TECHNICAL NOTE IDB-TN-03418

The Dual Return, Humanitarian and Fiscal, of Investing in Anticipatory Action

Prabhmeet Kaur Matta
Rocco Zizzamia
Jasper Andrée
Avinash Persaud
Juliana Salles Almeida
Juan Chaves-Gonzalez
Billie Getachew Alemaye
Hanna Paulose

Inter-American Development Bank
Climate Change and Sustainable Development Sector

November, 2026

The Dual Return, Humanitarian and Fiscal, of Investing in Anticipatory Action

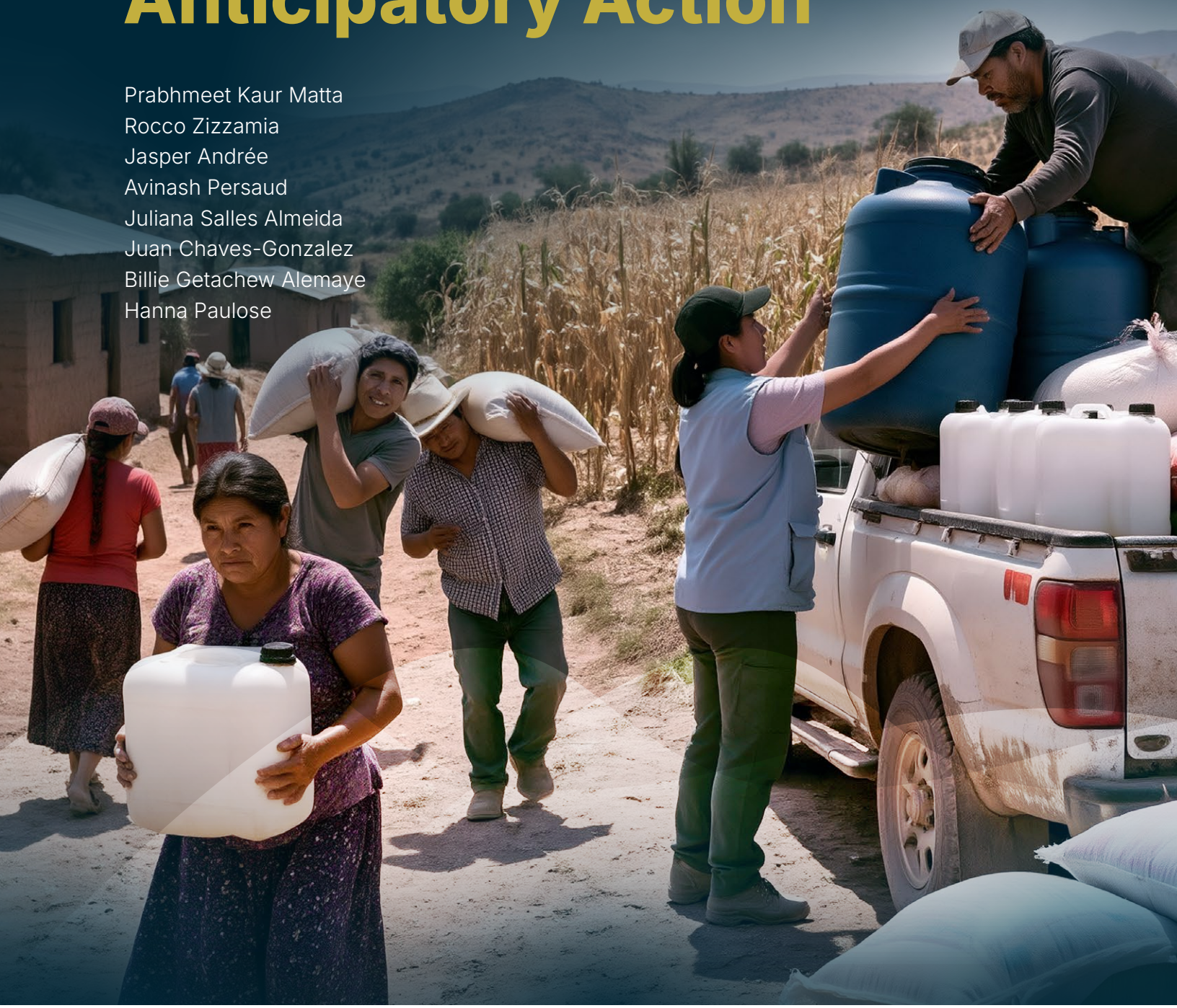
Prabhmeet Kaur Matta
Rocco Zizzamia
Jasper Andrée
Avinash Persaud
Juliana Salles Almeida
Juan Chaves-Gonzalez
Billie Getachew Alemaye
Hanna Paulose

