's analysis comprised a panel of 929 financial institutions that lend to households and MSMEs in low- and middle-income countries. The dataset spans 78 countries and 18 years. This robust analysis finds that financial institutions in general reduce lending after geophysical shocks. The most severe disasters result in a reduction of annual loan portfolio growth by 30 percent on average. Based on the panel of data, a core driver of this behavior is capital constraints experienced by institutions effected by the disasters. Lenders have difficulty replacing equity lost due to systemic borrower repayment problems from the event.

[17] Hurricane Sandy's economic impact - Fox School of Business (temple.edu)

Collier and Babich consider two groups of institutions, high capital (i.e., ample capital cushion) and low capital (i.e., more leanly capitalized), and find that institutions with a low capital position pre-disaster reduce lending substantially more while high capital institutions tend to continue lending at the same rate post disaster. Low capital lenders are shown to reduce annual loan growth by 81 percent following large disasters. The analysis also compares the behavior of lenders across countries with relatively high and low insurance penetration. Collier and Babich find that in low insurance coverage countries credit reduction is accentuated with even the high capital lenders reducing lending after geophysical shocks. Collier and Babich conclude that this outcome is likely due to a perceived deterioration in the creditworthiness of borrowers where households and MSMEs are less able to protect their assets with insurance.

Given the important role that credit can play for recovery, these results suggest a shortfall in the financial services market's ability to respond to communities' needs post disaster and an important opportunity for insurance markets. Collier and Babich conclude that finding ways for financial institutions to transfer geophysical shocks from their capital base through insurance or financial hedges could offer a useful means for lenders to increase access to credit for households and businesses after major shocks.

Klomp (2018) perform analysis like Collier and Babich on over 1000 MFIs in 80 countries. His findings are that hydro-meteorological shocks impact the financial soundness of MFIs more than climatic or geophysical shocks. He concludes that geophysical shocks 'are a serious threat to the solvency and liquidity of an MFI'. He recommends that regulators require stress test on the impact of shocks on capital adequacy and asset quality.

Using DRF Solutions

> *DRF solutions are used to Rebuild the balance sheet and support the MFI and the community by adding to business continuity.*

The core value of DRF solutions involves rebuilding the balance sheet of MFIs quickly after an extreme event so that there is business continuity including implementing recovery lending needed to restore the livelihoods of the poor. With properly structured DRF solutions, the MFI's reserves and access to contingent credit will rebuild liquidity. The risk transfer component will rebuild the capital of the MFI. With this balance sheet support, the more resilient MFI can continue supporting the poor and vulnerable when there is a geophysical shock. While the poor use many coping strategies following extreme shocks, to the extent that they have access to savings and small loans, they are better able to absorb geophysical shocks. These financial services mitigate significantly more dire coping strategies that are prone to push the poor into a poverty trap. By using DRF solutions, MFIs are better positioned to manage the withdrawal of savings and continue or increase lending. As properly structured DRF solutions facilitate business continuity, a key commercial outcome is to secure the growth of the MFI despite a geophysical shock.

*The dynamics of business interruption created by geophysical shocks create problems in **accessing** capital and ultimately increase the **cost of capital.** The business interruption following geophysical shocks create **negative growth** for up to two years after the shock.*

The direct value of recovery lending is relatively easy to understand. But it is equally important to grasp how efficient DRF solutions can also lower the cost of capital and increase access to capital by MFIs and, in turn, the poor. The setback suffered for the livelihoods of the poor and for the MFIs supporting them is tied to the dynamics of geophysical shocks that create lost income, added cost, and reduced access to capital. Only recently are we developing a deeper understanding of this dynamic – putting numbers to the problem. Climate risks alone added 117 basis points (BPS) to the cost of capital in recent years[18,] and that evidence comes from looking back at only climate risk – seismic risks and pandemics are excluded. Looking forward, we see more concern, such as the UN reporting that "extreme weather events have increased fivefold over the past 50 years".[19]

The prospect that DRF solutions can lower the cost of capital and open greater access to capital is significant. These benefits will feed into the entire financial sector and spur economic growth. Economic growth has been demonstrated to be the biggest driver in poverty reduction. An added benefit of efficient DRF solutions is that they will promote investment into climate sensitive sectors, scale-up of private sector climate finance, and uptake of climate technologies. As policy makers understand the totality of the benefits that follow development of DRF solutions, there will be great demand for properly targeted public investments in DRF solutions. Key among these are investments in the legal and regulatory environment to facilitate innovation in DRF solutions.

Banking regulators in developed countries are investigating what can be done to protect the banking sector from the effects of climate change. New policy actions are emerging as central banks and regulators are working to mainstream climate risks into processes (e.g., stress testing) of financial institutions. For example, in the United Kingdom, the Prudential Regulation Authority has implemented several regulatory questionnaires for financial institutions to complete. Global efforts are also being led by the private sector. The Task Force on Climate-Related Financial Disclosures[20] represent a clear example.

Global discussions also open some consideration that the initial use of DRF products and structures may fit better with the banking regulators in Bangladesh and Indonesia. These regulators will be better positioned to capture the prudential and consumer protection benefits of DRF solutions for MFIs. Regulators of MFIs in Bangladesh and Indonesia can chart their own course about what may be needed to facilitate use of efficient DRF solutions (e.g., lowering provisioning or capital adequacy requirements for MFIs building DRF solutions, etc.). Understanding the significant social value in creating efficient DRF markets that will lower the cost of capital and open more access to capital for the poor fits the mandate of banking

[18] Climate Change and the Cost of Capital in Developing Countries (UN Environment, 2018)
[19] Climate Reports | United Nations
[20] Task Force on Climate-Related Financial Disclosures | TCFD) (fsb-tcfd.org)

regulators. These changes take time but are clearly a major goal of any economy that strives to build proper risk transfer markets as the important completion of financial services.

In the near term, the starting point for the regulatory discussion is the direct benefit of using DRF solutions via MFIs to finance response to smooth consumption and for rebuilding with investments that ideally will be made in revised and more resilient livelihood strategies is more obvious. Under any circumstance, the ability to rebuild livelihoods of the poor is fundamental for resiliency. Thus, it can easily be argued that the most important aspect for building resiliency for the urban poor is ex ante financing offered by DRF products and structures that flow through the financial institutions with the greatest access to the poor.

Building DRF structures must include ownership of the risks and strategic planning for the financial needs when there is a geophysical event. The planning process evaluates event-based structuring to trigger three different types of financing (1) internal reserves, (2) contingent credit, and (3) risk transfer via global capital markets. Event-based structures trigger payments using the statistical rank of a geophysical event. The statistical rank provides a view of the frequency of events. These ranks can be converted to what insurance providers reference as a return period (e.g., an event that has a frequency of 1 in 10 years has a 10-year return period). As the return period increases (less frequent events), the shock is more disruptive (severity of the event increases as the return period increases), thus requiring more financing. Amounts and modalities for financing are scaled based on the return period (e.g., using only reserves for a 5-year return and above, using both reserves and contingent credit for a 10-year return and above, and use of all three modalities for shocks with a 20-year return and above).

With numerous benefits in mind, this report is primarily focused on use of DRF solutions in rebuilding the balance sheet of financial institutions immediately after a geophysical shock. The primary motivation is to assure that the MFI can continue to lend post-shock. Recovery lending is an important service that fits with building resiliency. As the focus of this document is on DRF solutions for MFIs, microinsurance programs are not directly covered. Without careful consideration of who will pay and how the actual financing systems will work when building DRF solutions, efforts to build microinsurance products for extreme geophysical hazards can be costly and, potentially, ineffective in resolving poverty. Building efficient DRF solutions at scale and targeted to support the balance sheet of MFIs supporting the poor, can serve as a basis for more efficient microinsurance products to follow.

As will be developed, the risk transfer component of DRF solutions can be used to crowd lending into MFIs. This can be done in a variety of fashions. If structured properly, the risk transfer component can serve as a form of credit guarantee. Several market failures likely explain why DRF solutions are not currently being used by MFIs. The public good tied to DRF solutions merit public action to support their adoption.

As a major theme of this report is that shoring up the balance sheet quickly when there is a geophysical shock enables recovery lending, a cautionary note is warranted. Except for a pandemic and potentially, a prolonged drought, most geophysical shocks are short-lived and are not correlated from year to year (i.e., bad years typically do not follow bad years). COVID has had four peaks in its two-year life. The global community should be cautious in developing conclusions based on recovery lending programs implemented during COVID.

Structure of the Report

The next section reviews the literature on how geophysical shocks impact the poor and vulnerable. Section 3 includes experience of MFIs using DRF solutions and details of how to structure and use DRF solutions to support recovery lending. The section also reviews the rapid pace of parametric risk transfer to show the reader that these solutions are reaching maturity in that they can be developed for any geography (exposure) and nearly all important geophysical shocks (hazard). Section 4 is devoted to MFIs and geophysical shocks in Bangladesh and Indonesia. Finally, Section 5 makes recommendations for how to use risk transfer to crowd in contingent credit building the case for why and how development-oriented institutions can support the adoption of DRF solutions.

Section 2: Literature on geophysical shocks, lending, and poverty[21]

The observed impacts of geophysical shocks are directly tied to poverty as the poor are significantly more vulnerable than other members of society. Not only do we expect that a geophysical shock can push a vulnerable household into a poverty track, but it can be expected to slow economic activity and economic development. Poverty and inequality dynamically affect economic choices, such as the level of disaster risk mitigation effort both individually and collectively. For example, while poorer countries are unable or unwilling to spend scarce resources on mitigation investments, and may be subject to a variety of other institutional and market limitations, high inequality at any level also correlates with fewer resources being devoted to mitigation (Cavallo and Noy 2010).

Stylized observations emerging from the empirical literature include that smaller and poorer states are more vulnerable to geophysical shocks impacts (Clay and Benson 2005; Kellenberg and Mobarak 2011; Cavallo and Noy 2010; Loayza et al. 2012), that they experience more disaster-related deaths (Toya and Skidmore 2007), that larger disaster events have a proportionally greater impact on poor countries than wealthy countries (Noy 2009), including larger losses relative to their GDP (Wenzel and Wolf 2013). Furthermore, the poor are not homogenous, with gender an obvious but often underappreciated distinction. While women and girls are frequently more vulnerable and hence experience greater negative impacts from geophysical shocks, women also have important, but unexploited, contributions to make to disaster risk mitigation (UNISDR 2009). These and other studies have included socioeconomic characteristics and indicators of development as part of their investigations, but more is needed for a fuller understanding of the channels and magnitudes through which geophysical shocks influence income distribution, poverty, and recovery (Noy 2009).

Disaster resiliency and prospects for disaster recovery at both the micro and macro levels are dependent on the availability of emergency and reconstruction funding, where capacity further depends on the functioning and penetration of credit and insurance markets (Kellenberg and Mobarak 2011; Loayza et al. 2012). Not only are formal financial markets critical for ongoing development and poverty alleviation, but they also serve important risk management and recovery functions (Becchetti and Castriota 2011; Khandker 2007; Skoufias 2003). In particular, financial markets provide a means through which to efficiently allocate risk and help minimize economic losses through the timely finance of recovery and reconstruction efforts (Garmaise and Moskowitz 2009; Loayza et al. 2012; Yaron 1997). When these markets exist the human toll and economic effects of geophysical shocks are less pronounced.

The poor are generally more vulnerable when financial access and formal risk management are limited (Loayza et al. 2012). Self-insurance strategies for the poor are costly in terms of current income and opportunity costs. In addition, localized informal group risk sharing and consumption smoothing strategies employed by the working poor are designed for idiosyncratic risks that are overwhelmed by highly correlated geophysical shocks events where group income

[21] This section is largely reproduced from the Rockefeller Foundation report from GlobalAgRisk entitled "Designing Financial Disaster Risk Management Solutions to Support Recovery Lending via Microfinace Networks and Microfinance Investment Vehicles."

moves strongly together (Anderson 1976; Becchetti and Castriota 2011; Skoufias 2003). Losses in the immediate aftermath of geophysical shocks are compounded by the temporary failure of local markets and employment opportunities, which further exacerbates livelihood disruptions. When consumption-smoothing efforts force the sale of productive assets, poor households face a real threat of persistent poverty, trapped in a state of low productivity that inhibits future growth (Barnett et al. 2008; Carter et al. 2007; Dercon 2005; Wenzel and Wolf 2013). Poverty can be further transmitted into the future via curtailed childhood education and poor nutritional status when there are few sources of financing for disaster coping and recovery (Becchetti and Castriota 2011).

Improving access to financial services to help moderate the effect of geophysical shocks, improve resiliency, and speed post-event recovery is more pressing with the recognition that the return period (i.e. they are more frequent) for some catastrophic natural events appears to be shortening, and as populations of the poor and vulnerable increasingly concentrate in disaster-prone areas.

Perspective on How Lending Works in Under-Developed Markets

The focus here is on lending financial institutions, and on microfinance in particular, and their role in credit provision to the real economy, and for the working poor in particular. While formal banking services can help improve the risk management capacities and disaster resiliency of the working poor, correlated geophysical shocks also pose special problems for the availability and performance of these services. That is, the disaster risk exposure of a lending institution's borrowers can greatly constrain financial market development and overall access to finance (Collier and Skees 2012; Garmaise and Moskowitz 2009; Skees and Barnett 1999; Skees et al. 2004). Here, we describe the underlying economic dynamics of MFI lending and show how lenders react when many of their clients are exposed and/or impacted by a geophysical shock. It is important to recognize that non-bank lending institutions in underdeveloped markets are not usually subject to prudential regulation. To the extent that such institutions are regulated, this will usually extend only to their business conduct. In these circumstances, those supporting the financial institutions with equity and liquidity (e.g., MFNs and MIVs) may become the de facto prudential regulators and may require certain practices like stress testing for geophysical shocks.

