Increasing the Resilience of Financial Intermediaries through Portfolio-Level Insurance against Natural Disasters

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Abstract

Financial intermediaries [FIs] in developing and emerging economies are poorly equipped to manage natural disasters. These events create losses for FIs, eroding capital reserves and compromising their ability to lend. Portfolio-level insurance against disasters can improve FI management of these events. We model microfinance lenders exposed to severe El Niño in Peru with a decision tool that we develop to enhance lenders' understanding of their exposure. These FIs can now insure against this risk. Our analyses suggest that insurance allows these lenders to manage this risk more efficiently and effectively. These risk management improvements can translate into better financial performance, expansion of banking services, reduced volatility in access to credit, and greater access to credit at lower interest rates.

1 Disasters, development, and financial services

Natural disasters create many problems in developing and emerging economies. Disasters can limit income opportunities; destroy the assets of households and firms; dismantle public infrastructure, isolating communities and disrupting markets; and increase health and disease problems.

The effects of disasters can be even more acute in regions with underdeveloped financial markets where communities rely on informal substitutes to financial services. Informal risk-sharing arrangements break down as entire communities need assistance. Commonly used illiquid 'savings' such as livestock or

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building materials must be sold at firesale rates during a crisis (Dercon, 1998). While formal financial services would improve the risk management capacities of these communities, it is their vulnerability to disasters that can greatly constrain financial market development.

Financial intermediaries [FIs] such as banks are poorly equipped to manage the community and regional effects of disasters. Because disasters affect so many borrowers concurrently, FIs experience portfolio-level problems that can threaten their solvency. In many contexts, loan losses are the major threat as FIs write down and write off loans due to the inability of borrowers to repay. The risk of these disasters reduces borrower quality, increases interest rates, and impedes FI expansion.

FIs in developing and emerging economies tend to be more exposed to natural disaster than those in developed countries for several reasons. To name a few, these FIs tend to manage portfolios with greater geographic and economic sector concentrations (BCBS, 2010); fewer households and firms are insured; social safety nets are less developed; and households tend to be more interdependent (Townsend, 1994). These differences may limit the effectiveness of developed country approaches for developing and emerging economies that are exposed to natural disasters. As one alternative, this paper presents portfolio-level insurance against natural disasters as a mechanism that may be particularly pertinent to FIs in developing and emerging economies.

Given the potential value of portfolio-level insurance for FIs, we evaluate the specific example of microfinance intermediaries [MFIs] operating in Peru that are exposed to severe El Niño and can now purchase insurance against these events. This paper describes the work that we conducted with several MFIs and the detailed analyses we developed with three of them. The remainder of the paper is organized as follows. First, we develop the conceptual underpinnings for why natural disasters hurt FI performance. Second, we describe the process of assessing FI risk using both historical data and the estimations of potential losses in the current portfolio. Limited data due to the infrequency of these events complicate the risk assessment; we use a modified Delphi method to estimate the risk by eliciting the views of local experts — agronomists, loan officers, and credit risk managers working in the MFIs. Third, we discuss a banking model we developed as a decision tool for the risk managers in the MFIs that simulates disasters and evaluates the effects of insurance on MFI performance. Fourth, we use Monte Carlo simulation to demonstrate the risk-return tradeoffs in taking on different levels of insurance. Out of respect for the confidentiality of those MFIs, we present findings for a 'representative MFI' which combines the results of each. These analyses are motivated by three objectives: 1) evaluate portfolio-level El Niño insurance in terms of banker and policymaker objectives, 2) demonstrate the effects of a severe systemic risk on an FI portfolio, and 3) describe the risk assessment process needed to conceptualize and manage this severe natural disaster risk in a banking context.

1.1 The effects of disasters on financial intermediaries

Disasters affect many aspects of the operations of an FI, not only destroying its loans but constraining loan origination after the event. The income statement and balance sheet are important accounting tools that highlight FI vulnerability. Net income comprises three broad categories: revenues, costs, and changes in asset values. Each of these can be affected by a disaster. As borrowers have trouble repaying loans, revenues decrease. Funding costs increase due to stiffer competition for funds among affected FIs and to the increased risk of lending to these FIs. In the worst cases, FIs may be unable to access additional funds. FIs also incur higher administrative costs from loan restructuring, exercising rights on collateral, and so forth. Asset values decrease through provisioning as the FI recognizes its inability to collect the full face value of its loans. The level of nonperforming loans increases post disaster (Collier et al., 2011). Each of these effects reduces net income, and net losses on the income statement translate into equity losses on the balance sheet.

FIs are highly sensitive to equity losses because they tend to be much more leveraged than other firms. One of the key mechanisms used to assess and manage banking risk is the capital ratio, which is a ratio of FI capital to its risk weighted assets (for example, loans). International banking standards recognize several forms of capital, but the highest quality and main element of capital is equity (BCBS, 2006, for example, issued and fully paid ordinary shares of common stock). This capital acts as a buffer to protect liability holders, and international standards set a minimum capital ratio of 8 per cent (BCBS, 2006). An FI holding this minimum capital ratio should be able to withstand losses of up to 8 per cent of its risk weighted assets and remain solvent.

Disasters create portfolio level losses that deplete FI capital and so reduce the capital ratio. When the capital ratio is below its targeted amount, the FI has two possible strategies: recapitalise or deleverage. Recapitalising is undesirable to current shareholders as new equity investments dilute current shares and enter the FI when equity values are lowest. Moreover, many FIs in developing and emerging economies may be unable to find investors willing to recapitalise them during a crisis. FIs that are not recapitalised need to deleverage to improve their capital ratios by reducing their risky asset holdings to align with their smaller capital bases. In developing and emerging economies, deleveraging generally entails originating fewer loans. Cutting back on lending post-disaster is problematic as this is the moment that the community needs funds the most. Furthermore, returns on lending may actually be higher after the disaster as the demand for credit is higher as communities work to recover and rebuild. Thus, the process of deleveraging represents a substantial opportunity cost to an FI as it reduces its ability to generate revenues (Van den Heuvel, 2006).

1.2 Managing risks and the discrete goals of bankers and policymakers

The inability of FIs to manage natural disasters challenges the policy goals of many developing and emerging economies, which emphasize both increasing financial inclusion and limiting credit supply shocks. Regarding financial inclusion, improving access to financial services is an important policy goal as underdeveloped financial markets can slow economic growth and perpetuate poverty (King and Levine, 1993; Levine, 1997; Levine and Zervos, 1998; Ray, 1998; Armendáriz and Morduch, 2011). Another important goal is protecting the real economy from banking shocks, which can occur for example when loan losses reduce the supply of credit and constrain the activities of firms relying on credit for production. These dynamics encourage policymakers to balance a tradeoff between the objectives of 1) increasing access to credit and 2) limiting volatility in access to credit by discouraging excessive risk taking. International banking standards now characterize banking policy goals as promoting 'sustainable economic growth' (BCBS, 2011, p. 1).