Inter-American Development Bank
Climate Change and Sustainable Development Sector

November, 2026

The Dual Return, Humanitarian and Fiscal, of Investing in Anticipatory Action

Prabhmeet Kaur Matta
Rocco Zizzamia
Jasper Andrée
Avinash Persaud
Juliana Salles Almeida
Juan Chaves-Gonzalez
Billie Getachew Alemaye
Hanna Paulose



OCHA IDB

The Dual Return, Humanitarian and Fiscal, of Investing in Anticipatory Action

Authors
Prabhmeet Kaur Matta (UC San Diego), Rocco Zizzamia (University of Oxford), and Jasper Andrée (The New School)
Juliana Salles Almeida (IDB)
Juan Chaves-Gonzalez (OCHA)
Billie Getachew Alemaye (OCHA)
Hanna Paulose (OCHA)

Coordinators/Editors
Avinash Persaud (IDB), Juliana Salles Almeida (IDB) and Juan Chaves-Gonzalez (OCHA)

Acknowledgement
We gratefully acknowledge the review and support provided by Laura Rojas Sanchez (IDB), Roberto Guerrero Compean (IDB), Gines Suarez Vazquez (IDB), Daniel Pfister (OCHA), and Jeffrey Schlegelmilch (Columbia Climate School and National Center for Disaster Preparedness)

JEL Codes: O54, Q54, Q58, G15 y H63.

Design: Words for Development.

Cover image: Created using generative AI tools (Midjourney and Magnific).

Contents

PREFACE 1

EXECUTIVE SUMMARY 5

The Problem: Disasters Are Treated as Fiscal Surprises 5
A Different Approach: Financing Before the Shock 6
What the Evidence Shows: Anticipatory Action Can Pay for Itself 6
Why the Payoff Differs by Type of Disaster 8
The Long-Run Payoff: Growth, Debt, and Fiscal Space 8
Turning Data Gaps into an Investment Priority—Not a Barrier to Action 9
A Call for Collective Action 9
Conclusion: Anticipatory Action Is a Sound Investment in People and Public Finances 11

POLICY RECOMMENDATIONS: THE SHIFTS NEEDED TO MOVE FROM RESPONSE TO READINESS 13

1 INTRODUCTION 19

2 MOTIVATION 24

2.1 How Disasters Affect Government Spending 25
2.2 How AA Reduces Government Spending 27
2.3 The Relationship Between Disaster Response and Debt-to-GDP Ratios 28
2.4 Uncertainty Deters Government Commitment 33
2.5 Anticipatory Action Alongside Traditional Reactive Responses 35

3 PROJECT OBJECTIVES 37

3.1 Compile a Parameter Dataset for LAC Anticipatory Action Frameworks 38
3.2 Develop a Calibrated Fiscal Savings Model 38
3.3 Publish the Model, Code, and Data as a Public Good 38

4 THE FISCAL SAVINGS MODEL 39

4.1 Core Identity 40
4.2 NPV Extension 41
4.3 Fiscal Friction Wedge 41
4.4 Delta Reinterpretation: Fiscal vs. Social Effectiveness 42
4.5 Parameters 44
4.6 Illustrative Example 45

5 DATA SOURCESAND QUALITY 46

5.1 Parameter-to-Source Mapping 47
5.2 G_0 Priority Rule 48
5.3 Subregional Pooling 48
5.4 Limitations 48
5.5 Correlation of G_0 Across Sources 49

6 TAKING THE MODEL TODATA—DIAGNOSTIC TESTS 51

6.1 Prior Predictive Checks 52
6.2 Deterministic Case Studies 52
6.3 Program Cost Dynamics 54
6.4 Robustness 55

7 AA BY REGION AND DISASTER TYPE 56

7.1 Central America: Droughts 57
7.2 Central America: Storms and Floods 58
7.3 Andean Floods 58
7.4 Caribbean Storms 58
7.5 Southern Cone: Brazil Drought 59