Lending and the Information Problem

Research supports concerns that lending involves a fundamental challenge that can be framed as an information problem – when the bank makes loans there is always uncertainty about whether the borrower will repay (Diamond 1984; Stein 2002; Stiglitz and Weiss 1981). Banks need some method for selecting good investments and holding these borrowers accountable. Collateral is one form of accountability. Developed country credit markets have expanded in recent decades with commercial banks lending to small firms due to new forms of collateral (e.g., accounts receivable, inventory, etc., Berger and Udell 2006). Information technologies such as credit bureaus have also contributed to this expansion by increasing both information about borrowers and their accountability through linking repayment to future credit access (De Young et al. 2004; Petersen and Rajan 2002).

These information problems are perhaps greatest in markets serving the poor (Armendáriz and Morduch 2010; Behr et al. 2011), small and medium enterprises (SMEs, Agarwal and Hauswald

2010; Beck et al. 2008; De Young et al. 2004; Peterson and Rajan 2002) and agricultural producers (Binswanger and Rozensweig 1986; Boucher et al. 2008; Hoff and Stiglitz 1990). For these borrowers, production risks are high; few formal financial records are available; collateralizable assets are few; and in some cases, potential borrowers are remote. Consequently, these are some of the least developed credit markets. For example, about 50 percent of SMEs in developing countries cite access to financial services as an operational constraint, and 40 percent report not having any access to a formal financial institution (Stein et al. 2013). Stein et al. (2013) estimate that this developing-country credit market gap is over US$ 2 trillion. Formal SMEs account for approximately 30 percent of total economic output in these countries (Ayyagari et al. 2007). Given the important role of SMEs in developing country economies, the benefit from approaches that reduce these credit constraints could be substantial.

To reach the poor, MFIs have developed alternative approaches to overcome information problems (e.g., see Armendáriz and Morduch 2010). For example, these lenders offer improving loan terms over time so borrowers repay based on the potential of larger loans or lower interest rates. Also, group lending relies on the group to select its members, taking advantage of their private information and holding all members accountable for repayment.

In both developed and developing countries, the community bank model is perhaps the most pervasive lending approach to overcoming information problems in MSME and agricultural credit markets. With this strategy, lenders imbed themselves in a community. They select borrowers based on their expertise in the local economy and the reputation of community members, and they monitor these borrowers through frequent interaction (Agarwal and Hauswald 2010, Behr et al. 2011, Uchida et al. 2012). For example, agricultural lenders often hire agronomists and maintain small rural offices near their borrowers (Wenner et al. 2007).

This approach has expanded credit to households and firms that would have otherwise been excluded from formal markets, but it has two important consequences for managing disaster risks. First, it motivates geographic specialization (BCBS 2010, DeYoung et al. 2004), constraining the ability of these lenders to diversify portfolio concentrations of disaster risk. Second, it increases lender autonomy (Houston et al. 1997, Stein 2002). Lending to informationally opaque borrowers creates opaque lenders. In contrast to commercial banks that can provide lending rules based on credit scores and collateral quality, the lending rules for these MFIs rely on judgment and qualitative information. Consequently, MFIs often find attracting new equity investors difficult (Portes and Rey 2005). Moreover, the challenge of communicating this information from a subsidiary to a parent company decreases the likelihood that lenders using the community bank model, or who are part of a bank holding company, will be provided additional support in periods of crisis (Stein 2002).

Lender Financial Structure and its Implications

While banks perform a variety of functions and often have numerous investments and sources of revenue, consider a stylized situation where the sole business activity is retail lending to the working poor for business investment, working capital, and consumption smoothing, which is supported by retail and wholesale funding. This stylized model closely aligns with the functions of many MFIs. In it's simplist terms the bank earns revenue from the interest rate spread between its source of funds and the loans it makes to businesses and individuals.

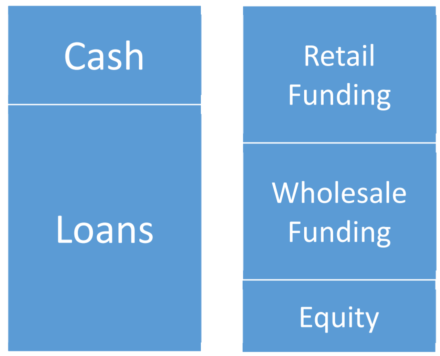


Figure 1 – Stylized Balance Sheet

Figure 1 represents a stylized balance sheet of a bank. The left-hand side describes the assets held by the bank (the use of funds); the right-hand side describes how those funds are sourced. These two columns must always be equal in size.

Lender Assets

Lender assets comprise cash and loans. Cash holdings are used for lending, addressing financial obligations, and managing liquidity risks, as discussed below. Loans are the main assets of the lender. A loan's value is a function of its current and expected performance. Credit risk refers to the risk that a lender's borrowers fail to repay their loans in part or in full on schedule. When a lender recognizes there is some likelihood of a loan not being fully repaid, it is considered impaired and the lender adjusts the value of the asset on its balance sheet (Krueger 2002).

Lender judgment also influences the adjusted value of an impaired loan. While standards differ across countries, frequently, they emphasize proactive management of credit risks and so loan quality depends on both the actual payments made by the borrower and the lender's assessment of the borrower's ongoing ability to repay (van Gruening and Bratanovic 2009). For example, impairment standards for regulated financial institutions in Peru state that a loan is "deficient" and its book value should be written down by 25 percent if it is in arrears for 60 to 120 days or if the borrower is in a weak financial situation and cash flow projections do not suggest improvements soon (SBS 2008). Additionally, standards provide lenders additional flexibility in that they typically allow poorly performing loans to be valued at higher levels if they are restructured (e.g., increasing loan maturity and reducing monthly payments, SBS 2008; van Gruening and Bratanovic 2009). Because lenders have an incentive to signal that their assets are of good quality, the discretion available to them challenges the external assessment of potential investors.

Lender Liabilities and Equity

Financial intermediation can be accomplished through several channels. One is through consolidation and transformation of many small deposits of short-term maturity into larger loans with a longer maturity (retail funding). Alternatively, institutional investors (second-tier banks or even donor organizations) provide funds for on-lending (wholesale funding). Deposits can reduce funding costs as retail customers typically accept lower interest rates than institutional investors, but deposit-taking institutions are more closely regulated to protect depositors. Moreover, deposits increase a lender's liquidity risk as these investors can often withdraw their funds on demand.

Equity (i.e. the interest of the owners in lending institution) is calculated by deducting total liabilities from total assets. Equity holders, whose interest represents their investment together with retained earnings (adjusted for accumulated losses), do not usually have any direct claim against the entity in respect of their interest unless the entity is being liquidated. Even then, equity holders usually have the lowest priority in any distribution of the assets on liquidation. In contrast to liability funding, which lenders can typically adjust as needed, equity therefore has a degree of permanence and can be used by a lender to build its operations and absorb losses. Equity is the most significant component, and often the only component, of a lender's capital.

Fixed claims (retail and wholesale funding) tend to be easier for banks to access than equity because the value of equity is determined by the value of its asset holdings, which is difficult to assess externally. With some exceptions discussed below, wholesale funding is primarily based on demonstrated cash flow – whether a lender's cash flow is likely to be consistent enough to service the fixed claim. Banks rely more heavily on liabilities than firms in other sectors (van Greuning and Bratanovic 2009). These forces increase the financial risks of banks. Banks need consistent returns to meet these liabilities. But also, large liabilities that are not offset by quality assets increase the risk of insolvency.

Diversification is the linchpin that allows this business model to work. On the assets side, lending to many borrowers reduces the consequences of nonpayment from a single borrower. On the liabilities side, holding deposits from many savers reduces the consequences of funding withdrawal from a single depositor.

Concentrations of risk in a lender's loan portfolio may remain after the lender has exhausted its ability to diversify. A lender's capacity to bear losses is largely based on its capital ratio, its level of equity relative to its risky investments (loans in this case). Thus, a lender with a capital ratio of 10 percent might face insolvency as non-performing loans approach 10 percent. All lenders must manage their capital ratio due to insolvency risk. Funding costs and equity share prices are also influenced by the capital ratio, motivating lenders to adhere to market norms. Almost universally, those regulated lenders that take deposits must comply with minimum capital requirements (e.g., that the capital ratio must remain above levels like 10 percent). Thus, whether regulated or unregulated, lenders tend to operate with an internal target capital ratio that provides some capacity to manage losses.

In underdeveloped markets where the need for credit is great, lenders are typically constrained not by profitable lending opportunities but by their capital. The capital base will largely determine the size of the loan portfolio. As an example, consider a bank that has US$1 million in capital and targets a capital ratio of 10 percent. This target capital ratio fixes a target value of outstanding loans at US$10 million (US$1 million/0.1). Without additional external capital, lenders grow through reinvesting profits.

Capital constraints limits wholesale funding opportunities

Capital constraints are apparent in development-oriented sector of "impact investing." Asset managers such as Blue Orchard specialize in investing in microfinance institutions, marketing their services as providing both a financial and social return. In periodic reports, the Consultative Group to Assist the Poor (2012), MicroRate (2011), Symbiotics (2013) and others identify access to equity as a capacity constraint for MFIs. These asset managers hold about 20 percent of their investments in equity and those in the largest and safest MFIs. They would like to provide additional wholesale funding, but the MFIs with which they work do not have enough capital to expand lending.

Summary

Lenders face an information problem in identifying to whom they should lend. Agriculture and MSME lending perhaps face the greatest informational constraints. Lenders serving these markets frequently specialize geographically, overcoming the information problem through developing local expertise and monitoring borrowers. Lending based on the judgment of loan officers creates a credit portfolio of assets that are difficult to evaluate externally and so limits access to additional equity funding. Instead, lenders rely on retail and wholesale funds that are structured as fixed claims. This model works as long as lenders can reduce risk concentrations via diversification.

Lenders and Geophysical shocks

Lenders specializing geographically cannot fully diversify against local shocks such as geophysical shocks. In the developing world, disasters are first and foremost a credit risk. Loan losses reduce the returns and assets of the lender.

Geophysical shocks can also create two financing challenges – a need for liquidity and a need for capital. Both challenges are information problems which are compounded by a shock as the extent of lender losses will be unknown to the lender. If improperly addressed, these problems can have a lasting impact on the lender including insolvency (Berg and Schrader 2010, Collier and Skees 2012)

Disasters and Liquidity

Disasters increase demand for cash in the local economy to meet emergency consumption needs, offset business disruption losses for firms, and finance recovery and reconstruction. Frequently, depositors withdraw their funds as a result (Hoque 2008). Moreover, poor loan performance concurrently decreases lender revenues.

A liquidity crisis emerges if the lender cannot access enough cash to meet its current obligations (e.g., deposit withdrawals, debt servicing, operational expenses). At the extreme, cash shortages can motivate lenders to sell assets. Especially in developing countries, markets for unsecured loans are very thin and so can lead lenders to liquidate assets at fire-sale rates, taking substantial losses. Any investment (equity or liability) in the lender will tend to enter as cash and so can address liquidity shortages; however, short-term liabilities are typically well suited to address emergency liquidity needs as these events can be acute but short-lived.

Liquidity risk is typically managed through an appropriate mix of funding sources to ensure stability and by maintaining a buffer of liquid assets. First, lenders hold cash reserves. These cash holdings are costly. Second, some lenders have access to emergency liquidity funds through their governments or a private source. These emergency facilities are intended to provide a rapid injection of funds into otherwise healthy lenders facing an unusual stress event. They can be quite valuable for the lender and in turn the market is served; however, whether to lend to a lender in crisis often remains at the discretion of the liquidity provider so these facilities are not a guaranteed solution to liquidity risk.

Disasters and Capital

For financial institutions focused on lending, capital is quite sensitive to loan losses. For a lender with a 10 percent capital ratio, losing 5 percent of its loans to a disaster translates into losing 50 percent of its equity. Without access to external capital, lenders may choose to deleverage, reduce investments in risky assets. This process effectively reduces the size of the lender to bring it in line with its smaller capital base. Secondary markets are thin in most developing countries for small business investment, working capital and consumption loans so the primary avenue to deleverage is through a reduction or temporary suspension of new loan origination (Collier et al. 2013; Collier and Skees 2012; Khandker 2007).

Using data from over 500 MFIs in 58 developing and emerging economies that report to MIX Market (2014), Collier (2015) finds that *disasters reduce lending following the event*. Median annual loan growth for these MFIs is 24 percent. On average disasters reduced loan growth by 11 percentage points in the current year and another 8 percentage points the following year. These effects are largely explained by capital constraints. Lenders with low capital ratios before a disaster lent substantially less afterward, but those with high capital ratios lent at the same rate following the event.

Unfortunately, deleveraging by distressed lenders comes at the precise moment when the affected community most needs robust or even expanding financial services to assist victims. Financial services have been shown to reduce the economic consequences of geophysical shocks (Zander 2009). These missed opportunities represent delayed recovery and more suffering for affected communities.

Lenders manage capital risks by operating with large capital reserves and rationing credit. Those lenders who have limited ability to diversify their portfolio or avoid areas at higher risk to correlated disaster events are forced to maintain higher precautionary capital buffers, holding capital well above regulatory minimums or market norms. For example, while regulated minimum capital requirements are typically 8-10 percent, the average capital ratio of lenders reporting to MIX Market (2014) is 38 percent.

The implications of this strategy are huge for communities with underdeveloped credit markets since higher capital buffers implies less lending for each dollar of equity to cushion against an infrequent but severe shock. Returning to the example of a lender with US$1 million in equity, a 10 percent target capital ratio as might be seen at a commercial bank would lead it to hold a portfolio of US$10 million. However, a capital ratio of 38 percent results in total loan allocations of only US$2.6 million.

Van den Heuvel (2006) goes further to show that lenders will reduce loan origination following a shock to its capital base even when bank capital erosion does not fall below regulated minimums, and that this effect can be persistent. Given the substantial operational challenge and cost of these undiversifiable shocks, it is perhaps unsurprising that lenders avoid vulnerable populations and communities despite the presence of profitable lending opportunities during non-disaster conditions (e.g., Boucher et al. 2008; Hoff and Stiglitz 1990).