In contrast to the goals of policymakers, bankers and their investors tend to emphasize financial performance. These goals include maximizing expected financial returns over time, but also managing solvency risks. While managing risk can be an important goal for bankers and their investors, several theories of market failures in financial intermediation (for example, Carletti, 2008) and ample empirical evidence (for example, BCBS, 1999) indicate that FIs tend to take on more risks than policymakers would prefer. In sum, mechanisms that enhance the ability of FIs to manage risks at a limited cost are important to policymakers and bankers alike; however, policymakers are motivated to evaluate these mechanisms in terms of their cost to financial inclusion whereas bankers are motivated in terms of their cost to expected financial returns.

The status quo for managing systemic risks is capital requirements. These requirements give FIs capital reserves that are flexible as they can be used to manage losses from any source, but they have several limitations. First, FIs in developing and emerging economies tend to operate in incomplete financial markets with limited access to capital. In this context, capital requirements limit the amount of loans an FI can extend. Larger capital requirements reduce risk, but ceteris paribus, reduce access to credit. Second, managing losses with capital reserves can lead to deleveraging after a crisis, limiting the credit supply as described above.

Portfolio-level insurance is an alternative mechanism that may be particularly suitable for events that cause large portfolio losses such as natural disasters. Insurance against a disaster acts as a form of asset diversification that can limit the effects of the disaster on the FI. Such insurance pays when many of the other assets (loans) of the FI are performing poorly. The insurance payout protects the capital base of the FI, and should put it in a stronger position to lend after the disaster — an important objective for policymakers. By protecting the ability of the FI to lend after the disaster, insurance has the potential to contribute to the financial performance of the FI — an important objective for bankers. Additionally, for vulnerable regions where disaster risk limits the supply of credit, insurance against these disasters can provide effective means for transferring this risk and increasing the supply of credit more generally.

2 Background: Banking and severe El Niño in Peru

Severe El Niño creates significant flooding in northern Peru. El Niño is associated with a warming of the Pacific surface temperature off the coast of Peru (Lagos et al., 2008). Warm air from the west meets cool air coming down the Andes in the east, resulting in extreme rainfall in the northern, coastal regions (McPhaden, 2002). During the severe events of 1983 and 1998, rainfall was roughly 40 times normal levels for the months January to May. The water volume in the Piura River, a major river in the region, was also about 40 times normal levels during these events (Skees and Murphy, 2009). As a result of the extreme weather, bridges are wiped out, roads are destroyed, crops are inundated, assets are lost, communities are isolated, food prices rise, and pest and disease problems increase.

Severe El Niño creates problems for MFIs and limits access to credit. The 1998 El Niño created loan repayment problems that lasted years (Trivelli, 2006). Furthermore, the increased risk of default associated with El Niño increases interest rates by approximately 3 percentage points in northern Peru (Skees and Barnett, 2006). If access to credit were increased through lowering interest rates and reducing credit rationing, Boucher et al. (2008) estimate that total output for Piura, an important region in the north, would increase by 26 per cent.

Because of these severe events, the MFIs have invested significantly in El Niño risk management. After the 1998 event, some of the MFIs drastically reduced access to credit in the sectors they perceived as most vulnerable to El Niño, especially agriculture. They have also expanded to less vulnerable regions such as southern Peru and the jungle. The MFIs employ specialists such as agronomists and engineers to consider the physical consequences of El Niño conditions during loan underwriting. They also take strategies to mitigate losses such as refusing to extend loans in flood prone regions and offering very few long-term loans. While these strategies reduce their risk, severe El Niño affects so much of Peru and affects the north so acutely that MFI managers in northern Peru continue to report that their firms are vulnerable to these events.

El Niño insurance is a form of index insurance. Index insurance makes payouts based on an objective measure of the severity of the disaster and is being used widely in places where traditional forms of insurance are insufficient to meet the needs of the target market. El Niño insurance makes payouts based on the warming of the Pacific surface temperature, which is the standard measure of the severity of El Niño among climatologists. These temperatures are highly predictive of catastrophic flooding in northern Peru (Khalil et al., 2007). Because higher Pacific temperatures are predictive of flooding, the insurance was designed to pay *before* the most catastrophic flooding occurs. Thus, the extreme El Niño insurance in Peru may be the first regulated forecast insurance in the world. The contract being evaluated is based on November and December Pacific temperatures and pays in January. Reports of the previous severe events indicate that flooding began no earlier than January and increased to dramatic levels in the following months. In this context, the benefits of an index insurance structure include 1) early insurance payouts that can be used to help the FI dynamically manage the disaster; 2) coverage against business interruptions and increased costs that would not typically be covered under a traditional insurance structure; and 3) lower costs for the insurance as the adverse selection and moral hazard problems of traditional insurance are substantially reduced with index insurance, assuming proper underwriting standards such as appropriate sales closing dates are followed.

3 El Niño risk assessment

Conducting a proper risk assessment in this context is an important yet daunting exercise. Two effects of severe El Niño on the MFIs were deemed particularly important to estimate: 1) the level of nonperforming loans, that is loans failing to pay based on the terms in the original loan contract, which is an indication of the effect of the event on MFI revenues; and 2) the per cent of the loan portfolio lost, for example through loan defaults, to which the capital base is particularly sensitive.

Historical data analysis and physical loss models can inform these estimates. Yet, only two severe El Niño events have occurred in living memory and the most recent in 1998. The economy, financial sector, public infrastructure, production methods, and even landscape have changed significantly since 1998 so estimating the effects of the next severe El Niño requires local expertise to integrate historical records with current conditions.

3.1 Factors complicating risk measures in historical data

Understanding the effects of disasters on key risk metrics such as the capital ratio is further complicated by institutional and political decisions and flexibility in reporting loan losses. For example regarding institutional decisions, two of the three MFIs with which we collaborated closely are owned by local municipalities and municipal leaders serve on their Boards of Directors, including the mayor and even the local priest. These municipalities are doubly exposed to severe El Niño because not only do they face decreased tax revenues, increased costs due to recovery, and asset losses, but their MFIs perform poorly. It is perhaps due to these difficulties that the data show one of these MFIs paid dividends to the municipality in May 1998, during the height of the severe El Niño while the capital ratio of that MFI was falling. A more common scenario may be where current shareholders agree to recapitalize a FI after a specific disaster (for example, Caprio and Klingebiel, 1996), but they may be unwilling or unable to commit to recapitalize the FI in the case of a future event.