8 CASE STUDY: HONDURAS DROUGHT 60

9 LESSONS LEARNED 63

9.1 AA Can Pay for Itself Under the Right Conditions 64
9.2 Post-Disaster Financing Is Expensive 64
9.3 Data Gaps Should Inspire Better Learning, but Not Justify Delay 65

10 CONCLUSION ONTHE AA MODELING 68

REFERENCES 71

APPENDIX 75

Appendix A. The Full Model and Its Reduction 76
A.1 The Decision Problem 76
A.2 Reduction to the Calibrated Identity 77
A.3 What the Reduction Sets Aside 77

Preface

Around the world, disasters are treated as fiscal surprises. In Latin America and the Caribbean alone, governments spend billions of dollars each year on emergency relief and reconstruction after floods, storms, and droughts have destroyed homes, livelihoods, and public infrastructure. These outlays occur after the disaster and its associated losses have materialized. They are made under crisis conditions that inflate procurement costs by 30–50 percent and are frequently financed through borrowing at elevated interest rates that burden public finances for years afterward or through sudden budget cuts that have adverse knock-on effects.

What if a portion of that disaster spending were shifted to before the shock, guided by credible forecasts and pre-agreed triggers? Advances in subseasonal-to-seasonal forecasting and impact-based modeling mean that, in some cases, governments now have the option of acting before damage and debt accumulate. They can use prearranged financing to protect people and limit losses to an extent that also safeguards public finances. This is the proposition under consideration.

Anticipatory action offers precisely such an approach. Under an anticipatory framework, the amount, source, and intended use of financing are agreed upon in advance, and funds are released when a forecast indicates that a drought, storm, or flood of a pre-specified severity is likely. Funds are used to pre-position supplies at non-crisis prices, deliver early cash transfers that enable households to protect their crops, livestock, and assets, and implement evacuations and other risk-reducing measures before a hazard strikes. Humanitarian evaluations already show that anticipatory cash transfers improve food security by 3–28 percent compared with assistance delivered after the shock, and that program-level benefit-cost ratios for households range from 1.2 to 7.0 in pilots from Lesotho to Nepal. However, these findings concern household-level benefits. Until now, the fiscal dividend for governments responsible for providing transfers after disasters—the savings on future emergency budgets, borrowing, and debt service—has remained largely unquantified. This is not just an academic question. If a comparable fiscal dividend can be demonstrated at the sovereign level, it would strengthen the case for a new generation of prearranged financing instruments for governments. Unlike conventional contingent financing, which is typically disbursed after an event occurs, these instruments would disburse when an event is forecast with sufficient confidence and lead time to reduce subsequent losses. Forecast-triggered financing already operates in the humanitarian system but remains scarce at the sovereign level—precisely where it now needs to be scaled up.

Prepared for the Inter-American Development Bank (IDB) and the United Nations Office for the Coordination of Humanitarian Affairs

(OCHA), this report adopts a deliberately conservative approach. Its core model captures direct government emergency expenditure and excludes broader, longer-term fiscal spillovers—such as revenue losses, deferred public investment, and the wider effects of higher public debt-service costs—that often follow disasters but are not consistently recorded or publicly available. To reflect the fiscal cost of mobilizing resources after a shock, the preferred specification separately applies a narrowly defined financing-friction adjustment to account for the additional costs governments incur when they must borrow or reallocate funds under crisis conditions.

The central finding is that anticipatory action pays for itself in fiscal terms when forecasts are credible, risks are recurrent, and the government's expected emergency expenditure is high. In Honduras, where country-specific data are available for all key parameters, an anticipatory drought program yields a fiscal benefit-cost ratio of 1.69 under the preferred specification, which incorporates financing frictions—the additional costs governments incur when they must raise or redirect funds quickly after a disaster. These include higher interest rates on emergency borrowing and opportunity costs associated with cutting or delaying planned spending on health, education, or infrastructure. In other words, for every dollar invested in anticipatory action, the government avoids approximately US$1.69 in emergency spending and crisis-financing costs it would otherwise incur once drought impacts materialize. Even under a conservative assumption that excludes financing frictions, the benefit-cost ratio remains above one, at 1.21. To break even, the program needs to avoid just 12 percent of the emergency spending a drought would otherwise require.