Disasters and Credit Rationing

Geophysical shocks damage lenders and induce price and non-price rationing to preserve survival and profitability. Rationing behavior is not only a consequence of efforts to cope and deleverage following a disaster event that erodes the lender's capital, but also as a means to protect the institution from future events.

In isolated credit markets, the combination of effects is internalized and forces up interest rates (Ray 1998) or can be expressed as an increase in the minimum loan size to lower per-unit administrative costs (Jonston and Morduch 2008). In some situations of slow-onset events such as drought or where there are reliable indicators of an impending geophysical shock, lenders may simply curtail additional lending until the crisis has passed to avoid predictable default problems. This reaction was found among some agricultural lenders in areas of Northern Peru as a strong El Niño was known to cause extreme rainfall and catastrophic flooding (Collier and Skees 2012; Skees et al. 2007).

Rationing can also be expressed through preferential lending in ways that minimize the information problem and default risk. For example, Berg and Schrader (2011) show that relationship lending is an important rationing device when credit demand exceeds bank capacity following volcanic disasters in Ecuador. While overall lending declines, clients with known histories of good repayment are just as likely to be approved for a loan before and after the disaster disruption. Unknown clients are less likely to be approved for a loan after the disruption. In related work, Berg and Schrader (2010) also find that the same known clients were offered preferential interest rates following the disaster while new clients were charged higher rates. While the higher rates also resulted in higher defaults among new clients, the preferential treatment of known clients help maintain a monopolistic lending dynamic that would allow the lender to recover lower returns in the future.

Managing disaster risk as a bank holding company: A contrasting case

Bank holding companies (groups of banks that are typically organized with parent and subsidiary banks) also lend in areas experiencing disasters. These lenders operate "internal capital markets" by which they can reallocate capital and liquidity toward the greatest needs in the group. Hard information (credit scores, borrower financial records, collateral, etc.) greatly improves the functioning of internal capital markets. Soft information (lending that relies on lender judgment) can put the parent office in a difficult decision of differentiating between bad luck – losses due to a disaster that could not be avoided – and bad management – imprudent lending practices by the local office (Stein 2002).

Large banks have been shown to use internal capital markets inter-regionally (Campello 2002, Houston et al. 1997) and internationally (De Lis and Harrero 2010). Lenders with access to these internal markets behave differently. Independent banks target higher capital ratios and exercise additional caution after a shock to manage their scarce capital; however, bank subsidiaries with international parents hold small capital reserves and lend more after a shock based on their access to additional capital if needed (De Haas and Van Lelyveld 2010).

Section 2: Literature on geophysical shocks, lending, and the poor

Similar bank lending channel impacts are documented by Mian and Khwaja (2006). They show that developing market lenders that face liquidity shocks frequently transfer these instabilities to their clients when credit market imperfections are affecting both lenders and clients. The effect of lender damage is rationing of the amount of credit offered, with both new and existing clients having a lower probability of obtaining a loan even if the client's creditworthiness is unchanged. They show that larger firms, which are better known to other lenders, typically found alternative sources of funding, but smaller firms did not. Firms that could not find alternative funding in essence absorbed the liquidity shocks of their lenders and were significantly less profitable in the following periods. Even in well-developed capital markets, the impact of geophysical shocks can result in a decline in lender capacity and transmit rationing effects even to firms unaffected by the disaster event (Hosono et al. 2012).

Section 3: Disaster Risk Financing to Support Recovery Lending[22]

This section begins with some experience in using DRF solutions to protect Financial Institutions. It then describes the basic principles of event-based DRF solutions that fit effectively in using different modalities of financing with risk layering in building financing using internal reserves, contingent credit, and risk transfer. Within this explanation, the value of structuring and using event-based triggers to provide financing is reviewed extensively.

Experience in Using DRF Solutions for Financial Institutions

Among the first examples of a financial institution using catastrophic insurance to protect its portfolio was in Peru. Working with a Gates Foundation Grant, GlobalAgRisk partnered with a Peruvian insurance company and a global reinsurer to build a parametric risk transfer product based solely on the sea surface temperature (SST) as reported by the US National Oceanic and Atmospheric Administration (NOAA). SST captures the ENSO (El Nino Southern Oscillation). It was a well-known fact that strong ENSO events were a prelude to extreme rainfall and flooding in the northern regions of Peru. Caja Nuestra Gente purchased the ENSO insurance with an explicit goal of expanding lending in the impacted regions (Collier 2018).

As the MFI sector in Peru is among the most advanced in the world, the Peruvian Banking and Insurance regulator (Superintendencia De Banca and Seguros) complied excellent records. These records demonstrated that MFIs operating in the Northern regions of Peru were actively managing their loan portfolio as there was evidence that a strong El Nino was forming. This meant that they were restructuring some loans before the event. These actions represented an extra cost to the MFI. The case was made that there was business interruption even prior to the extreme flooding. The regulator approved what is very likely the first 'forecast-based' insurance in the world that would pay up to 2 or 3 months prior to the geophysical shock. The product was a business interruption offering.

VisionFund International (VFI)[23] successfully implemented recovery lending programs after typhoon Haiyan devasted the Philippines in November 2013. VFI owns around 30 MFIs around the world. Given the positive experience with recovery lending, VFI used information supplied by GlobalAgRisk about the impending strong El Nino of 2015 to make the case for a returnable grant of two million pounds from the British agency DFID[24]. VFI and the MFI network provided additional loans to clients in several African countries as the strong El Nino created drought and some flooding events. Some rigorous monitoring and evaluation was part of the program (Recovery Lending in Africa). Again, findings demonstrated that recovery loans performed well. In this case, the performance was even better than other loans made by the MFIs.

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[22] Some segments of this section are reproduced or modified from a Rockefeller Foundation report produced by GlobalAgRisk.

[23] VisionFund International is a subsidiary of global charity organization World Vision that oversees its microfinance operations, providing loans and insurance to low-income population.

[24] GlobalAgRisk (Skees, et al. 2007) used a Gates Foundation grant to develop an El Nino index insurance product in Peru that paid before extreme flooding in the North (strong El Nino causes heavy rainfall in Northern Peru). A Peruvian MFI purchased the special forecast insurance product in 2011 and 2012. This may have been the first case of a FI using an index insurance to expand lending and protect the balance sheet from an extreme geophysical shock.

Based on VFIs experience, the Rockefeller Foundation provided a grant to determine how to integrate DRF solutions into the flow of funds that support Microfinance Institutions (MFIs) in implementing recovery lending after a geophysical shock[25.] The project involved GlobalAgRisk, VFI, and BlueOrchard. BlueOrchard operates a fund which can be characterized as a microfinance investment vehicle providing lending to MFIs around the world.

The Rockefeller study demonstrated how to implement DRF by using event-based structures (parametric) to trigger financing from reserves, contingent credit, and risk transfer contracts (insurance-like structures). By 2018, VFI was using these structures with Global Parametrics[26] providing the risk transfer and BlueOrchard providing the contingent credit. This type of risk layering is common in finance and is represented in Figure 2.

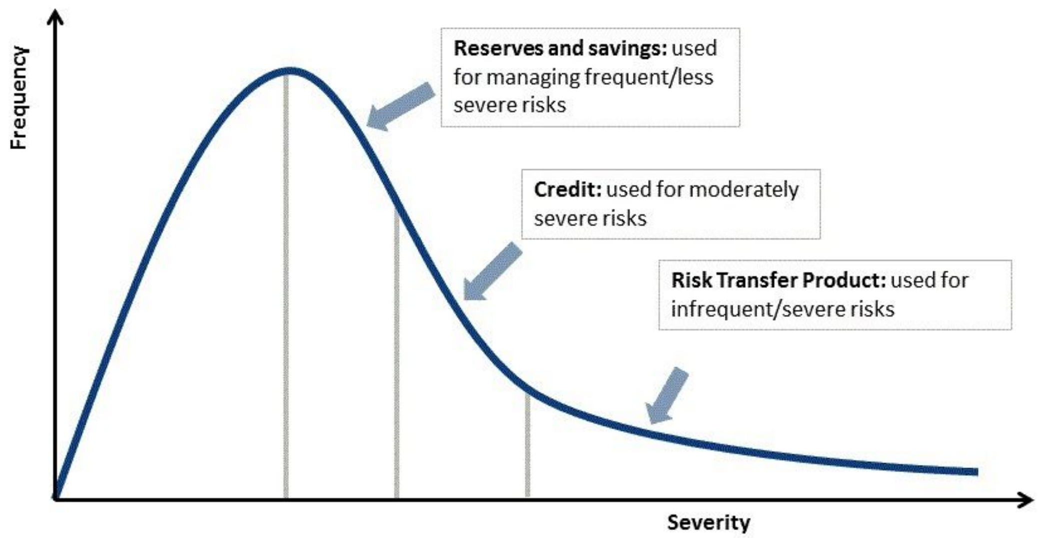

Figure 2 – Risk Layering is used to build efficient DRF structures

Event-based structures trigger payments using the statistical rank of a geophysical event. The statistical rank provides a view of the frequency of events. These ranks can be converted to what insurance providers reference as a return period (e.g., an event that has a frequency of 1 in 10 years has a 10-year return period). As the return period increases (less frequent events), the shock is more disruptive (severity of the event increases as the return period increases), thus requiring more financing. Amounts and modalities for financing are scaled based on the return period. While any number of structures are possible, an example structure may use only reserves for a 5-year return and above, use both reserves and contingent credit for a 10-year return and above, and use all three financing modalities for shocks with a 20-year return and above.

Among the more interesting concepts that were reviewed in the Rockefeller report was the idea that the risk transfer funding could be packaged with contingent credit as subordinate debt.

[25] Rockefeller Report "Designing Financial Disaster Risk Management Solutions to Support Recovery Lending via Microfinance Networks and Microfinance Investment Vehicles" September 30, 2016. GlobalAgRisk

[26] Global Parametrics is a parametric disaster risk transfer company managing a natural disaster fund supported by the British and German governments and matched by Hannover RE. Global Parametrics is a world leader in inclusive insurance for the poor and vulnerable in low and middle income countries.

Subordinate debt could be forgiven and then counted as capital. Thus, by using a single debt instrument, the global side of VFI could offer both liquidity (contingent debt) and capital (subordinate debt) to their MFIs. This has proven to be an efficient and proper mechanism for rebuilding the balance sheet of FIs. This financial innovation facilitates risk transfer in jurisdictions where index insurance has not yet been considered which, of course, is most geographies in the world. In nearly all jurisdictions, banking regulations are suited for contingent and subordinate debt.

VisionFund International

When VFI first used these systems, it protected six MFIs using a single contact structure with their corporate headquarters and the two counterparties (Global Parametrics and BlueOrchard). This pooling across geographies and two perils (drought and tropical cyclone), gave VFI some advantages in developing a more efficient system to rebuild the balance sheet of their MFIs when there was a geophysical shock. The overarching objective has been to use the stronger balance sheet to implement recovery lending.

In the early years, VFI passed costs to clients. Because of the efficiencies, these costs added around 50 basis points to the cost of the loans[27]. More recently, VFI has found other ways to finance the program and in 2021 protected 28 MFIs from 5 different perils (drought, earthquake, tropical cyclone, excess precipitation, and flood). As there was a portfolio of risk represented, VFI was able to have a sum of risk transfer at around $10 million of protection while purchasing only $2 million (i.e., the probable maximum loss for the portfolio was around $2 million). This added more efficiency. The VFI structures have had several payouts since the inception of the program in 2018.

International Finance Corporation

Based on the learning with VFI, Global Parametrics presented some of these ideas to the World Bank's International Finance Corporation (IFC). IFC modified the concepts and worked towards a program where they would use the risk transfer to purchase non-performing loans (NPLs) from the FIs using the payouts from the risk transfer. The MFI would pay for the risk transfer. By using the cash to purchase NPLs, the balance sheet would be strengthened in two ways; 1) removing NPLs and 2) adding capital via the cash purchase. By purchasing the NPLs, IFC would have also created a revenue stream as there were built-in mechanisms to continue to attempt to collect the loans. While discussions are still underway, thus far, this program has not been launched. Initial testing demonstrated the challenge of explaining the benefits to FIs as there was limited demand.

Enabling Qaptial

Another case following concepts developed in the Rockefeller report involves Enabling Qapital (EQ)[28]. EQ has packaged an offering with their regular debt commitments that adds the optionality to secure contingent debt and capital (using subordinated debt) into a single debt contract for their MFIs. The regular debt is provided in the usual fashion. For the triggering of the contingent

[27] 50 basis points was added to loans costing in the range of 20 to 30 percent per year as is common for MFI lending in emerging economies.

[28] Enabling Qapital (https://enabling.ch/) operates a Microfinance Investment Fund specializing in impact investing via MFIs.

debt and capital, EQ uses the Global Parametrics product structure. EQ provides the contingent credit and Global Parametrics provides the contingent capital via their Geophysical shocks Fund. The first packaged debt of this nature was purchased by a Cambodia MFI for drought and flood in 2021.

Principles of Structuring, Layering, and Financing for MFIs

The eloquence of event-based structures that *rank geophysical events by return period* is that the layering and use of different financing modalities can be organized before an event. And that risk analysis process has value in the first step to be taken in managing risk which is understanding the risk. This leads to ownership of the risks and, in turn, to the recognition that the risk can be managed. The basic principle of this type of structure is that the less frequent events are more severe and more damaging; thus, requiring more financing. The other overarching principle is that decision-makers generally plan for more frequent events or even for averages and very rarely perform the stress test for extreme and infrequent shocks.

DRF solutions make use of advances in big data to capture hazards and exposure. By carefully considering how to use geophysical data and with advanced financial engineering, it is possible to price DRF products and structures using a time series and to settle financial contracts using either real time or forecast data – be they contracts providing contingent credit for liquidity or risk transfer for capital. The same structures can be used to trigger internal reserves. Unlike an insurance offering, event-based risk transfer products are triggered based on third-party data and require no proof of loss. Importantly, this means the financial protection can be used for the expected extra cost and lost income (business interruption)[29] created by geophysical events. Event-based DRF products[30] are available for drought, excess rain, heatwaves, flood, tropical cyclone, earthquakes, volcanoes, landslides, pandemics, and other geophysical hazards.