Additionally, typical standards for assessing loan risk provide FIs with flexibility in reporting loan losses. In many jurisdictions including Peru, FIs are required to rate loan risk among several discrete categories and to ‘write down’ the value of a loan based on the identified risk category. These specific provisions for troubled loans are intended to be assigned ex ante, before the FI incurs losses, with the goal that these steps will motivate FIs to manage losses proactively. Peru, like other jurisdictions, allows FIs to mark a loan with a lower risk rating and so hold fewer specific provisions if a risky, poorly performing loan is restructured (SBS, 2008). FIs can even offer borrowers a ‘grace period,’ an allotted amount of time in which borrowers do not need to service their loan. Eventually FIs must realize their losses, but strategic reporting can make a crisis look less acute by delaying the realization of those losses on the balance sheet.

It is to this complex and sometimes opaque reporting system that political intervention can add additional complexity during a crisis. Policymakers face pressure to help maintain a stable banking system and sometimes change reporting standards during a crisis, which for example happened during the Japanese banking crisis in the 1990s (Hoshi and Kashyap, 2000; Kanaya and Woo, 2000). In Peru after a 2007 earthquake, the banking supervisor announced that loans potentially affected by the earthquake would be treated with lower levels of specific provisioning than under the general law (SBS, 2007). Additionally, in a more dramatic form of intervention in late 2001, the Peruvian State purchased outstanding and poorly performing agricultural loans from the 1998 El Niño at a deep discount from the MFIs (El Peruano, 2001).

In sum, the underlying fundamentals of how a disaster affects retained earnings and is transmitted to the capital ratio of the FI can be obfuscated by strategic loss reporting, political interventions, capital infusions, and dividend payments. Thus, historical records should be interpreted with caution, and we have taken the position that loss scenarios should be built on ‘primitive’ variables such as the expected effects of a disaster on loan performance over the life of the loan.

3.2 Using historical data and physical loss estimates

Regarding historical data analysis, the Peruvian banking regulator provides basic income and balance sheet records for all of the registered FIs since the early 1990s. With only one observation of severe El Niño in the banking data, mapping extreme Pacific temperatures to MFI losses cannot be done with statistics. Still, analyses of the 1998 El Niño demonstrate sizable portfolio effects. For example, Collier et al. (2011) estimate that approximately 4 per cent of the loan portfolio was restructured for one vulnerable MFI due to the onset of extreme El Niño. Using the same methodology, Collier (2010) finds another vulnerable MFI restructured roughly 6 per cent of its loan portfolio and that these higher levels of restructuring persisted for five to six years after the occurrence of the severe event. Additionally, ten per cent of all agricultural loans in northern Peru defaulted due to the 1998 El Niño (Trivelli, 2011). While these estimates provide a starting point for assessing the exposure of those MFIs to El Niño, conditions have changed and so loss estimates must be adjusted. For example, these MFIs have grown substantially — the loan portfolio of one has grown roughly 25 times its 1997 value.

3.3 Using an adapted Delphi Method to estimate El Niño risk

Because of the challenges of limited data and confounding policy decisions, we used an adapted Delphi Method to assess MFI exposure to severe El Niño. The Delphi Method relies on the knowledge and opinions of experts to for forecasting outcomes. Experts are interviewed in an iterative process that allows them to express their views and respond to the feedback of other experts (Linstone and Turroff, 1975; Landeta, 2006). This process is intended to help experts converge toward a predicted outcome and to identify the level of uncertainty associated with that prediction.

While the Delphi Method outlines a very specific protocol for the interview and data collection process, we adopted a modified approach more suitable to the risk assessment. Because the portfolio composition of each MFI differed, this application differed from other uses of the Delphi Method. Typically, a variety of experts are working to forecast a single outcome; however, in this applications, the experts at each MFI were forecasting distinct but related problems — the exposure of their MFI to severe El Niño. Using the collective expertise across MFIs required careful consideration to respect the confidentiality of each firm. Consistent with the Delphi Method, we provided experts with general estimates developed by their peers at other MFIs while protecting the anonymity of those firms.

Over the course of several meetings, we used historical data and the views of other experts to help the risk managers at each MFI develop informed estimates of the exposure of their firm. The reference for severe El Niño was the events that occurred in 1983 and in 1998. We organized interviews with MFI field officers and credit risk managers in the vulnerable regions. This process provided estimates from their physical loss assessments and institutional memory as each of the MFIs employed risk managers that had worked in the MFI during the 1998 event. Their risk estimates indicate several highly vulnerable economic sectors, namely, agriculture, fishing, and transport sectors. Each of these sectors is exposed to a different aspect of the event. Agriculture is affected by severe rain and significantly higher ambient air temperature. Fishing is affected by elevated ocean temperatures. Moreover, loans to small fishers were thought to be highly vulnerable because many of these loans are not collateralized and the MFIs anticipated that troubled borrowers would default on these loans. Transportation is affected due to the potential breakdown of roads and bridges. Table 1 outlines results from a representative risk assessment. In sum, the estimate suggests that 10 per cent of the portfolio of a representative MFI will require restructuring and 4 per cent of the portfolio value will be lost during a severe El Niño.

Table 1: Severe El Niño Risk Assessment Results

Sector	Nonperforming loans (%)	Lost (%)
Agricultural	75	50
Fishing	75	70
Transport	30	15
Other	10	3
Total MFI portfolio	10	4

Source: Authors from detailed interviews. Table notes: The sector estimates are presented as a per cent of the loan portfolio in the vulnerable regions, which are the northern coastal regions. The final line 'Total MFI portfolio' summarizes these effects as percentages of the whole portfolio of the MFI as these MFIs have diversified nationally to reduce their exposure to severe El Niño.

Because of the many sources of uncertainty, we developed at least three loss scenarios with each MFI, an optimistic, moderate, and pessimistic scenario. For example, the rainfall pattern and timing of the 1983 El Niño differed from that of the 1998 event, and differences in the geographic presentation of these events could result in notably different loss profiles. Additionally, the State created a precedent in Peru where after the 1998 event, it bought nonperforming agricultural loans at roughly 50 per cent of the original loan value (El Peruano, 2001). One MFI wanted to compare risk scenarios where the State purchased poorly performing loans with one where they did not. Table 2 summarizes the three scenarios in terms of the total portfolio for a representative MFI.

Table 2: Three Loss Scenarios for Severe El Niño

Scenario	Affected (%)	Lost (%)
Optimistic	7	2
Moderate	10	4
Pessimistic	13	6

Source: Authors from detailed interviews.