These returns arise in part because post-disaster financing is structurally expensive, especially compared with prearranged financing. When disasters strike without prior planning, governments are forced into a "post-shock scramble": borrowing on unfavorable terms, reallocating funds from health, education, and infrastructure maintenance—often with costly knock-on effects over time—and paying emergency prices for food, shelter, and equipment. Recent analysis suggests that each dollar of such reactive spending may, in fact, cost governments an average of approximately US$1.40 once the opportunity costs of emergency budget reallocations are accounted for. In contrast, anticipatory action often allows procurement at close to normal prices, thereby shifting a portion of disaster spending to a planned, lower-cost channel. Evidence from OCHA's anticipatory action framework in Bangladesh illustrates this logic: pre-crisis procurement enabled assistance to be delivered at a cost of US$13 per person, compared with US$26 under a reactive response, roughly halving the cost of reaching each person.

The fiscal argument for anticipatory action extends beyond individual emergency budgets to the trajectory of growth and debt. Cross-country evidence shows that major disasters increase debt-to-GDP ratios by approximately 2.5 percentage points

and that these increases persist for years as governments finance reconstruction and cope with reduced tax revenues. Simulation exercises presented in this report illustrate that, over a 40-year horizon with recurring shocks, a country that consistently combines anticipatory action with post-shock assistance can maintain a debt-to-GDP ratio approximately 12 percentage points below that of a country relying on reactive spending alone, with the widest gap occurring in the most adverse scenarios—despite paying a modest annual "premium" for early action. In other words, anticipatory spending functions as an investment: a predictable and manageable outlay that prevents substantially greater debt accumulation and output losses.

Anticipatory action for different hazards and contexts will yield different returns. Not all hazards can be predicted with the same degree of certainty or lead time. Droughts, for which fiscal costs are concentrated in transfers and support programs that can be reduced when households and producers protect their assets, present the strongest investment case. Floods and storms, for which a large share of government spending goes toward infrastructure reconstruction—much of which remains necessary even with the best forecasts—have lower fiscal effectiveness. Nevertheless, anticipatory measures can still reduce emergency response costs and human losses, although the available lead time and degree of forecast certainty may be lower than for droughts. For storms, the main constraint is lead time: storm tracks become predictable only days in advance, whereas rainfall deficits accumulate over weeks. For floods in the region, the main constraint is the absence of tested triggers. The model in this report makes these trade-offs transparent by expressing expected fiscal savings as a function of four parameters: disaster frequency, forecast quality, baseline fiscal exposure, and the share of that exposure that early action can avoid.

The growing precision of early-warning technology and impact-based forecasting opens a new frontier for prearranged financing instruments—both risk retention and risk transfer—that convert credible forecasts into timely funding before hazards reach their full impact. Precision matters because every forecast-triggered instrument carries the risk of releasing funds for a crisis that never materializes. Better forecasts reduce that risk and, with it, one of the main reasons governments may hesitate to release resources before a shock occurs.

Governments and development partners will be reluctant to scale up anticipatory action while evidence remains scarce, but this creates a chicken-and-egg problem: the evidence will likely remain limited until anticipatory action (AA) is implemented at scale in some contexts. For 6 of the 11 country-hazard pairs analyzed, the model generates positive gross savings under all assumptions, yet benefit-cost ratios cannot be calculated because program costs or event-level fiscal expenditure are not systematically recorded. Investing in the empirical infrastructure needed to track government expenditure by event, back-test triggers for floods and droughts, and record

program costs at the framework level would help translate these indications of potential savings into quantified fiscal returns.

For ministers of finance, their development finance partners—including multilateral development banks (MDBs)—and the markets that price sovereign risk, the implication is the same: anticipatory action should be viewed not as an additional claim on scarce fiscal space but as a way of protecting it. Investments in data collection, analysis, and well-designed anticipatory frameworks can reduce the scale and cost of post-disaster spending that would otherwise be necessary, moderating public debt accumulation and safeguarding development investments that might otherwise be cut to fund emergency relief. As early warning improves, the question for governments is shifting from whether a shock can be foreseen to whether the right financing instrument is in place to act on the warning.

Markets already price disaster exposure. Storms raise 10-year sovereign bond yields by approximately 140 basis points for highly indebted emerging-market borrowers. Rating methodologies identify vulnerability effectively, but they are less equipped to recognize preparedness and have no established treatment for financing released in response to a forecast rather than an event that has already occurred. Climate-resilient debt clauses demonstrate how quickly this can change. When Barbados issued debt containing such a clause in 2022, the instrument was untested; by late 2024, S&P had published an approach to assessing these clauses. We invite credit rating agencies to develop a similar approach for anticipatory risk retention and transfer instruments, so that preparedness strengthens a country's credit standing rather than undermining it.