[29] Parametrics Plugging the Gaps in Business Interruption

[30] Event-based products are also referred to as index or parametric insurance. As the same structure can be used to trigger financing from reserves and contingent credit, the boarder term of event-based products is used.

Table 1 Advantages of Event-Based Risk Transfer versus Indemnity Insurance

Benefit	Description
Quicker Payments	More timely payments have the potential to add significant value to policyholders who are provided with those funds during difficult conditions. Parametric products provide payment based on a predetermined measure of the disaster event and so can be paid more quickly than indemnity insurance, which requires a loss assessment sometime after the event.
Broader Scope	Different entities are affected by the same event and there is potential for any vulnerable party to use the same risk transfer product structure. Indemnity insurance such as agricultural insurance only serves a specific set of those who are vulnerable. For example, agricultural insurance markets protect producers from yield losses but do not tend to be available for agricultural processors or wholesalers whose revenues are also adversely affected by low yields.
Greater Flexibility	Disasters create a variety of adverse consequences for those affected such as revenue losses, increased expenses, and asset losses. With parametric risk transfer products, the level of coverage is chosen by the policyholder, and the payout can be used for any purpose the policyholder chooses. Indemnity insurance such as property insurance traditionally will only protect against asset losses.
Lower Transaction Costs	By using a transparent third-party metric to trigger payments, parametric risk transfer products avoid the costs of verifying actual losses and are much less prone to problems of moral hazard and adverse selection that can dramatically increase the cost of indemnity insurance for agriculture or business interruption.
Better Form of Risk Protection for Business Interruption	Firms can purchase risk transfer products to protect against business interruption and extra costs that may be tied to an extreme catastrophe event. Traditional business interruption insurance is prone to legal disputes and prolonged court cases to resolve different assessments in evaluating loss. No disputes should emerge from event-based DRF solutions.The event occurs and the conditions of the contract specify the payment based on a third-party metric.

The risk transfer component of DRF solutions can take many forms as well – derivatives, insurance, or reinsurance. By using exposure of the MFI (e.g., geographical exposure of the loan portfolio), tailored DRF structures can be developed. Weighting exposure by the geophysical hazard results in more efficient DRF solutions. Vulnerability weights can be an added feature to structuring the index to trigger the various modalities of financing. For example, if there is one region of the MFI portfolio that has a higher share of non-performing loans, those loans may be given a greater weight as they will be more vulnerable to a geophysical shock.

One DRF product to be examined more closely in Section 3, is heatwaves. Heatwaves are already impacting MFIs, and certainly, heatwaves impact urban areas more than rural areas. These events impact labor productivity and reduce the ability to service loans. For illustration and to bring to life how risk layer works, it is assumed that only the ambient temperature is a good representation of the problems created by heatwaves. Given a time series of temperature (hazard event) for a specific location (exposure), advanced statistical procedures can be used to fit a probability distribution function (pdf). That distribution can then be used to rank events. The ranking uses the match between the event (temperature) and the cumulative frequency coming from the curve fitting of the pdf.

$$Return\ Period\ (Rank) = \frac{1}{(1 - CFreq)}$$

At the 80th percentile, the rank is 5 (i.e., 1 divided by 1-0.8). Let's assume a temperature of 30 °C corresponds to the 80^{th} percentile, this means that temperatures of 30 °C or less would have a return period of 5 years or less. These values would be expected 80 percent of the time and do no damage to labor productivity. Even in hotter climates it is generally reasonable to assume that the local society has adapted to temperatures occurring 80 percent of the time (e.g., it may be that the 5-year return temperatures if 38 °C). For events with a 5-year return period or less there would be no need to organize financing – self-retention of these events works fine. In the range from 5 to 10-year return, there may be some loss of productivity and business interruption for the MFI. This can be managed with internal reserves. As

Table 2 presents, the 5 to 10-year range will happen 10 percent of the time. As temperatures get into the 10 to 20-year range, they are significantly higher and more disruptive to the livelihoods of the poor and the MFIs that support them. In this range, contingent credit might be a good financing mechanism. As it is contingent and the MFI can choose to take some or all the financing, the value at the upper end (in this case 41°C that corresponds to the 20-year return) might be $3 million. As implied, lower amounts of credit would be available for lower temperatures.

Once temperatures exceed 41°C, there may be significantly more costs and balance sheet disruptions for the MFI. This is where risk transfer fits. In **Error! Reference source not found.**, it is assumed that risk transfer is used for return periods of 20 to 100-years. As most decision-makers have difficulty considering shocks that are beyond 100-year, this example only uses pre-organized financing modalities for shocks below the 100-year return period. It may be that governments and humanitarian organizations will provide additional financing for these very catastrophic shocks.

Table 2 Using risk layering to map hazard (temperature), return period, and financing.

Temperature	Return Period	Probability for this range	Financing modality	Value at upper end of return period
30 °C and less	Less than 5	80%	Self retention	
30 - 38 °C	5 to 10	10%	Reserves	$ 1,000,000
38 - 41 °C	10 to 20	5%	Contingent Credit	$ 3,000,000
41 - 47°C	20 to 100	4%	Risk transfer	$ 2,000,000
47 °C and higher	> 100	1%	Gov't or humanitarian community	unknown

In this example, the MFI would have access to up to $6 million of financing when temperatures reach 47 °C. The treatment of these different modalities of financing is also important for the MFI. Contingent credit aids with liquidity problems as do the reserves that can also be dawn when contingent credit triggers. As the MFI pays a third party upfront for the risk transfer component, this financing comes with no further obligation and, if properly organized, it can count as capital on the MFI balance sheet. As will be explained further below, it is possible to have this financing structured as subordinated debt that can be forgiven. This allows that debt instrument to serve as capital. This type of financial engineering is valuable as it allows the provider of these services to bundle them into a single debt instrument.

In all cases, the MFI will collect fully on the risk transfer component as, like insurance, a fee (premium) is paid for the pre-arranged financing. As the risk transfer component is based upon ex-ante analysis of the hazard and best estimates of financing needs, it is a given that the analysis will not perfectly match the needs. Overpayments are possible where the risk transfer pays more than the business interruption cost. In other cases, payments can fall short of the business interruptions cost. This mismatch can be created by two conditions. First, and potentially the most limiting, the MFI could purchase too little protection. This behavior is common for innovations. The second condition creating a mismatch occurs when the index (temperature in the example above) doesn't perfectly correlate with the business interruption. That is called basis risk when selling index or parametric insurance products. There is an entire literature on optimal hedging that shows that correlation levels around 70 percent or higher will yield significant financial value for a firm. For example, Gonzalez-Perez and Yun (2013) demonstrate the value of using weather derivatives for energy firms citing 'higher valuations, investments, and leverage'.

The structure in

Table 2 allows the MFI quite a bit of flexibility to manage the limitation of the risk transfer component reviewed above. This management occurs post-event as more clarity emerges regarding the full impact of the specific event. For example, for the 100-year event, the MFI could obtain the risk transfer capital very shortly after the event and then determine how much to draw from both the reserves and the contingent credit keeping in mind that both these financing modalities give the option and not the requirement to draw down any portion up to the maximum available. In the rare case where the risk transfer payment is more than is needed, that payment can be used to finance the DRF structure in the following year. These dynamic management decisions are a significant aspect of the value of the ex-ante financing that comes with risk layering and different modalities of financing. As will be explained below, the optionality of various structuring is being used as a feature to attract MFI in using DRF solutions. There are many choice variables. Thus, the section of recommendations will attempt to simply the choices given prior experience in structuring.

Understanding the dynamics of poverty and the practices of the poor who may seek loans from another source to pay off an existing loan when there is a disaster provides some concern for the unintended consequences that may follow disasters. If the poor turn to more expensive sources (Khandker 2007 evidence of the poor using moneylenders to pay off loans after the Bangladesh flooding), the clients of MFIs suffer the most. Do these dynamics of disasters and the incentives to pay off loans partially explain worrying trends associated with over-indebtedness? There is a need to understand more about how the poor repay their loans post-disaster.

What should be well understood is that when lenders withdraw loans post-disaster it is *harmful to the poor.* To be sure, the current systems of lending to smallholder households and those operating small and medium enterprises largely pushes the effects of geophysical shocks to the borrower. The unanswered question is to what extent can recovery lending play a role in mitigating this problem.

MFIs have inadequate tools to manage geophysical hazards. MFIs can suffer from impacts such as capital erosion, increase in non-performing loans (NPL), withdrawal of savings, and withdrawal of wholesale credit. But local borrowers and their communities shoulder the lion's share of the burden as their access to credit **dries up when they need it the most**. Often the practice of the MFI is to hold large amounts of capital to guard against these dire consequences. This is highly inefficient and slows economic growth as the value of leveraging capital is diminished. DRF solutions can open the path to lower capital reserves. This benefit can offset the costs of DRF solutions.

Perhaps the most important impact on the MFI is what happens to the growth trajectory, which gets to the core value of DRF solutions. When MFIs are forced to reduce lending due to a geophysical shock, this lowers income and significantly impacts the growth path. Collier (2015) evaluated this issue in using mix-market data from over 500 MFIs in 58 countries to capture the balance sheet of MFIs over time with EMDAT[31] to capture geophysical shocks. The average loan growth for the same was 24 percent. The econometric results suggested that, on average, growth of the MFI was negatively impacted by 11 percentage points in the year of the event and another 8 percentage points in the year following the event. To the extent that DRF solutions can ease this slowdown in growth, the benefits and cost can be favorable.

Figure 3 represents the average case from the Collier study for an MFI starting with a loan portfolio of $100,000 compared to a case that might have a severe event and impact the growth path more significantly. To the extent that DRF protection can provide business continuity, the difference in the growth paths can be significant.

[31] https://www.emdat.be/

Figure 3 Impact of Geophysical Shocks on Growth of MFI With and Without DRF Protection

Figure 4 presents the dynamics of a geophysical shock on MFI clients and, in turn, on how these feeds through to the MFI. As the shock weakens the clients, it also weakens the MFI.

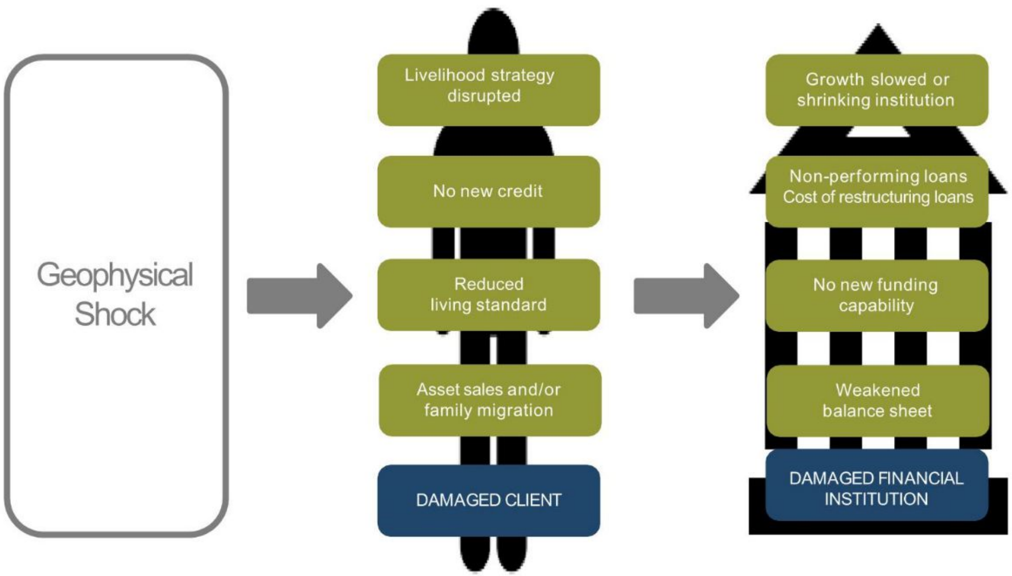

Figure 4- Impact of Geophysical shock on MFI Client and on the MFI

Without a financial recovery program, geophysical shocks often leave both borrowers and the financial institution serving them in a significantly weakened position that can slow growth capacity, create liquidity stress or in an extreme situation, lead to a bankruptcy situation.

Figure 5 illustrates how contingent credit rebuilds the liquidity of the balance sheet and risk transfer rebuild the capital. This process provides the business continuity to continue or enhance lending with recovery loans.

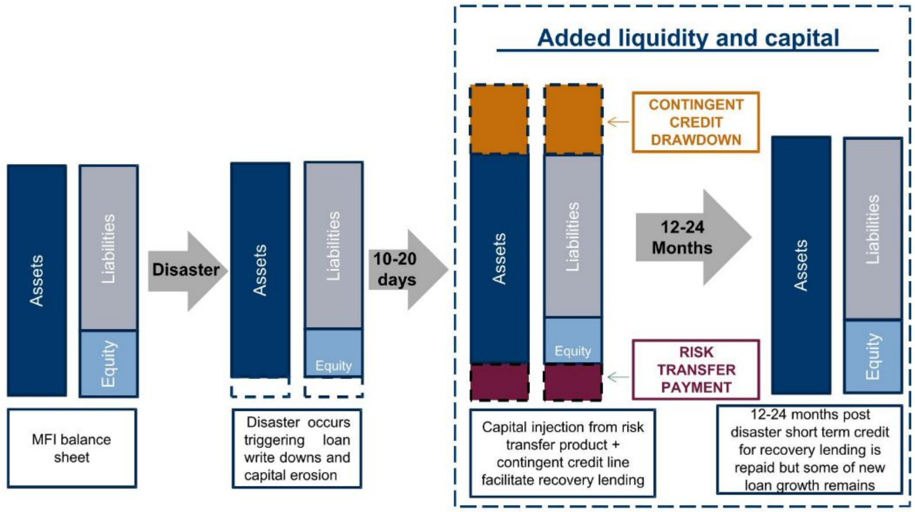

Figure 5 – Rebuilding the balance sheet with contingent credit and risk transfer financing

> *Building resiliency against geophysical hazards requires ex-ante Disaster Risk Financing whereby the balance sheet of MFIs slammed by extreme geophysical shock can be quickly rebuilt.*

With efficient DRF solutions in place, recovery lending (i.e., post event lending programs) can offer highly impactful mechanisms to build client resilience, strengthen client loyalty and improve the financial institution's economic performance. Shoring up the balance sheet of MFIs quickly by using DRF products and structures when there is an extreme geophysical event, fits many of the objectives of the Asia-Pacific Climate Finance Fund (ACliFF). Doing so enables MFIs to implement a number of responses to serve their clients but key among them would be recovery lending programs that allow the poor and vulnerable to rebuild their livelihood strategies immediately after an extreme event.