4 Description of the banking model

The banking model used in these analyses comprises an income statement and balance sheet that simulate the dynamics of banking activities over time. It is based in a spreadsheet and was designed to be accessible to credit risk managers. The model is recursive. Each month, the amount that the modelled MFI earns depends on the assets and liabilities on the balance sheet (for example, the level of loans on the balance sheet determines the gross interest income). Monthly net income is then allocated on the balance sheet as retained earnings that increase the capital base. The modelled MFI retains all earnings, no dividends are paid to shareholders. The modelled MFI uses a target capital ratio and originates loans based on this target. Generally, each month, the MFI is profitable and increases its loan portfolio and so has the potential to earn more income in the following month.

We use data from one of the MFIs to illustrate the process of calibrating the model and testing its performance. For that MFI, data from August 2010 to August 2011 were used. First, the model is calibrated based on the average performance of variables on the income statement, accounting for any trends in the data. For example, monthly interest income from that period indicates its expected value is approximately 2.35 per cent of the value of the loan portfolio. On the balance sheet, cash and loans comprise assets; interbank debt and deposits comprise liabilities. Liabilities are modelled as the residual of assets minus equity. Deposit and provisioning levels are set in the model based on historical averages, but both include an error term to capture volatility seen in the data. The minimum capital requirement for MFIs in Peru is 14 per cent, and we specify a target capital ratio of 15 per cent based on our interviews with the MFI managers. To test the model, we compare the empirical indicators of financial performance for August 2010 to August 2011 with those generated by the model, which is shown in Table 3.

Table 3: Comparison of Monthly Actual and Modelled Financial Performance

Indicator	Empirical (%)	Modelled (%)
Gross financial margin	1.63	1.62
Net financial margin	1.40	1.40
Net operational margin	0.39	0.35
Return on loan portfolio	0.19	0.17
Return on equity	1.17	1.16

Source: Authors. Table notes: All indicators in the figure are as a per cent of productive assets, except for return on equity, which is net income divided by equity.

4.1 Modelling El Niño

Because of the limited observations of El Niño, we asked experts to predict nonperforming loans and loan losses if an El Niño of the same severity as the 1998 event recurred now. Based on the last 30 years of data, severe El Niño occurs with about a 1 in 15 probability. While climate scientists recognize the very remote possibility of severe El Niño conditions for two (or more) years in a row, stakeholders in Peru report strong beliefs that severe El Niño will not occur for several years after a year with an extreme event. To model stakeholder beliefs, severe El Niño occurs with a 1 in 15, cannot occur for two years after an event, and cannot occur more than twice in the 10 year evaluation period in the model.

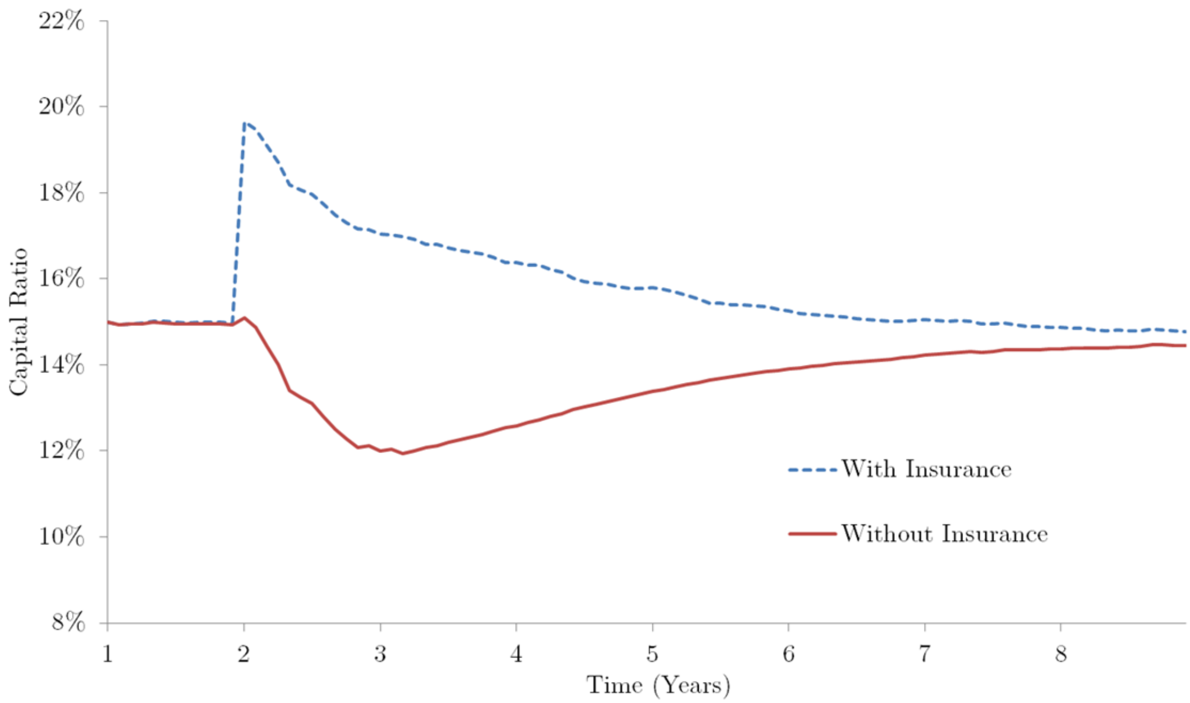
We model the effects of El Niño on the MFIs through its influence on income statement and balance sheet variables. For example, the increase in nonperforming loans created by severe El Niño reduces monthly interest income. We also model the time anticipated for each variable to converge back to pre-disaster performance levels. The risk managers in the MFIs estimated that monthly interest income would converge to pre-disaster levels after 36 months.

We also attempted to model very basic management decisions as reported by the risk managers. For example, the managers reported that they plan to stop lending as severe El Niño conditions emerged, especially to vulnerable sectors like agriculture. At the start of the event, it will be difficult to estimate the extent of losses and which communities will be affected most. Thus, the modelled MFI stops originating new loans just before severe El Niño begins and begins making new loans when its net income is positive.

4.2 Benefits of insurance during El Niño

Figure 1 was generated by simulating an El Niño in the second year of the model that results in the moderate loss scenario. The solid line illustrates the effect on the capital ratio. As described above, losses in net income, especially loan losses, reduce the capital ratio. The dotted line illustrates the ability of the insurance to protect MFI capital. The sum insured in this scenario is equal to 6 per cent of the value of the loan portfolio. The insurance pays just before a severe El Niño. The insurance payout would enter the balance sheet as new equity through retained earnings. Therefore, it increases the capital ratio. The capital ratio for the insured MFI falls after El Niño. This occurs because 1) the insurance for the MFI portfolio does not directly address the default problems of its borrowers so the value of the loan portfolio still declines; and 2) the insured MFI begins lending aggressively after El Niño. While the MFIs report that they have mechanisms to manage liquidity risks due to severe El Niño, the timely insurance payout also improves the cash position of the MFI and so can address unforeseen liquidity needs that might arise.