There is also an opportunity to align life-saving objectives with fiscal resilience. Anticipatory cash transfers, early warnings, and pre-positioned supplies are first and foremost intended to prevent human suffering. But as this report shows, they can also help stabilize budgets and debt trajectories. They save money. They are fiscal investments that strengthen the case for scaling up financing.

This jointly commissioned IDB–OCHA study is an invitation to governments, multilateral development banks, and the wider aid community to treat anticipatory action as both an investment and a core component of disaster risk financing portfolios. It provides a transparent, open-access framework that countries can adapt and refine as better data become available, along with a set of initial estimates that already point in one direction: when deployed for the right hazards with appropriate triggers, anticipatory action is not only good humanitarian policy; it is also good fiscal policy and sound public investment.

Avinash Persaud (Special Advisor to the President of the Inter-American Development Bank) and **Laura Rojas Sánchez** (Unit Chief, Disaster Risk Management, IDB)

Juan Chaves-Gonzalez (OCHA Lead Advisor, Crisis Risk Financing), **Hanna Paulose** (OCHA Humanitarian Affairs Officer), and **Billie Getachew Alemayehu** (OCHA Humanitarian Affairs Officer)

Executive Summary

THE CORE ARGUMENT

Many disasters—droughts, floods, and storms—can now be forecast days in advance or, in the case of droughts, weeks in advance. Yet governments frequently treat their fiscal consequences as unexpected shocks, responding only after losses materialize through emergency borrowing, disruptive budget reallocations, and higher-cost procurement. This report shows that where forecasts are reliable and triggers are pre-agreed, shifting a portion of spending to before the shock can protect people while reducing contingent liabilities, preserving fiscal space, and limiting pressure on public debt. Anticipatory action therefore belongs within broader disaster risk management and financing strategies: governments, international financial institutions, multilateral development banks, and humanitarian actors should integrate anticipatory financing into medium-term fiscal frameworks and fiscal risk analyses and develop and deploy anticipatory financing instruments.

The Problem: Disasters Are Treated as Fiscal Surprises

Across Latin America and the Caribbean, governments spend billions of dollars every year responding to droughts, floods, and storms after the damage has already occurred. That spending is rarely planned for in advance, even though many of these disasters are recurring and increasingly forecastable.

Waiting until a disaster strikes is expensive in three compounding ways. First, emergency purchases of food, shelter, water, and equipment cost 30–50 percent more than the same goods purchased through normal procurement channels because governments must buy urgently, often in a seller's market. Second, disasters shrink the economy by approximately 1–2 percent and reduce tax revenues precisely when governments face the greatest spending needs. Third, governments typically cover the gap by borrowing on unfavorable terms or cutting budgets for health, education, and infrastructure—an emergency response associated with an increase in public debt of approximately 2.5 percentage points of GDP in the years following a disaster.

These costs are not one-time expenses. Simulations presented in the report show that a government facing recurring shocks and relying exclusively on post-disaster spending ends up with persistently higher debt and a smaller economy than one that also invests in early action.

A Different Approach: Financing Before the Shock

Anticipatory action works differently. Financing is agreed upon and set aside in advance. When an independent forecast crosses a pre-agreed threshold—for example, rainfall falling below a specified level or a storm track crossing a defined line—funds are released automatically, before the disaster fully materializes. These funds are used to pre-position supplies while prices remain at normal levels, provide cash transfers to households so they can protect their crops, livestock, and other assets, and support early evacuations that reduce loss of life.

The humanitarian benefits of this approach are already well documented: households that receive cash transfers before a shock have food security scores 3–28 percent higher than those of households that receive assistance only afterward, and program-level benefit-cost ratios for households range from 1.2 in Lesotho to 7.0 in Nepal. The benefits of early action for households are widely recognized. What has been missing is a clear answer to a different question: does acting early also save governments money? If so, it could open up important policy options.

What the Evidence Shows: Anticipatory Action Can Pay for Itself

To answer that question, the report develops a deliberately conservative model. It accounts only for direct government expenditure that would otherwise be incurred in responding to emergencies, excluding lost tax revenues, delayed investment, and additional debt-service costs, all of which are real but more difficult to measure. Even under this conservative approach, the case for early action remains compelling in the best-documented example (Table 1).