Figure 6 **Error! Reference source not found.**presents the potential value of DRF solutions that quickly rebuild the balance sheet and enable recovery lending when there is a geophysical shock. The core idea is that the added liquidity and capital flowing from the DRF will enable the MFI to maintain their business of lending to the poor and vulnerable. It is important to recognize that the MFI management can respond in-real time to the needs of their clients as information emerges. In some cases, the DRF enables business continuity to cover the business interruption (i.e., covering the cost of restructuring loans). MFIs can also be well-placed to provide cash response to clients as part of a humanitarian response and to smooth consumption of clients to avert harmful risk coping strategies. But the key is providing recovery lending allowing clients to rebuild their livelihoods.

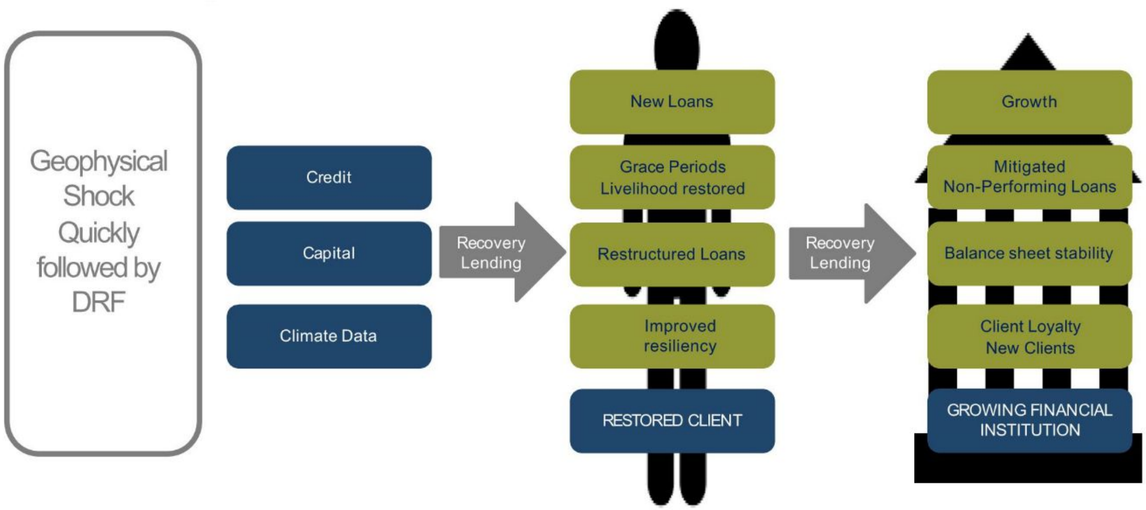

Figure 6- The Value of DRF Given a Geophysical Shock

DRF solutions allow MFIs to actively rebuild impacted communities quickly after a geophysical shock. But beyond this important benefit which contributes to resiliency of the poor, there are numerous commercial benefits to the MFI:

1. **Client Retention:** By providing its borrowers with financial support through recovery loans and other mechanisms after a geophysical shock, it is expected that the level of retention will increase due to this unique value proposition to their clients, who will have no need to go elsewhere or forfeit their debts.
2. **New Client Acquisition:** MFIs may be able to lend into more risky geographies, and after the geophysical shock, with a DRF program in place will be able to reach out to new clients in their community, while their competitors contract lending. Evidence has shown that ample opportunities exist for attracting new clients to grow portfolios.
3. **Reduced Loan Write Downs:** Experience shows that by providing impacted borrowers with the new loans to restart their businesses and rebuild livelihoods efficiently, the longer-term performance of participating MFI's loans is improved resulting in less overall write downs.
4. **Cash From Risk Transfer Payout:** According to the MFI's selected payout structure for their risk transfer products, they receive a cash infusion when there is a geophysical shock that helps build capital managing the impacts to their balance sheet and supporting planned response programs within their target communities.
5. **Uninterrupted Growth:** As presented in Figure 3, perhaps the most important benefit of DRF solutions is the ability to mitigate the slowed growth that will follow a geophysical shock.
6. **Lower cost of capital and greater access:** By using DRF solutions, the MFI may be able to lower their cost of capital and find new sources of capital to extend their access. It is prudent to consider how DRF solutions will enhance the MFIs negotiation position with capital providers.
7. **Increased Leverage:** Depending on the regulator, lenders, and risk management protocols, the FI may have the opportunity to marginally reduce the amount of capital

reserves held on its balance sheet, effectively increasing the ability to leverage, with significant benefits for profitability and growth.

While the potential benefits of DRF solutions are significant, there are costs to be considered. These costs include frictional cost of making DRF solutions operational as well as charges for contingent credit and the cost of the risk transfer to global capital markets. The cost of extra reserving has been mentioned. These are typically costs being incurred by most MFIs. The challenge is discovering the optimal blend of using other financing mechanisms to lower the cost of reserving. This is precisely the calculus performed by many corporates as they determine how much insurance protection they should purchase.

The benefit-cost evaluation will be more fully covered in Section 5 where options and recommendation are reviewed. Before getting into more a detailed analysis, a simple construct is useful in giving an early view that the benefit-cost ratio can be positive with a comprehensive DRF system that is built into the operations of the MFI. For simplicity, this example only focuses on the *leverage benefit* and the risk transfer component of the DRF protection. Certainly, many circumstances will influence the expected benefit-cost of fully operational DRF system.

Cost: If an MFI were paying for a 20-year DRF product (i.e., one that pays 100 percent with a frequency of 5 percent – 1 in 20 years), the expected loss for the risk provider would be 5 percent of the value of protection. To account for the uncertainty and cost of capital, the risk provider may load this product by two times the underlying risk (2 x 5 percent = 10 percent cost). The risk transfer component of the DRF solution should be focused only on protecting ***a portion*** of the capital adequacy of the MFI. If the capital adequacy is normally maintained at 15 percent, protecting 2 percentage points of the capital base might be adequate. Liquidity protection is provided by reserves and contingent credit in the DRF structure. Given the 10 percent cost of the risk transfer and with protection at 2 percentage points of the capital base, the cost of the risk transfer would add 20 basis points to the loan portfolio operations (i.e., 0.10 x 0.02 = .002).

Benefits: To simplify this example, consider that the MFI operates with a 15 percent capital adequacy ratio to cushion against highly correlated geophysical events. We assume that with the DRF protections, the MFI can move their capital adequacy from 15 percent to 13 percent, leveraging in another 200 basis points for lending. Holding the extra capital has an opportunity cost that is equal to the expected earnings of lending. If the 200 basis points earn a net profit of 10 percent[32], the freed-up capital would add 20 basis points more profit to offset the 20 basis points of added cost for the risk transfer component.

Simplified Benefit-Cost Analysis
Benefit = 200 bps freed for lending x 10 percent return (20bps)
Cost = 10 percent rate for risk transfer x 200 bps of protection (20bps)

[32] MIX Market | DataBank (worldbank.org) show that several MFIs operating in Bangladesh returning 10 percent or higher for their net loan portfolio (Profits divided into Net Loan Portfolio).

Section 4: Urban Poverty and Geophysical Shocks in Bangladesh and Indonesia

While there are similarities between Bangladesh and Indonesia, perhaps the most important difference is the geography of the two countries. Bangladesh is significantly smaller than Indonesia (57,321 sq miles versus 735,358 sq miles). Equally important, Bangladesh is largely a contiguous landmass and Indonesia is made up of over 6,000 inhabited islands. In assessing and managing geophysical risks, it will be difficult to pool geophysical risks in Bangladesh. Efficient DRF solutions will require global capital. Indonesia is large enough and diverse enough that some geophysical risks can be pooled within the country.

MFI record on poverty reduction in Bangladesh and Indonesia

Perhaps the most important question before supporting DRF solutions that are used by MFIs to rebuild the livelihoods of the poor is whether MFIs in Bangladesh and Indonesia are successful in reducing poverty. While MFIs in both countries are highly diverse and represent different types of institutions, the literature shows good progress in poverty alleviation. Khandker, et al. (2016) provide a rigorous review of Bangladeshi MFIs and poverty from 1991 to 2011. Their book finds positive effects on poverty reduction. At the time of publication, MFIs were providing over $7 billion to 32 million members. In comparing MFIs across the world, the book also finds that the two largest MFIs in Bangladesh (Grameen Bank and BRAC) are highly efficient.

Experience in Indonesia is also positive. Santoso and Ahmad (2016) reviewed how Baitulmaal Wa Tamwil (BMT) institutions[33] have contributed to poverty reduction via the two functions they perform (social and business). They show significant progress in poverty reduction and wealth creation with members of BMTs. Additionally, Wahibur (2013) examined 20 Islamic MFIs from Central Java, Indonesia, and found that they were improving household income, children's education, and business progress.

While the overview above is promising, not all MFIs operating in Bangladesh and Indonesia are likely to be good candidates for DRF protection. Making determinations of which institutions are best suited is beyond the scope of this study. A general observation must be considered. The larger MFIs are both more diversified and in a better position to adopt DRF solutions. Furthermore, many of these MFIs are holding significant amounts of capital. By contrast, the smaller and more geographically concentrated MFIs are more exposed to geophysical shocks and are less likely to be able to use DRF solutions. As will be more fully developed, the focus for DRF solutions should flow from the institutions providing credit to smaller MFIs. These institutions are in a better position to implement more complete DRF solutions cost-effectively than having the MFI work on these solutions in isolation.

Urban Poverty and Geophysical Shocks

It can be argued that the *urban* poor have more vulnerability to geophysical shocks than the rural poor in Bangladesh and Indonesia. Urban populations in both Bangladesh (40 percent) and Indonesia (57 percent) are growing. Banks et al. (2011) argue that the urban poor in Bangladesh has been largely ignored. Rahman and Hill (2019) report that progress in lowering poverty in

[33] BMTs are a dominate form of Islamic MFIC in Indonesia with more than 5,000 around the country.

urban areas has slowed. Their analysis suggests that despite the current mix of rural vs urban in Bangladesh and historically high poverty rates in rural areas, the number of urban poor will be nearly equal to rural poor by 2030. Climate change is likely to tilt these numbers further. In Indonesia, the Jakarta Post reports that urban poverty increased from 9.86 million (September 2019) to 11.16 million (March 2020). This was a 13.2 percent increase as opposed to rural poverty which increased about 2.2 percent over the same time.[34]

The differences in poverty rates between the urban and rural populations of Bangladesh and Indonesia are likely to grow given the geophysical risk profile of both countries (**Error! Reference source not found.**). This reinforces the need to focus on the urban poor. Earthquakes, tsunamis, and flood risks are likely to be more disruptive to the livelihoods of the urban poor.

A risk that is notably missing from Table 3 is heatwave which is significantly more detrimental to the urban poor and merits some special consideration. Both floods and heatwaves are expected to be more frequent and severe given climate change. While drought is an issue in both countries, it is ranked lower than other risks and will also impact the rural poor more than the urban poor except in cases where extreme drought create a food price spike. In that case, the urban poor who have a greater dependency on purchased food will be impacted greater. A widespread flood like those experience in Bangladesh can also create a food price spike.

Table 3 Index for Geophysical Hazards

	Indonesia	Bangladesh
Tsunami	9.7	8.2
Earthquake	8.9	9.2
Flood	8.1	10
Epidemic	7.0	7.6
Tropical Cyclone	6.1	6.9
Drought	3.4	4.7

Source: Statista Risk Index for Geophysical shocks 2021 (10 represents the most severe risk)

All the hazards described above have one thing in common – when there is an extreme event many of the poor will be impacted at the same time. Geophysical shocks that are highly correlated across a wide geography are also difficult to insure without access to global capital markets. This issue must be resolved before efficient DRF solutions can be created. As for the MFI itself, when many borrowers have disruptions in their livelihood earnings, the ripple effect into the balance sheet can be dire. This creates business interruptions for the very financial institutions that should be ready to support the poor and vulnerable in their recovery. More severe events can erode the liquidity and capital base of the MFI which, in the worst conditions, may lead to stopping lending at the greatest moment of need from their borrowers. The obvious consequence is that the urban poor become less resilient to shocks from hazards; many of which are driven by climate change.

[34] The disparity of gig economy and rural-urban poverty

Banks et.al., (2011) emphasize how urban poverty in Bangladesh is a neglected issue for research, policy, and action. They conclude that '*climate change will accelerate Bangladesh's ongoing urbanization as well as deepen the scale and severity of urban poverty'*. Raham and Hill (2019) review how geophysical shocks harm the Bangladesh macroeconomy and make the case for financing immediately a shock to enable firms and households to invest in income-generating activities and mitigate these macroeconomy effects.

Bangladesh very likely has the longest history of MFIs working to enhance financial services after a geophysical shock. Several early studies have examined the use of various coping mechanisms, including various credit mechanisms employed by the poor and vulnerable during the 1998 catastrophic flood event in Bangladesh that affected approximately 68 percent of the country. Khandker (2007), using household-level panel data, found that robust and well-capitalized microcredit facilitated borrowing as a key coping strategy for poor and vulnerable households following severe flooding in Bangladesh. Access to credit, such as through microfinance organizations, enabled households to maintain both consumption and asset holding. Shoji (2008) employed a micro panel dataset to examine coping strategies of agricultural-based households during covariate shocks when mutuality fails. Under moderately severe conditions, the poor use interest-free credit from friends and relatives and increase the hours devoted to fishing to smooth consumption.