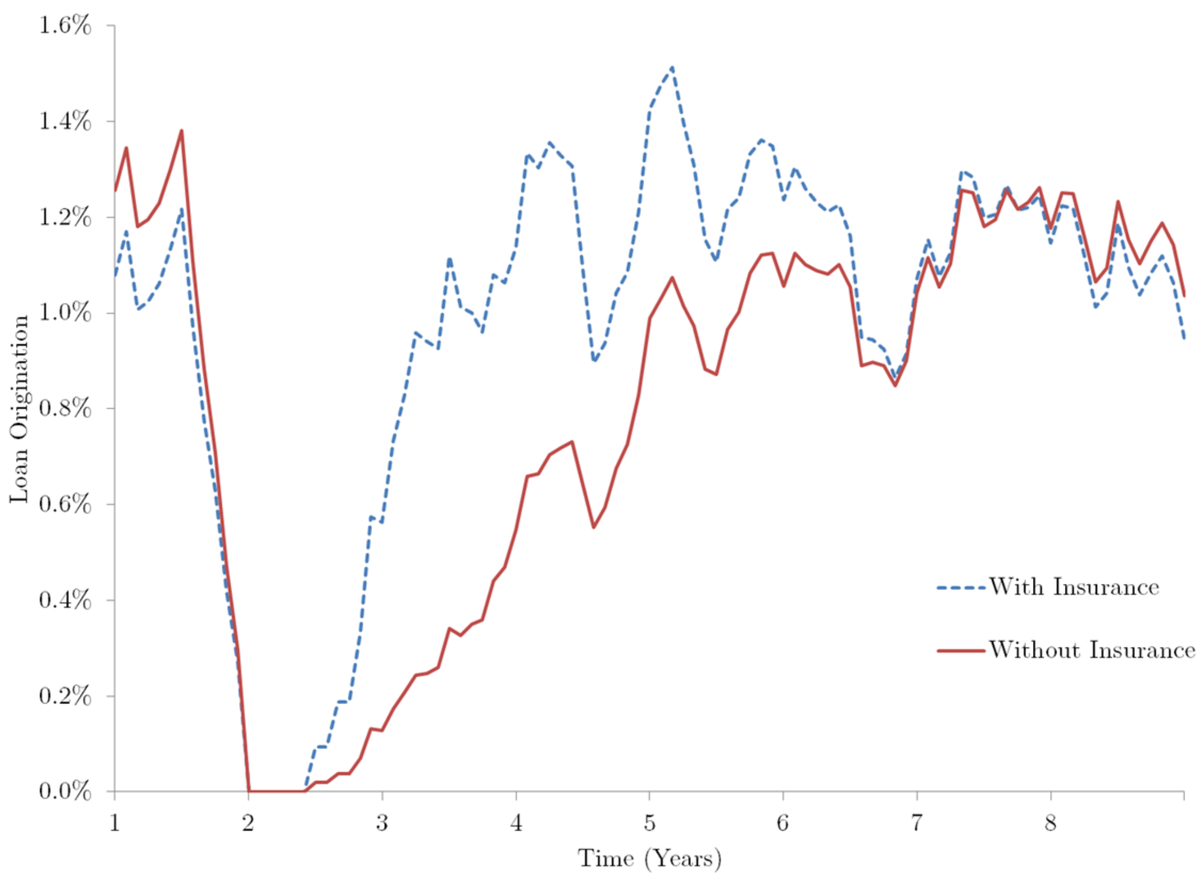
Figure 1: Effects of El Niño on the capital ratio with and without Insurance



Source: Authors. Figure notes: The dotted line corresponds with insuring a value equal to 6 per cent of the value of the loan portfolio. The capital ratio is measured as equity divided by the value of the loan portfolio net of provisions.

In the model, the insured MFI is in a strong position entering a severe El Niño due to the insurance payout, and Figure 2 compares modelled loan origination for the MFI with and without insurance. After the severe El Niño, the insured MFI originates much higher levels of loans. In reality, the insured MFI will have a choice of how aggressively it would like to leverage this new capital into loans. It must balance the impending losses associated with borrower default, which will reduce MFI capital, with the new lending opportunities associated with households and firms needing to rebuild. We anticipate that the MFIs will rely on some blend of maintaining extra capital reserves as they ascertain the repayment capacity of their current borrowers while taking advantage of strong opportunities in the market. An unmodelled benefit of the insurance to financial performance is that after a severe event, the stronger MFIs have the potential to capture market share from weaker MFIs.

Figure 2: Loan Origination



Source: Authors. Figure notes: The figure uses a six month moving average of loan origination. Loan origination is measured as the per cent growth in the face value of the loan portfolio (that is, without discounting for provisions).