TABLE 1 Honduras Drought Program—How the Numbers Add Up

HONDURAS DROUGHT PROGRAMME — HOW THE NUMBERS ADD UP	
Government fiscal exposure per drought (G0)	$201.6 million
Chance of drought in a given year (p)	35% (9 of the last 26 years)
Forecast accuracy / hit rate (α)	69% of droughts correctly flagged in advance
Central estimate of avoided spending (δ)	20% of emergency costs avoided when triggered
Programme cost	$8.0 million per year
Benefit-cost ratio (BCR), accounting for crisis financing costs	1.69 — $1.69 saved per $1 spent
BCR, direct costs only (conservative)	1.21
Break-even point	Pays for itself if it avoids just 12% of emergency costs

In Honduras, where country-specific data are available for all key parameters, an anticipatory drought program yields a benefit-cost ratio of 1.69 under the preferred specification, which incorporates financing frictions—the additional costs governments incur when they must raise or redirect funds quickly after a disaster. In this case, these costs include higher interest rates on emergency borrowing and the opportunity costs of cutting or delaying planned spending on basic services (e.g., health and education). In other words, for every dollar invested in anticipatory action, the government avoids approximately US$1.69 in costs it would otherwise incur once the impacts of drought materialize. The pattern extends, although to varying degrees, across the other country-hazard combinations examined in the report (Table 2):

TABLE 2. Benefit-Cost Ratios of Anticipatory Action by Country and Hazard

COUNTRY AND HAZARD	BCR (INCLUDING CRISIS FINANCING COSTS)	BCR (DIRECT COSTS ONLY)
Honduras—drought	1.69	1.21
El Salvador—drought	0.93	0.67
Guatemala—drought	0.78	0.56
Cuba—storm	0.65	Not reported
Haiti—storm	0.59	Not reported

Note: Floods and storms in Guatemala, storms in Honduras, floods in Bolivia and Ecuador, and droughts in Brazil all yield positive savings under every scenario tested, but benefit-cost ratios could not be calculated because program cost data are not yet available for these frameworks.

These results depend heavily on the additional costs governments incur when financing emergency spending under crisis conditions—through emergency borrowing, forced budget reallocations, or the drawdown of reserves. The report estimates this "crisis financing penalty" at approximately US$0.40 per dollar reallocated, based on experience with budget reallocations during the COVID-19 pandemic. A comparable example from OCHA's operations in Bangladesh shows that pre-crisis procurement enabled assistance to be delivered at US$13 per person, compared with US$26 per person under a reactive response—roughly halving the cost of delivering assistance through early action.

Why the Payoff Differs by Type of Disaster

Anticipatory action does not yield the same returns for every hazard, nor should policymakers expect it to. The report finds that droughts present the strongest fiscal case because most drought-related spending goes toward transfers, food distribution, and water trucking—costs that can be reduced when households protect their assets in advance.

Floods and storms are different. A large share of their costs arises from infrastructure reconstruction—rebuilding roads, bridges, or clinics—which remains necessary regardless of how much advance warning a community receives. Anticipatory action can still reduce emergency response costs, procurement costs, and loss of life associated with these hazards, but it cannot eliminate reconstruction costs to the same extent that it can reduce drought relief expenditure. Policymakers should therefore prioritize anticipatory financing where forecasts are reliable and a substantial share of spending is avoidable—particularly for droughts and, increasingly, floods and storms that can be forecast with sufficient accuracy—while continuing to invest in adaptation and resilience and to use contingent credit to address damage that early action cannot prevent.

The Long-Run Payoff: Growth, Debt, and Fiscal Space

The fiscal case becomes even stronger when assessed over decades rather than individual events. Major disasters increase debt-to-GDP ratios by approximately 2.5 percentage points on average, and debt growth remains elevated for about three years afterward. For highly indebted emerging-market governments, a severe storm can raise yields on 10-year government bonds by approximately 140 basis points.