Under the most severe conditions, both of those coping strategies are replaced with borrowing from moneylenders at high-interest rates, suggesting that access to formal credit markets would be helpful for household coping and recovery. Zaman (1999) and Hoque (2008) focus on the role of household participation in the Bangladesh Rural Advancement Committee (BRAC), a large microfinance provider, in coping and recovery from economic crises, including geophysical shocks. Hoque's work showed that BRAC participants *borrowed more, used more of their own savings, and sold fewer assets compared to non-BRAC households*, but for nearly half of the households of both groups the only coping activity was to increase time spent at work.

Zaman describes the multiple efforts BRAC took to help their clients during the flood, including the ability to borrow an additional 50 percent of their current loan amount with repayment extended by six months. The loans were intended for both immediate consumption needs as well as for livelihood recovery. He found that the credit program was used in conjunction with other coping mechanisms, including reduction in food consumption, personal savings, and borrowing from both relatives and moneylenders. None of the studies, however, attempted to formally measure the contribution of credit access or use to livelihood recovery following the flood event.

Following some of the early programs in Bangladesh, a contingent repayment system was developed to allow for rescheduling savings and installment when there was flooding. This program was set up in 2002. Masahiro (2010) suggest that these policies did decrease the probability of the poor skipping meals after a flood in 2004

Indonesia: Tsunami and Earthquakes

Save the Children commissioned a study of microfinance lending on long-term indicators of child welfare after the 2004 tsunami that struck Aceh, Indonesia (Stark et al. 2011). The evaluation was undertaken four years after the loan intervention and focused on the "Group-Guarantee Lending and Savings" (GGLS) program that specifically targeted women, where the rationale was that the extra income earned by women would be used for the family unit. The study intended to move beyond traditional financial indicators of microfinance lending performance and focus on client outcomes, which included lending effects on health, childcare, diet, and education.

While the evaluation found that there were no significant differences between welfare indicators for women who received loans compared to those who did not, it did find that the average loan amount predicted whether clients were still engaged in their business. The authors' interpretation is that higher loan amounts may make businesses more sustainable over time. Average loan size was around 42 US$ but the variation in loan size across the sample was not reported. The study suffers from several biases but does raise the important points that outcome indicators for recovery programs should look beyond MFI loan performance only, should carefully consider the anticipated time path of intervention outcomes, and that loan size may importantly determine the degree to which lending is capable to aiding successful recovery.

Becchetti and Castriota (2011) made use of a quasi-natural experiment to investigate the role of MFI recapitalization and additional lending as an effective recovery tool after a geophysical shock. They conceptualize that credit rationing could be avoided using bank recapitalization and can serve as a recovery tool to correlated disaster events, possibly at lower cost than other donor supported modalities. Credit, rather than cash, has the benefit of not affecting income in only that short term and, if the loan is repaid, perpetuates financial flows. MFI recapitalization, in their view "acts as a sort of expansionary monetary policy for the poor". The context is that of a Sri Lankan MFI (Agro Micro Finance http://www.agromicro.org/) whose capital base was depleted following portfolio losses of ~24 percent in the aftermath of the 2004 Indian Ocean tsunami. Real income was reduced for both those clients directly impacted by the tsunami as well as for clients experiencing indirect market disruptions, though the reduction was less for the latter. Recapitalization enabled the MFI to avoid default and continue lending.

Welfare indicators examined were the percent change in income and worked hours after financing, which was available to both directly and indirectly impacted clients. Lending was represented as a loan-to-income ratio measured as the size of issued loans scaled by the clients' post-tsunami, pre-financing monthly income. Loan size, on average, was found to be equivalent to nearly nine months of income, but with some important differences related to relationship lending practices and social objectives. For example, clients suffering the most damage, having lower income, and with longer seniority received loans first and larger loans relative to their income.

Evaluation results found that the poorest were the most impacted by the event and demonstrated the most significant recovery over time. The loan significantly affected worked hours and real income for directly impacted clients but only income for those indirectly impacted. After three years, directly impacted clients had not yet fully recovered to their pre-disaster purchasing level while those indirectly affected showed significant improvement. Nevertheless, the effect of lending was found to significantly affect clients' recovery and relatively more so for directly affected clients, contributing to convergence between those most and least impacted by the event. The study, however, did not compare these outcomes with other types of recovery interventions.

In the same Sri Lanka and tsunami disaster setting, Becchetti et al. (2012) study MFI lending and client default using a panel data set spanning the period 1995 to 2011, composed of bank records and interview data of 200 individuals and 767 loans. As preliminary to the analysis, they note that following an 18 percent default rate, lending peaked after the tsunami due to recapitalization that enabled it to respond to an increase in credit demand. About half of post-tsunami lending was issued to those directly impacted. An interesting condition emerged around average interest rates that, prior to the tsunami, fluctuated in response to market conditions, in particular the inflation rate. Donor recapitalization, however, was conditional on the offer of favorable interest rates to those who were directly impacted. While the overall average interest rate fell after recapitalization, interest charges to those who were not or only indirectly impacted rose by an average of 8 percent to cross subsidize the reductions of the former. This has important implications later for strategic default among clients.

Of loan size determinants, the authors found that those impacted by the tsunami received larger loans relative to those not impacted, and that loans were provided post-tsunami even if outstanding loans had not been fully repaid, consistent with the view that without further financial support recovery may not have been possible, including repayment of previous loans. The authors also found a positive relationship of social relationships with both financial access and loan size.

Determinants of loan default probability showed no relationship between impact status nor an index of intensity of damages—default rates between impacted and non-impacted clients were similar—an unexpected result since one would anticipate less default among those clients without tsunami damage. Interest rates were negatively associated with default as were larger loans. However, credit history in terms of repayment or default is not associated with higher default post-tsunami. This is an important observation for MFIs as it shows that support following a disaster-induced default does not imply anything about future repayment performance. While the MFI showed a preference for existing business expansion and recovery over new business start-up in terms of loan size, probability of default was the same.

The interaction of the interest rate differential combined with group lending liability may have contributed to the higher-than-expected default rate among non-impacted clients. They suggest that group contagion (a domino effect of group members having to support members who defaulted) or strategic default (rational response to the additional cost imposed to support the tsunami impacted clients) could be at play, although they are unable to distinguish the two with their data set. Note that donor interest-rate conditionality for recapitalization may be partially responsible for the interest rate differential, although Berg and Schrader (2010) document preferential interest rate setting that occurs independently of donor conditionality in a study of relationship lending practices during crises events. Zander (2009) also documents similar opportunistic behavior of non-impacted MFI clients following the 2006 Yogyakarta earthquake in Indonesia. Becchetti et al. (2012 point to contingent repayment systems currently adopted in Bangladesh (Dowla and Barua 2006) as being able to mitigate strategic default, but that credit access may still be impaired for non-impacted or new clients. Their recommendation is to adopt individual compulsory disaster insurance to avoid uncertainty in timing, amounts, and conditionality of donor funds for recapitalization following future disasters.

Research into asset dynamics and poverty traps is currently attracting much attention in development economics and was recently the theme of workshop hosted by the National Bureau of Economic Research (NBER, Economics That Really Matters 2016). While research questions abound, many studies focus on three basic questions: 1) Which types of capital are available to the poor? 2) What role/potential does each type of capital play in regard to escaping the poverty trap? and 3) What positive external interventions can be implemented to help the poor escape the poverty trap in a sustainable and cost-efficient manner? Among the types of capital discussed at the NBER workshop were human capital, natural capital, and financial capital.

Financial capital has been seen as a key pathway out of the poverty trap for the past decade. Financial exclusion forces the poor to rely on their own savings or informal borrowing to invest in education or entrepreneurial activities, contributing to income inequality and stunted economic growth. On the other hand, inclusive financial environments and policies give the poor access to savings accounts and microcredit through structural and technological innovations. In 2012, it was estimated that 8 percent of adults in developing economies took out a new loan from a formal financial institution in the previous year (Demirgüç-Kunt and Klapper 2012). While a recent review of the literature finds that impacts from microcredit varies across different settings (Buera et al. 2016), microcredit loans started many entrepreneurs who would have been otherwise excluded from the financial system. Microcredit may not be a panacea for the poor, but by promoting economic independence and targeting aspiring middle-class entrepreneurs, it continues to play an important role in improving financial inclusion in the developing world.

Bad loans and erosion of the capital base. In many contexts, loan losses are the major threat as financial institutions adjust or write off loans due to the inability of borrowers to repay. This was clearly evident in the aftermath of the 2006 Yogyakarta and the 2009 Padang earthquakes. As Table 4 shows, nonperforming loans doubled, tripled, even quadrupled. One interviewed People's Credit Bank (BPR) in Padang lost IDR 1.5 million in loans due to client deaths and/or the complete destruction of their homes and businesses. Some financial lenders interviewed were forced to temporarily shut down and reopen after the earthquake.

Nonperforming loans lower the value of the asset base, resulting in a loss of equity. Even a small decline in the value of assets has a profound impact on the institution's capital base. Erosion of the capital base has a significant negative effect on the bank's future income streams and can even lead to bank failure.

Poor loan performance also leads to a reduction in interest income. Following the Padang earthquake, for example, lost interest income for the most severely affected BPRs (Bank Perkreditan Rakyat, or Rural Bank) was estimated to be only 15-35 percent of the income before the quake (Hiemann, 2009). The reduction of interest income can lead to liquidity shortages. It also reduces current and future profitability by lowering the capital base. It can take three years or longer for the rate of loan non-performing to return to pre-event levels.

While the conditions can vary and there may actually be an increase in demand for construction loans, the demand for the more typical loans suffers after the disaster as there is less business activity to finance. This is because people are not in a position to take on new obligations after their homes and livelihoods have been devastated. In some of the interviews, loan demand fell by 25 percent and took six months to a year to recover before people were in a position to restart their business. Many local FIs, however, simply do not have the capital needed to make significant lending for home reconstruction.

Table 4 Experience Following the 2006 and 2009 Earthquakes in Yogyakarta and Padang

FI Experience in Yogyakarta following the 2006 Earthquake:			
Financial Institution Type	***No of Clients***	***Loan Non-performance Before Earthquake***	***Loan Non-performance After Earthquake***
BPR	3,000	2 percent	7 percent
BMT	15,000	4 percent	7 percent
KSP	6,000	10 percent	17 percent
FI Experience in Padang following the 2009 Earthquake:			
BPR (A)	n/a	1.5 percent	4.5 percent
BPR (B)	n/a	5 percent	21 percent
BMT (A)	800	5 percent	15 percent
BMT (B)	2,100	4.5 percent	10 percent

Source: GlobalAgRisk Ford Foundation project from personal interviews with seven FIs in Yogyakarta and Padang. The names of the institutions are not provided to retain their anonymity.

Liquidity problems. Liquidity may not always be an apparent problem right away, since third party deposits may increase in the aftermath. However, savings withdrawals tend to surge within a year of the disaster to finance home rebuilding and merchandise replenishing. Financial lenders we interviewed in Padang and Yogyakarta report significant savings withdrawals—as much as 40 percent of their client base in the most affected areas. According to one assessment, roughly 20 of the most affected BPRs in Padang would require access to some USD $4 million in additional finance to withstand the resulting liquidity shortfalls (Hiemann, 2009). Bank runs, another source of liquidity risk, are also a concern if there is a lack of confidence in the solvency of the local financial institution. Deposit insurance may help to mitigate this risk for individual depositors, but second-tier lenders who are not protected by deposit insurance may also withdrawal funds or refuse to lend to a local financial institution if they lack confidence in its survival.

Extra business costs. As revenues decline and the capital base shrinks, financial institutions are hit with extra business expenses. The need to conduct loan term adjustments adds to the administrative burden. In addition, when deposits are withdrawn, financial institutions may have to borrow from other banks at higher interest rates. Finally, some financial institutions will have to absorb costs associated with physical damages to buildings and infrastructure after the quake.

Lost opportunity to provide critical service when it is needed. The timing of revenue and asset value losses coincides with a swell in loan applications for rebuilding and rebounding from the quake. But when faced with significant liquidity or capital shortages, financial institutions are not able to accommodate these emerging credit needs for reconstruction. Only one financial institution that was interviewed was able to offer emergency lending to the community.

Limited access to new funds. Declining portfolio quality affects the ability of banks to access new funds, either to satisfy short-term liquidity needs or capital for new lending. BPRs in Padang turn to Bank Nagari for loans after a disaster. Bank Nagari is their apex institution for financing. However, the financial institution must be sound to qualify for the loans. Again, the dilemma emerges—the earthquake reduces the rating of the BPRs and consequently restricts their access to much needed financing.

How Financial Institutions Cope with Earthquake Risk

Financial institutions are highly sensitive to capital losses because they tend to be much more leveraged than other firms. Because liquidity and capital fall to very low levels following a widespread disaster, it is customary for some financial institutions to voluntarily keep larger amounts of capital (more than 20 percent, some as high as 30 percent) and maintain a capital ratio that goes significantly beyond the 8 percent that Bank Indonesia (BI) and international standards prescribe.

In some cases, the FIs we interviewed increased their capital reserves in response to the earthquakes. In fact, Hiemann (2009) encouraged PBRs in Padang to follow this practice by holding 20 percent capital to withstand future earthquakes. His report projects that "only BPRs with capital adequacy ratio (CAR) of 20 percent would be able to withstand substantial losses wrought by the earthquake." It seems that most BPRs go beyond the CAR of 8 percent to levels of 15 percent or higher. Excessive reserving ties up productive capital and therefore come at high opportunity cost.

When the capital ratio is below its targeted amount, the financial institution has two possible strategies: recapitalize or stop lending. Because so few financial institutions have access to international markets, they compete for scarce bailouts from local investors. Often, shareholders have a limited capacity to mobilize sufficient equity to recapitalize the bank. Financial Institutions that are not recapitalized need to reduce their risky asset holdings to align with their smaller capital bases.