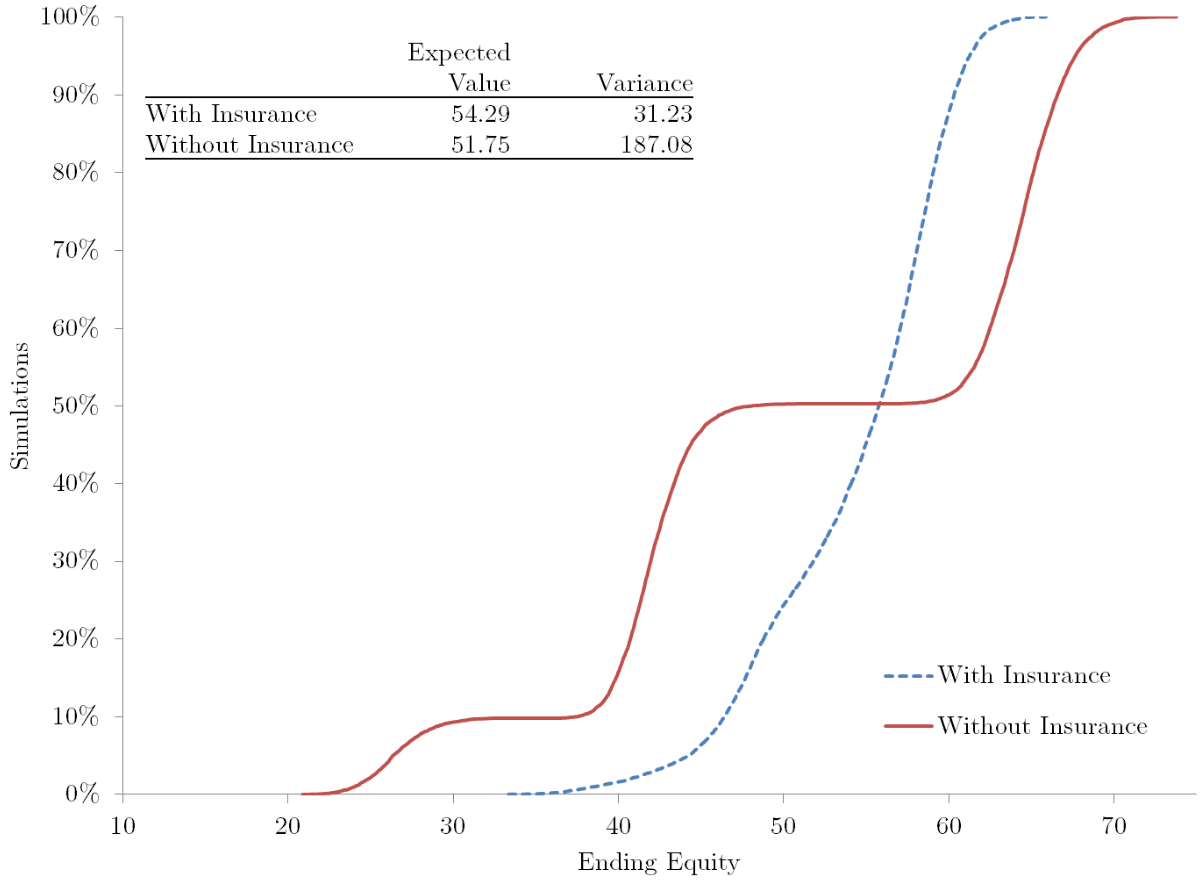
4.3 Comparisons across Outcomes with a 10-Year Time Horizon

The above simulates the effects of a severe El Niño occurring in the second year of the model. The next analysis compares a range of possible outcomes to determine the implicit tradeoffs of buying the insurance. Because the El Niño can affect the MFIs for several years, we use a long time horizon (10 years in this case) as a longer duration provides a clearer picture of how insurance can benefit the modelled MFI.

We use Monte Carlo simulation for this analysis. The random variable in this model is the occurrence of severe El Niño. The outcome of interest in this simulation is MFI equity at the end of the 10 year time horizon. Because the model includes no dividends or capital infusions, the equity position after 10 years represents the initial equity of the MFI plus its net income stream over the 10 year horizon. We evaluate risk management policies based on the expected ending equity and the variance in ending equity across Monte Carlo simulations. This analysis demonstrates risk-return tradeoffs generated by the simulation.

Continuing with our example of a sum insured of 6 per cent, Figure 5 presents the results of this analysis for the moderate risk assessment scenario. The price of the insurance used in this analysis is the actuarially fair rate (4.03 per cent of the sum insured each year), and this insurance contract would have made a payout of 76 per cent of the sum insured in 1998 and 45 per cent in 1983. Insurance payouts in the model are randomized between these two values (that is, when a severe El Niño occurs with an event frequency of 1 in 15 years, there is an equal likelihood in the model that the event will pay at the 1983 or the 1998 rate). We conduct 10,000 simulations for each risk management strategy (choosing a sum insured of 6% of the portfolio versus not insuring). The graph is organized so that simulations with the lowest ending equity are on the left and those with highest ending equity are on the right. Given the probability of the event, in roughly 50 per cent of the simulations El Niño did not occur. In the scenarios in which no El Niño occurs, the uninsured MFI has a higher ending equity position than the insured MFI. In any simulation where El Niño occurs, the ending equity position of the insured MFI is higher. This result is due to the concepts described above, that the insurance protects the capital of the MFI and allows it to continue originating loans — smoothing the net earnings of the MFI.