A 40-year simulation in the report, calibrated to drought conditions in Honduras, compares a government that responds only after each shock with one that also implements an anticipatory action program. The government implementing anticipatory action incurs a small, predictable annual cost (about 0.02 percent of GDP) and avoids a fifth of each triggered drought's emergency spending. By year 40, its median debt-to-GDP ratio is roughly 12 percentage points lower (63.5 versus 75.8 percent), with the largest gains in the worst disaster sequences; the effect on output is modest. The exercise is stylized—it rests on a specific set of assumptions and is not a full debt sustainability analysis—but it reinforces the case for treating anticipatory action as part of macro-fiscal risk management. Its expected costs and activations should be incorporated into budget baselines, fiscal risk assessments, and debt sustainability analysis so that governments can compare it transparently with contingent credit and post-disaster borrowing. In this sense, anticipatory financing behaves like a fiscal investment: a predictable expenditure that can reduce future liabilities and protect growth, debt sustainability, and fiscal space.

Turning Data Gaps into an Investment Priority—Not a Barrier to Action

The report acknowledges its limitations, but policymakers should not treat this transparency as a reason for delay. The available evidence points in a clear direction, even though the data do not yet allow for precise estimates. Of the 11 country-hazard combinations studied, only one—drought in Honduras—has country-specific data for every parameter required by the model. Four have reliable forecast data, but the report's authors must rely on regional averages to estimate the typical fiscal cost of a disaster. Six have data on the fiscal cost of disasters but lack historical records that would allow an assessment of how accurately forecast triggers would have performed.

For 6 of the 11 cases, the model indicates that anticipatory action generates positive savings under every scenario tested, but a precise benefit-cost ratio cannot be calculated because governments do not yet track disaster-related expenditure or program costs at the required level of detail. One of the report's practical findings is that data gaps should not delay action where the available evidence consistently indicates potential benefits. Governments and development partners should act on the best available information while simultaneously strengthening data infrastructure—an investment that can deliver substantial value by improving future decision-making, program design, and evaluation.

A Call for Collective Action

The report concludes with a message to the leadership of ministries of finance and development finance institutions: anticipatory action should not be treated as an additional claim on scarce fiscal space or as a parallel humanitarian mechanism, but as one component of an integrated disaster risk management and financing strategy. Its costs, expected activations, and potential fiscal savings should be assessed alongside those of other disaster risk financing instruments and incorporated into medium-term fiscal frameworks and macroeconomic risk analysis. Technological advances in forecasting and recent innovations in contingent financing now make it possible to convert credible forecasts into timely, prearranged funding before hazards reach their full impact. Realizing this potential at scale requires coordinated action among governments, regional and multilateral institutions, and the humanitarian community. The report identifies the following priority shifts for this collective effort:

1. **Reframe Anticipatory Action as a Fiscal Investment**. Governments and development banks should assess anticipatory programs as part of a broader disaster risk management and financing portfolio—not as stand-alone facilities—and evaluate them not only in terms of lives and livelihoods

protected, but also in terms of avoided emergency spending, lower procurement and financing costs, reduced contingent liabilities and debt pressures, and protected development budgets. This would allow ministries of finance to compare anticipatory action with risk reduction, contingent credit, and post-disaster borrowing on a consistent fiscal basis.

2. **Integrate Disaster Preparedness and Anticipatory Action into Core Fiscal Frameworks**. Particularly in countries exposed to large and frequent shocks, medium-term fiscal frameworks, debt sustainability analyses, and annual budgets should recognize predictable disaster costs, associated contingent liabilities, and the recurrent and activation costs of anticipatory action. Governments should establish clear budget classifications and appropriations, decision-making authority, spending authority, procurement and audit rules, and responsibilities for early-warning services and delivery. This institutional integration would make anticipatory action a standing government function and enable ministries of finance to plan, monitor, and evaluate it within the same framework used for other fiscal risks.

3. **Create a Protected, Risk-Layered Anticipatory Financing Capacity**. Anticipatory action should occupy a defined layer in the government's disaster risk financing strategy, with instruments matched to the frequency, severity, and predictability of shocks. In practice, this means using budget provisions and resilience investments for recurrent, lower-severity events; contingent credit and anticipatory transfers for forecastable events that exceed routine response capacity; and catastrophe risk instruments, debt-pause clauses, and post-disaster financing for rarer, more severe residual risks. The expected cost of each layer should be reflected in medium-term fiscal planning.

4. **Build the Data Infrastructure and Institutional Capacity for Anticipatory Action**. Hydrometeorological services need stable, long-term operating budgets, and ministries of finance should maintain event-level fiscal databases linking hazard data to emergency transfers, procurement costs, infrastructure repairs, and debt financing, with transparent classifications. Building capacity in adaptive social protection is also essential to making anticipatory action operational and sustainable.