Given that high reserving and capital ratios come at a high cost, more efficient solutions are needed to manage earthquake risk. An earthquake insurance that protects against the business disruptions due to this risk could enable the lender to reduce its capital ratio, which ultimately increases availability of capital for investment. Financial institutions with earthquake insurance will represent lower risk clients. This, in turn, should help them to attract new capital to maintain or expand their operations. These are the core principles for considering the advantages of blending any portfolio disaster insurance with other risk management strategies that come at potentially much higher cost than paying for insurance.

The development of efficient and sustainable index-based risk transfer mechanisms requires the actuarially sound quantification of risk. Geophysical shocks risk transfer, specifically, calls for a scientific approach to evaluate the risk of occurrence (i.e., frequency) of natural phenomena such as temperature and rainfall extremes. Scientific advances over the past several decades have both improved scientists' ability to understand and model natural phenomena, as well as the availability and quality of historical weather data.

Section 5: Conclusions and Recommendations

The economic case for using DRF solutions to support recovery lending when there is a geophysical shock has been developed throughout this report. The development of event-based index solutions has moved rapidly in the last decade. Numerous firms can quickly build structures for risk transfer into the global markets and the global markets are eager to participate in diversifiable risks that are offered by growing risk transfer in emerging markets. Some experience has both demonstrated how to build efficient DRF solutions and the efficacy of carefully organized lending to help the poor and vulnerable rebuild their livelihoods. Yet certain market failures are slowing the adoption of DRF solutions by MFIs.

Throughout this report, the emphasis has been on addressing the conundrum that the financial community stops lending when there is a geophysical shock – the very moment that any business needs cash the most to rebuild. Facilitating lending at this specific time fits with many of the stated goals of the development community to build resilience against climate shocks. Having the benefit of the fresh experience of a geophysical shock and capital to rebuild businesses and sources of livelihoods for the community link well to expected behavioral changes to rebuild the business with more resilience. In addition, recovery lending can help the community and the financial institution maintain business continuity and growth post-shock.

Two behaviors stand in the way of recovery lending by MFIs. First, the geophysical shock creates both liquidity and capital problems for the MFI. Lending must slow or stop until the MFI rebuilds its balance sheet. Second, the common belief is that lending to small and medium enterprises when they have just suffered a shock represents higher than normal credit risk. The first behavior (balance sheet problems) can be addressed with DRF solutions. However, these solutions need scale and are likely to only be adopted by larger MFIs. The second behavior (concerns about greater lending risks) should be reconsidered based on increasing evidence, that if done properly, recovery lending performs as well as other loans. Nonetheless, it will take more experience to give the entire financial value chain comfort that recovery lending can be a good business that allows for business continuity and growth.

Addressing these market failures should be a priority for the developmental community. While the economic and financial arguments are sound in making the case that DRF solutions can pay for themselves over time, adoption of any innovation takes time and experience. Furthermore, decision-makers are not likely to consider the long-term benefits of DRF solutions. Beyond these behavioral challenges that will take time to overcome, the core issue for small and geographically concentrated MFIs like those operating in urban areas in Bangladesh and Indonesia is one of scale. While these MFIs need DRF solutions the most, their small scale makes it difficult to implement cost-effective solutions. DRF solutions for small-scale MFIs require action by commercial financial institutions. Commercial financial institutions can serve as an aggregator of risks changing the economics of delivering DRF solutions.

There is very limited demand for DRF solutions as presented in this document. It takes time and experience for buyers to gain confidence. However, there is a more limiting factor. When considering the benefits of DRF solutions, the short-run focus on profitability outweighs the long-run focus on stability and support systems that demonstrate direct benefits infrequently.

Furthermore, decision-makers in the value chain of credit, discount the longer-term benefits. The operating systems simply do not support DRF solutions. While some have attempted to build the case for structuring risk transfer to pay more frequently so that buyers can gain experience in getting paid, this is the wrong approach because these structures become too costly if they are also structured to pay what is needed when there is a major event. As has been presented throughout this document, cost-effective and efficient DRF solutions should focus on infrequent payments for risk transfer, as this approach will be more likely to provide the needed financing when there is a major event.

With experience, commercial lenders and MFIs will grow to understand the value of using DRF solutions. That experience will be very limited and slow without some form of public action. Public action (grants, specialized funds, incentives, regulations, etc.) is justified by the significant public good benefits of DRF solutions. Foremost is that DRF solutions have a good chance of resolving the market failure of the credit crunch where credit is unavailable when it is needed the most – immediately after a geophysical shock. Making credit available and fostering recovery lending will build resilience against climate change. DRF solutions also promise to improve the efficiency of the entire financial sector and particularly the MFI sector. As DRF solutions are adopted, their use may pave the way for some regulatory adjustments such as lowering reserve requirements or leveraging slightly more capital. Collier and Skees (2012) reviewed how the Peruvian regulator was considering some of these types of changes given the introduction of El Nino insurance for MFIs. Hartell (2014) demonstrated that even a slight adjustment in capital adequacy requirements can have a large impact on the macroeconomic growth of a country.

While some limited experience may mean that a limited number of MFIs begin using DRF solutions, the novelty of the ideas presented within this document remains a serious impediment to their adoption. As with any innovation, it takes time and experience to gain traction. But when the innovation itself is something that only has a clear benefit (payouts) infrequently, there are more significant obstacles. Insurance markets for property and casualty losses fit this profile and serve a public good and most developed countries have used a combination of regulations and subsidies to assure that these markets are supported. Reviewing this aspect of market development first is useful.

How do developed countries build DRF solutions?

In developed countries, premium subsidies or regulatory requirements are used to increase the use of DRF products. This includes homeowners purchasing earthquake, hurricane, and flood protection and farmers purchasing crop insurance. In some cases, subsidies and mandatory requirements to purchase insurance are tied together (e.g., the US flood insurance program). In most developed countries, one cannot get a home mortgage without homeowners' insurance. Mortgages would be more costly without these requirements as the cost of capital would be greater without homeowners' insurance. Thus, both individuals and society benefit from these regulations.

Regulators in developed countries have *forced in* the needed efficiencies to complete financial markets by adding effective insurance markets. The lesson learned is that regulatory actions and subsidies are needed to build effective markets for DRFs solutions. Without regulatory pressures, it is safe to argue that property and casualty insurance markets in developed countries would be significantly smaller.

In developed countries, banks also rely on support from Central Banks post-shock. Central Banks impose moratoriums on loans, offer re-financing, payment holidays, and even additional liquidity in some cases. Actions to divert funds earmarked for long-term development can be taken to alleviate short-term problems created by a major disruption. In low-and-middle-income countries, these actions are limited.

Regulatory pressures are needed in part because decision-maker behaviors create low demand for DRF solutions. To some extent, these behaviors also explain the "protection gap" – the share of uninsured losses to total losses from a geophysical shock. The protection gap is much larger in low-and-middle-income countries. Decision-makers tend to underestimate geophysical shock risk until right after an extreme shock occurs, then the tendency is to swing dramatically in the other direction and greatly overestimate geophysical shock risk. For climate risks, these behaviors also manifest in attempts to purchase DRF when 'the house is on fire' (e.g., buyers asking for drought insurance when the drought is underway or when the forecast clearly shows a higher probability of drought). Again, in developed countries, these behaviors have been used to justify subsidies and regulatory requirements.

It should be clear that without regulatory pressures and incentives, insurance markets for geophysical shocks are almost always stagnant. There is an asymmetry of information in risk evaluation and assessment. Why should we expect something different in LMICs? Efforts to change the legal and regulatory environment from jurisdiction to jurisdiction in LMICs will be far too slow. In the near term, it should be recognized that in the value chain of capital flowing to MFIs, institutions lending to MFIs act as a quasi-regulator. Given these arguments, it is recommended that the focus in supporting DRF solutions for MFIs should begin with those supplying credit to the MFIs.

Louder drums are beating for more consideration of climate risk

In a global context, we see *new policy actions* emerging in developed countries as central banks and regulators are working to mainstream climate risks into processes (e.g., stress testing) of financial institutions. For example, in the United Kingdom, the Prudential Regulation Authority has implemented several regulatory questionnaires for financial institutions to complete. There is a 'learn-as-you-go' process underway; partly because the climate expertise is missing on both sides.

Global efforts are also being led by the private sector. The Task Force on Climate-Related Financial Disclosures[35] represents a clear example. The signs are all there. Moody's recently completed the purchase of Risk Management Solutions (RMS)[36]. RMS has been a leading risk modeling firm in the insurance and reinsurance industry for over 30 years.

It is almost certain, that as one of the world's leading credit rating agencies, Moody's is preparing for the new world where regulatory requirements will emerge either requiring or

[35] Task Force on Climate-Related Financial Disclosures | TCFD) (fsb-tcfd.org)
[36] Moody's Completes Acquisition of RMS - Bloomberg

rewarding financial institutions utilizing DRF solutions in managing extreme geophysical shocks. These approaches will also improve the value of many different businesses as they position themselves for the future. For example, Gonzalez-Perez and Yun (2013) demonstrated that reducing revenue volatility leads to a greater valuation for energy firms using weather hedges.

Using Risk Transfer to Crowd in Lending When there is a Geophysical Shock

To build the case for public action, it is helpful to review many aspects of what has been presented throughout this report in the context of how to crowd-in structured lending to MFIs by commercial financial institutions when there is a geophysical shock. The structure and commitment can be ex-ante with the lending occurring quickly after the shock. As will be demonstrated, this can be done by using the risk transfer for severe shocks as a form of a *loan guarantee.* Ideally, such systems would be built to assure that lending would come immediately when there is a shock (ex-ante credit agreements in the form of contingent credit). This follows numerous efforts from ADB to provide loan guarantees to de-risk activities by MFIs. However, in this case, the target is to build the resiliency of the poor and vulnerable via MFI recovery lending programs when there is a geophysical shock.

Figure 7 is a streamlined illustration of the three primary parties needed for complete DRF solutions for an MFI. The figure illustrates the flow of funds. Of note, the commercial lender is serving as the intermediary between the global risk transfer markets and the MFI using a single debt agreement.

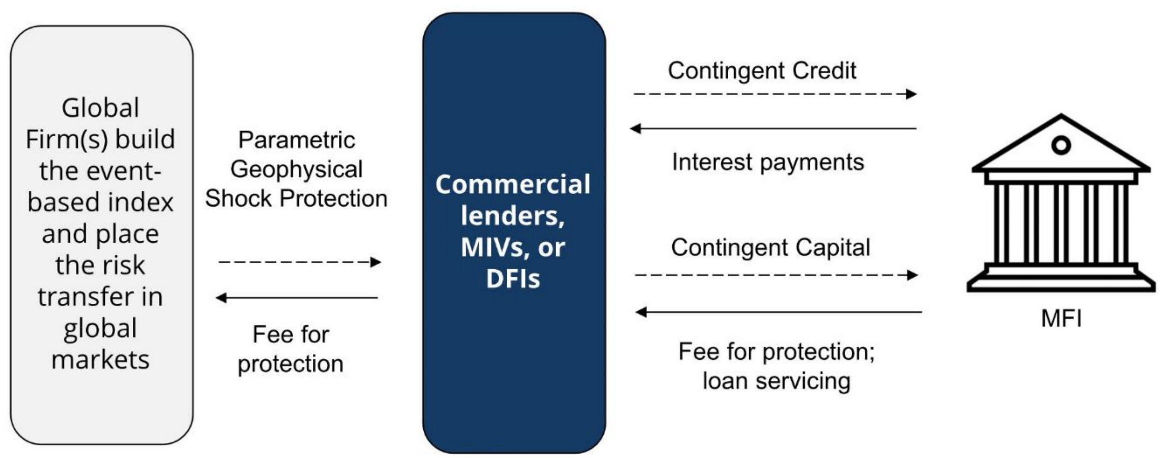

Figure 7 Flow of Funds for Complete DRF Solution for an MFI

Parametric Geophysical Shock Protection: Geophysical shock risk protection per tailored index; payouts based solely on index trigger.

Contingent Credit: Senior loan at pre-agreed terms that can be drawn down at different amounts depending on the severity of the geophysical event as defined by the parametric index

Contingent Capital: Tier 2 capital or Tier 1 capital at pre-agreed terms based on the severity of the geophysical shock as defined by the parametric index; possible mechanisms could include senior loan conversion to sub-debt, loan forgiveness, or distressed debt purchase. For the example presented below, the focus is on Tier 2 capital via subordinated debt.

In this structure, global firm(s) build the Parametric Geophysical Shock Index that best represents the portfolio of the MFI. This index is used to obtain risk transfer financing from global markets. Effectively the same index is used to trigger contingent credit and contingent capital.

As has been reviewed previously, there are three primary challenges that will continue to slow the adoption of more complete DRF solutions for MFIs: 1) small MFIs needing these protections the most are very challenging given their small scale; 2) paying the full cost of risk transfer remains an obstacle for un-tested programs; and 3) offering contingent credit can be highly inefficient if done in an isolated fashion where protected credit is not utilized. To address, the first issue, it is recommended that a commercial lender serves as the intermediary and the risk aggregator to add efficiency to a global risk transfer. To address issues 2 and 3, the recommendation is to organize a public fund that includes funds for both premium support and contingent credit. For the outset, the contingent credit that is leveraged with the premium support will earn revenue, creating conditions for a sustainable fund. The blending of premium support and contingent credit should be done so that larger amounts of the fund support premium in the early years while the program grows so that by a defined timeline (e.g., five years), the fund is only supporting the contingent credit and, at the point, is a sustainable emergency liquidity fund (EMF).

A properly designed EMF should only require a smaller share of premium support even in the first year (e.g., maybe 25 percent or less). For the target for MFIs across Asia, the fund should support DRF solutions throughout Asia. This will make the fund diversifiable and efficient. The fund would be operated with principles of risk pooling and diversification just as global reinsurers use. In this fashion, the EMF capital would be more fully utilized consistently. This would resolve the challenge of a stand-alone contingent credit offering where the call contingent lending is relatively infrequent leaving the capital on standby with no earnings.