Figure 5: Example Monte Carlo Simulation with Actuarially Fair Insurance

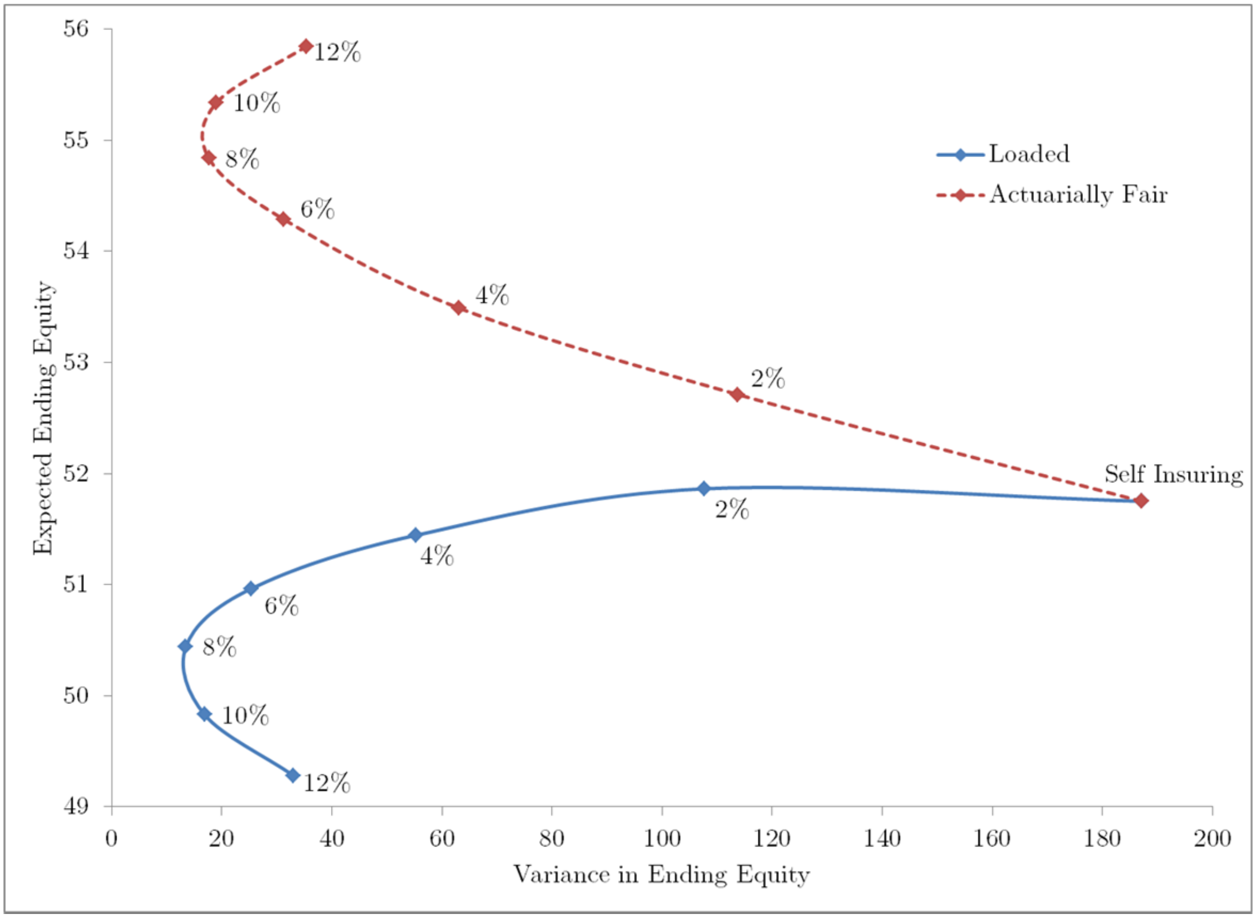


Source: Authors. Figure notes: Monte Carlo simulation conducted with 10,000 draws. The insurance is priced at the actuarially fair rate in this simulation. The variable of interest is the ending equity value of the modelled MFI after a 10 year period. The dotted line corresponds with insuring an amount equal to 6 per cent of the value of the loan portfolio.

Comparing across all 10,000 scenarios, the average equity position after 10 years for the insured MFI is higher than for the insured MFI by about 5 per cent. The effect on risk is much larger. The variance in ending equity — that is the volatility in the capital base — is reduced by 83 per cent.

Next, we compare outcomes across different levels of sum insured. Each point in Figure 6 represents a Monte Carlo simulation similar to one of the lines displayed in Figure 5. The dotted line in Figure 6 represents the results for the insurance were it to be priced actuarially fairly. For each of these analyses, both the expected value and volatility of ending equity improve for relatively small sums insured compared to no insurance, what we have called ‘self insuring.’

Figure 6: Comparisons Across Sums Insured: Ending Equity after 10 years



Source: Authors

Figure 6 is a form of mean-variance analyses in portfolio theory. The actuarially fair result suggest that given the loss expectations of the representative MFI, choosing a sum insured that is less than 8 per cent of the loan portfolio would be inefficient as the MFI could earn higher returns for taking on the same level of risk. The range of insuring 8 to 12 per cent (and higher) of the loan portfolio is called the 'efficient frontier.' Portfolio theory indicates that the point chosen on the efficient frontier by FI managers depends on their risk preferences.

Also shown in Figure 6 is the 'loaded rate' for the insurance. Market-based insurance always includes loading due to administrative costs, the cost of capital for the insurer, etc. For example, if we use a market price of 6.8 per cent of sum insured, this should be relatively close to the market price that will be charged in Peru. As shown in the solid line in Figure 6, this loaded rate offsets the benefits of the insurance to the expected ending equity of the MFI; however, the risk-reducing benefits of the insurance remain. For the solid line, the range in expected ending equity across sums insured is relatively small. Self insuring and insuring at 2 per cent result in equivalent expected ending equity (51.8 versus 51.9, respectively). Insuring at 8 per cent, the risk-minimizing level, reduces expected ending equity by 2.5 per cent. This model does not take into account a variety of possible return-enhancing behavioral changes that insuring against a catastrophe may motivate (e.g., lending to vulnerable borrowers in underserved regions) so given the advertised price, many opportunities may emerge to further increase the returns of an insuring MFI.

Experience suggests that, for large value contracts such as what would be purchased by an MFI, the advertised price may be effectively an opening offer in a negotiation for the transaction price. Thus, the two curves in Figure 6 represent an upper and lower bound for the risk-return tradeoff of the insurance for the MFI, depending on the final negotiated price.

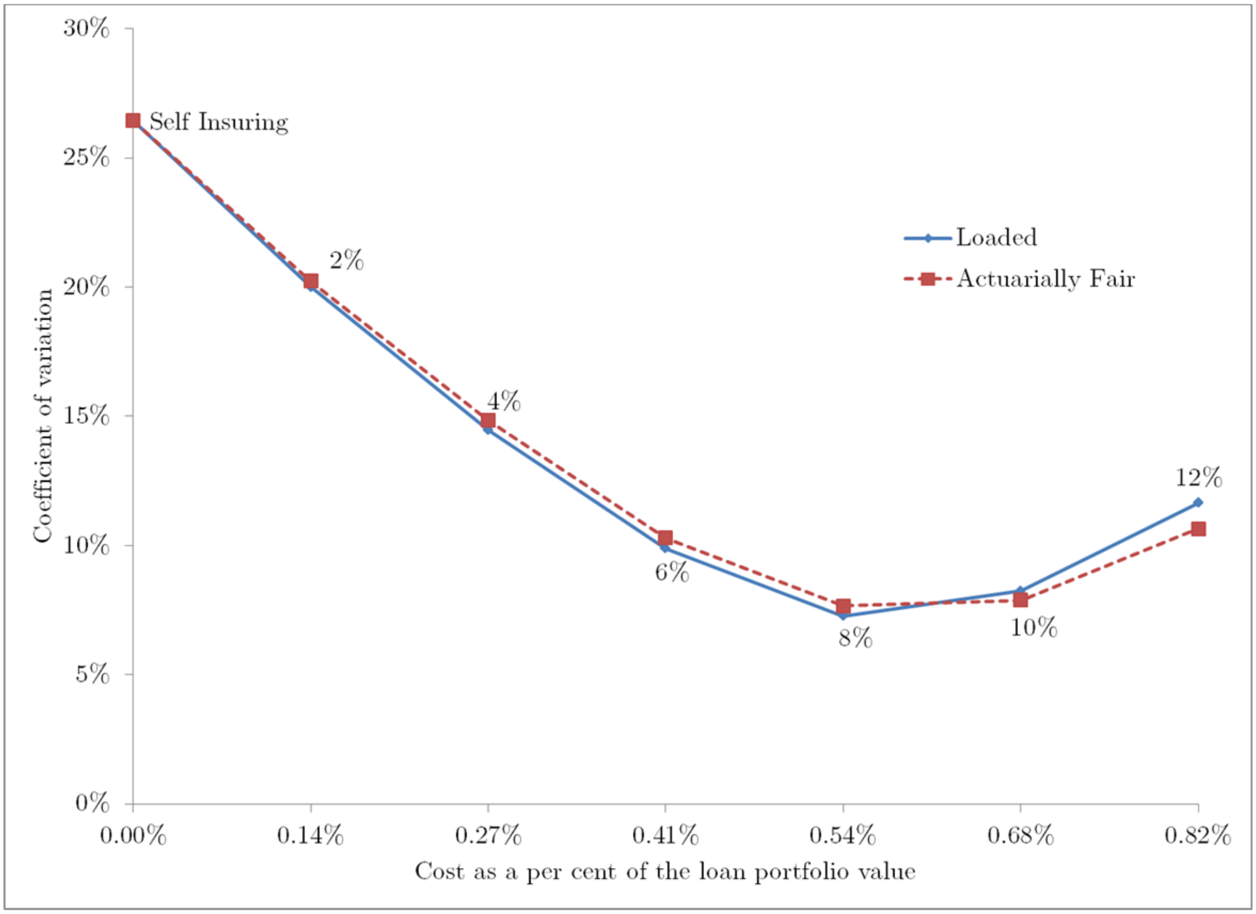
Finally, the sold line is also influenced by the probability of severe El Niño. Because catastrophic events occur infrequently, estimating their probability is difficult. This model uses an estimate that severe El Niño occurs with a 1 in 15 probability each year. Given the advertised price of the insurance, if severe events occurred less (more) frequently, the expected return associated with insuring would decrease (increase). For this analysis, we have followed the convention of many reinsurers in using the last 30 years of data to estimate the risk; however, some climate scientists and statisticians believe the annual probability of severe El Niño may be lower than 1 in 15.

A striking result of these analyses is that the El Niño risk for the representative portfolio can be managed with a relatively small amount of insurance. For example, suppose that managers of the representative MFI wanted the lowest level of risk and chose a sum insured of roughly 8 per cent of the loan portfolio value. The cost represents 55 basis points on the loan portfolio to insure against the greatest climate risk faced by these MFIs[2].

One of the MFIs with which we worked purchased El Niño insurance based on our collaboration during the most recent sales season, which ended in January 2012. Despite arguments about the seemingly low cost of managing this risk, our experience has been that purchasing portfolio-level insurance is a new and sometimes difficult proposition for many of the MFIs in Peru. Many operate on tight margins, and managers can be reluctant to pay 55 basis points for an untested innovation. Those stakeholders may benefit from recognizing that the marginal benefits are highest for low sums insured — in other words, moving from a strategy of self insuring to formally insuring a small portion of the risk provides the greatest risk reduction relative to the cost, as demonstrated in Figure 7.

[2] With a premium rate of 6.84 per cent of the sum insured, insuring at 8 per cent of the portfolio results in 55 basis points on the portfolio, 6.84%*8% = 0.55%.

Figure 7. Influence on the Coefficient of Variation from Purchasing Insurance



Source: Authors. Figure notes: The coefficient of variation (CV) is the standard deviation divided by the mean. In this case, the CV pertains to the ending equity position of the MFI across simulations

5 Conclusion

Portfolio-level insurance against natural disasters has the potential to align banker and policymaker objectives for FIs exposed to natural disasters. These analyses suggest that insurance allows FIs to manage disaster risks more effectively than via capital reserves alone. Moreover, they demonstrate the potential efficiency gains of disaster risk management strategies that combine insurance and capital reserves. This improved efficiency can translate into better financial performance, expansion of banking services, lower interest rates, and reduced volatility in access to credit.

Policy goals of increasing financial inclusion are often motivated by improving access to credit for specific, marginalized groups that may be under-served (for example women, the rural poor, ethnic minorities, and so forth). Our analyses do not specify borrower type and so cannot directly inform these policy dimensions; however, marginalized groups tend to be particularly exposed to disasters as they often live and work in vulnerable areas (for example flood zones, squatter settlements, isolated rural communities, Schipper and Pelling, 2006; Collier et al., 2009). Yet, because insurance reduces the costs and challenges of offering financial services to those exposed to the disaster, it is highly vulnerable populations who have the potential to benefit most.

Because limiting FI risk taking tends to be a higher priority for policymakers than bankers, policymakers will need to provide incentives for FIs to insure at levels that are close to the social optimum. Collier et al. (under review) suggest that portfolio-insurance could be used as a legitimate substitute for a limited portion of capital reserves and suggest that policymakers put the onus on FIs to develop analyses demonstrating risk reduction to the regulating supervisor before they receive benefits. For example, the banking supervisor in Peru is increasing the use of stress testing for its MFIs, which is an excellent avenue for MFIs insuring their risk to demonstrate the value of insurance and for the supervisor to formally recognize the improved resilience of those MFIs. This approach would likely contribute to the objectives of policymakers, but would require some divergence from international banking standards such as the Basel Accords. A great deal of research highlights the limitations of those accords for developing and emerging economies (for example Griffith-Jones, Segoviano, and Spratt, 2003; Stephanou and Mendoza, 2005; Tanveronachi, 2009), and the current transition to Basel III, which is even less relevant, may be a timely moment for divergence from developed country standards.

The metrics of financial performance, risk reduction, and financial inclusion are also important to ‘socially responsible’ investors who are increasingly investing in developing and emerging economies. These investors have the potential to reinforce risk management improvements among exposed FIs. Credit rating agencies play an important role in informing investors, and improved risk evaluations by rating agencies are needed in areas exposed to disasters. Too often, those agencies adopt the formats of developed country raters. As a telling anecdote from Peru, two risk analysts, one at a credit rating agency and the other at a socially responsible investor, reported independently that severe El Niño is a major threat to MFIs in northern Peru, but they also noted that disaster risk does not fit neatly into their rating protocols so this risk and its management are not considered in their risk analysis.

Our analyses have several limitations. First, complicating factors such as political intervention and flexibility in loan loss reporting make modelling historical disaster events for verification purposes difficult. We are looking for cases where such confounding variables are at a minimum and hope to test these in future research. While empirical demonstrations are worthwhile, overcoming the challenges of assessing risk is an important aspect of disaster management, and we consider the methodology described here a noteworthy contribution to that field. Second, while the model used in this paper demonstrates the fundamental effects of disasters on FIs, it was generated as a decision tool for banking risk managers and so it is therefore difficult to communicate all of its elements concisely. Our next planned research activities include producing mathematical models that demonstrate these mechanics more directly. Finally, these analyses were conducted for an event, severe El Niño, that causes both income and physical losses in several economic sectors. We hope to replicate these findings with other disasters that cause income and physical losses such as earthquake and windstorms. We also hope to test other types of disasters such as drought where losses are likely to be concentrated more heavily in the agricultural sector. Because of the dependence of rural economies on agriculture, the consequences of drought may propagate through the rural economy, affecting loans in other economic sectors. Thus, an important extension of this research is to test the effects of other disaster risks on banking portfolio performance.

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