Using Bangladesh Tropical Cyclone (TC) for Illustration

To bring recommendations to focus, we assume that a Bangladesh MFI is interested in DRF as they understand that certain TC shocks would devastate the businesses and livelihoods of their borrowers. Several structures could be developed to finance the MFI when there are major TC shocks. One of the most common parametric products for TC is called a Cat in a Box[37]. This is where a pre-agreed payout will be made when the TC shock occurs in a pre-agreed area (the 'box') with payouts increasing as the wind speed increases.

The risk modeling firm begins with the exposure of the MFI. This involves knowing the location of the lending portfolio. As the modeling firm plans to structure a parametric product that will optimize the path of the TC over the portfolio, they also draw a boundary around the lending portfolio that focuses on the cities having the greatest lending portfolio. The results of this process are presented in Figure 8. The next step in the process is to focus on the geophysical hazard. The tracks of TC are publicly available including the wind speed along the path. The

[37] What is the most popular parametric solution? | Swiss Re

structure of the parametric index uses the speed of the TC as it enters the polygon in Figure 8. The history of storms and their maximum wind speed that have entered the polygon are presented in Figure 9.

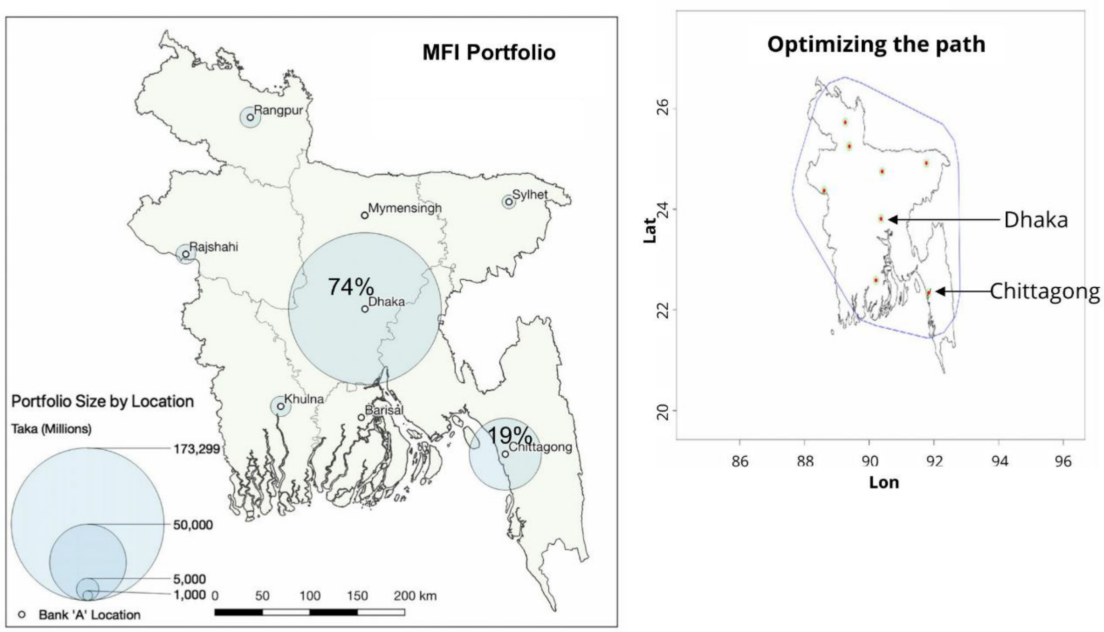

Figure 8 Developing the box that optimizes the lending portfolio.

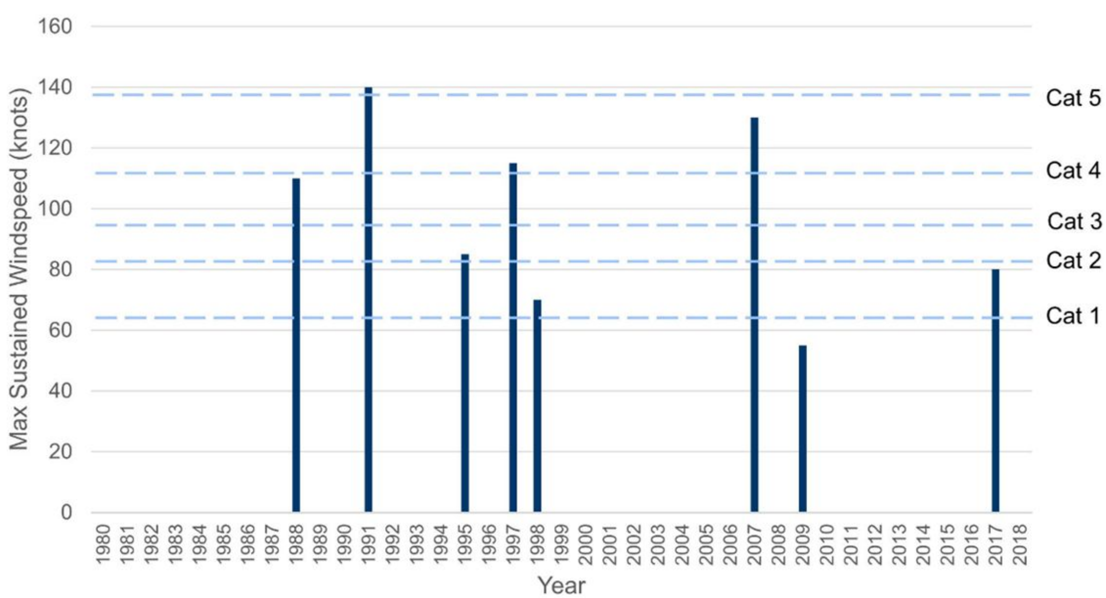

Figure 9 History of TC Shocks Entering the Polygon (1980-2018)

As has been emphasized throughout this document, financing can be organized to match the shock. As the classification system for TC is well-known, financing can trigger based on the category of the TC. It is assumed that the Bangladesh MFI has a lending portfolio of $100 million and that they source their capital from a single commercial lender or a larger MFI operating in

Bangladesh. That lender has decided to support DRF solutions and offer both contingent credit and contingent capital.

For any DRF solution using the classification of TC to trigger contingent debt and subordinated debt, there are some key assumptions. First, the lender to the MFI must have access to systems and funds that will allow for the efficient use of contingent credit. Making commitments for credit that is used infrequently is costly. Second, once the shock triggers the subordinated debt, the lender must have confidence that this risk transfer portion will cover the default risk of the contingent debt. This confidence will be a function of the amount of subordinated debt relative to the contingent debt and expectations regarding the credit risk of loans made post-shock.

To further illustrate how this might work, an example of an MFI operating in Bangladesh with exposure to tropical cyclone shocks is presented.

Setting:

- ✓ The MFI operating in Bangladesh has a loan portfolio of $100 million.
- ✓ The MFI has an average NPL ratio of 5 percent (loans >30 days in arrears) and is very conservative in maintaining a loan loss reserve for 100 percent of this amount (Loan loss reserve = $5 million).
- ✓ The commercial lender is willing to provide contingent credit (an option for credit) that scales up as the category of the TC scales up.
- ✓ Conditions for the contingent credit are that
    - The MFI has a loan loss reserve of $5 million
    - The MFI maintains a capital adequacy ratio of 15.5 percent or 3 full percentage points higher than the regulatory requirement (note that the long-term goal of DRF solutions is to ease these types of buffers used by lenders. Even a 50 basis point reduction can go a long way in covering the cost of the DRF solutions) The MFI must have risk transfer to protect an assumed higher default rate on recovery loans that use the contingent credit – 20 percent is used as a conservative protection level.
- ✓ In this stylized case, the risk transfer amounts will be equally divided so that 50 percent of payments go to the MFI in the form of subordinated debt that will be forgiven and counted as capital on the MFI balance sheet. The other 50 percent flow the commercial lender to protect the contingent credit for the potential 20 percent default rate. The latter amount crowds in the contingent credit (in this case at a ratio of 1 to 5).

The structure described above is summarized in Table 5.

Table 5 Structure of Bangladesh Example for Crowding in Contingent Credit

TC	Loan Loss Reserve	Contingent Credit	Risk Transfer Contingent Capital	Risk Tranfer Held by Commercial Bank
Cat 1	Up to $5M	$0	$0	$0
Cat 2	Up to $5M	$0	$0	$0
Cat 3	Up to $5M	Up to $4M	$0.8M	$0.8M
Cat 4	Up to $5M	Up to $8M	$1.6M	$1.6M
Cat 5	Up to $5M	Up to $10M	$2.0M	$2.0M

As a reminder, the loan loss reserve and contingent credit can be used at the discretion of the MFI; meaning that MFI can use any amount up to the maximum values matching the specific category TC in Table 5. However, the commercial lender may have some minimum requirements for use of the loan reserve as a condition for providing contingent credit. The commercial lender has a legal obligation to provide the amount of contingent credit requested from the MFI up to the amount that matches the shock and the level in

Table 5.

The risk transfer is also a legal obligation from a global risk provider who must *pay the full amount* in each category. Of note, blending financing in this way also mitigates basis risk from the risk transfer contract. For example, it the risk transfer does not pay what is needed, there are two other forms of financing (reserves and contingent credit) that can be more fully used. If the needs are less than anticipated (i.e., risk transfer pays more than needed), the MFI would use less of the reserves and contingent credit. This is important as it is difficult to anticipate the full scope of the financing needs in advance of the shock.

As has been made clear, one challenge for this type of DRF solution is who will pay? Benefits flow through the value chain of capital to several key stakeholders:

5. The commercial lender is securely increasing their business when there is a shock.
6. The MFI is getting access to contingent credit and contingent capital to quickly rebuild the balance sheet.
7. MFI clients benefit from access to recovery lending when there is a geophysical shock.

Passing the cost to the MFI clients should be avoided for a wide range of reasons. The MFI clients are generally the poor and vulnerable and asking them to pay may trap them into poverty. When DRF solutions are fully understood as being a form of business interruption and balance sheet protection for the MFI and the commercial lender, these are the entities that should pay. Given the direct flow of the payments that are presented in Table 5

Table 5, the payment for the risk transfer could be equally split.

As things mature, the commercial lender can negotiate terms with the modeling and risk transfer firms as they represent more than a single MFI that is of small size. This will make the risk transfer portion of the DRF solution less costly mainly as it reduces transaction costs. However, the underlying risk remains. In this example, the risk transfer is likely to cost about 10 percent of the $4 million of protection or $400,000. If we divide $400,000 into the $100 million loan portfolio, the costs are about 40 basis points. Despite the case made in previous sections of this report that these 40 basis points are very likely more than offset by several benefits, the cost comes up front and represents the focus for decision-makers. Given the highly competitive environment for the MFI and the fact that DRF solutions are untested, demand is largely missing. The same constraints affect the demand from the commercial lender.

Public Investment in a Contingent Credit and Premium Support Fund

To accelerate the adoption of DRF solutions for MFIs in Bangladesh, Indonesia, and other Asian markets, ADB could create a dedicated facility to address what are likely the two largest obstacles for using many of the ideas presented in the report – 1) reluctance to pay for largely untested DRF solutions; and 2) reluctance from commercial lenders to offer contingent credit. The challenge for any commercial lender offering contingent credit for shocks that happen infrequently is that, if not managed properly, they will have large amounts of idle capital. The commercial lender will need the services of the risk provider (e.g., a global reinsurer) to optimally manage a portfolio of contingent debt.

The purposed facility could be referenced as the Contingent Credit and Premium Support Fund (CCPSF). The facility could be capitalized with support from ACliFF and managed as Microfinance Investment Vehicle (MIV) that works across the region. The latter may offer more synergy as the MIV could use the CCPSF to accelerate their ongoing lending activity. The case for ACliFF operating the CCPSF is that some Asian countries do not use MIVs and in some countries such as Bangladesh loans to smaller MFIs come from the larger MFI such as BRAC or Grameen. Should ACliFF operate the CCPSF, they could allow MIVs access to all the services to accelerate the use of funds.

The CCPSF would have a special purpose and strong governance to assure that the dedicated funds were being used to spur DRF solutions. The CCPSF would be serviced by a risk-modeling firm with experience in evaluating event-based products. The core idea would be to have a limited life for premium support which may represent a large share of the use of funds in the early years but would be eliminated at some stage (e.g., 5 to 10 years). By the time the premium support is eliminated, the CCPSF would be fully dedicated to providing contingent credit across the region.

Governance would manage how rules for a commercial lender and MFIs to obtain premium support for the risk transfer. The commercial lender and the MFI should pay some share even in the first year (e.g., 25 percent). But these shares would increase over a defined period until the full cost is paid (e.g., 5 to 7 years). The core idea is that both the commercial lender and the MFI follow structures like what is presented in Table 5 where both are using the same structure in equal portions. In this type of structure, the risk transfer acts as a loan guarantee. In Table 5 the risk transfer crowds in contingent credit at a ratio of 1 to 5. The contingent credit is returnable capital with profits. The CCPSF would be funded by ACliFF and that funding would be designed to increase as the levels of adoption of DRF solutions increases. With best practices in fund management, the CCPSF would be optimizing the use of the available credit lines and the premium support.

While the CCPSF is an ambitious program it should be viewed as a unique model to address the market failures standing in the way of the adoption of DRF solutions like those presented in the report. It would open the way for increasing liquidity (contingent credit) and capital (contingent capital) immediately when there is a geophysical shock. With the advances in big data solutions to structure and price risk transfer and manage the portfolio of finaincing, the CCPSF also offers the best option for reaching smaller MFIs that need DRF solutions the greatest. The entire system would address the greater needs in making MFIs an essential agent in building resiliency against climate change for the livelihoods of the poor, businesses, and communities – all of which lead to poverty reduction, economic growth, and mitigation of conflict.

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