5. **Make Triggers Clear, Tested, and Accountable**. Drawing on best practices in the humanitarian and financial sectors, every trigger should specify its indicator, data source, threshold, geographic unit, lead time, and the precise funding and actions it activates. Triggers should be back-tested against historical events and reviewed periodically, with safeguards against discretionary delays.

6. **Connect Early Warning to Ready-to-Deploy Delivery Systems**. Governments should link anticipatory action to adaptive social protection systems—

including interoperable registries, digital identification, and payment platforms—that can quickly reach households exposed to recurring shocks once a trigger is activated.

7. **Use Prearranged Procurement to Secure Savings**. Framework agreements, prequalified supplier rosters, agreed price ceilings, and pre-positioned stocks allow governments to purchase supplies at normal rather than emergency prices, avoiding the scarcity premiums that drive up costs once a disaster strikes.
8. **Mobilize Development Banks to Help Shift the System from Response to Readiness**. Multilateral development banks should expand dedicated anticipatory financing windows, forecast-based drawdown options, and blended facilities that combine international resources with domestic cofinancing. These instruments should disburse funds automatically once an independently verified trigger is met, with success measured in terms of both humanitarian outcomes and avoided fiscal costs.

Conclusion: Anticipatory Action Is a Sound Investment in People and Public Finances

The evidence presented in this report does not suggest that anticipatory action will pay for itself in every context, and the report is transparent about where data remain too limited to draw firm conclusions. However, where credible forecasts exist, the risk is recurrent, and expected emergency spending is high, the economic case favors acting early. Honduras already demonstrates this potential, with estimated savings of US$1.69 for every US$1 invested. Its anticipatory program needs to reduce government emergency spending by only 12 percent—through better protection of people and livelihoods and the pre-positioning of emergency equipment, food, and medicines—to break even. The policy implication is that anticipatory action could be included among fiscal risk management tools: evaluated and financed alongside other instruments, with its costs, contingent liabilities, and expected savings explicitly reflected in the budget decisions and macro-fiscal analysis of governments and international financial institutions.

Advances in early-warning technology and climate modeling create a timely opportunity for development institutions to explore innovative financing instruments, including contingent credit facilities that release resources in response to credible forecast triggers. These facilities could channel prearranged cash transfers to vulnerable households and local response agencies while supporting the pre-positioning of critical equipment and supplies. By enabling action before a hazard reaches its full impact, such instruments could reduce humanitarian losses and emergency expenditure, with the resulting fiscal savings helping to offset financing costs and limit additional debt accumulation. Realizing the

full potential of this opportunity will require targeted and consequential policy shifts.

The imperative for governments, development banks, and the humanitarian community is therefore not to choose between humanitarian action and fiscal prudence, but to recognize that—for the right hazards, with the right triggers—they are the same choice. Adjusting budgets, designing risk-layered financing mechanisms, investing in forecasts and data, and scaling up prearranged instruments through multilateral partners are the collective steps needed to transform disaster response from a recurring fiscal surprise into a planned and substantially less costly public investment.

Policy Recommendations: The Shifts Needed to Move from Response to Readiness

This study draws on operational data from the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) to examine categories of natural hazards that can be forecast with a high degree of confidence at least one to two days before impact. It explores whether governments could make effective use of prearranged contingent financing during this forecast window to support targeted anticipatory actions that help vulnerable households protect their livelihoods, crops, livestock, and other productive assets before disasters occur.

This analysis finds that, by releasing prearranged financing when objective forecasts reach agreed thresholds, governments can protect lives, reduce avoidable emergency expenditure, and limit the additional costs of reallocating or borrowing funds during a crisis. Under the report's central assumptions, the Honduras drought framework generates an estimated US$1.69 in fiscal savings for every US$1 of program costs; this framework breaks even when it reduces government emergency expenditure by approximately 12 percent in correctly triggered disaster years. Returns vary by hazard, forecast performance, program design, and fiscal exposure. When credible triggers, effective actions, and recurrent fiscal liabilities coincide, investing before a shock is not merely humanitarian preparedness—it is sound public financial management.

This evidence opens the door to a new generation of anticipatory financing instruments. Contingent credit facilities could release funds in response to credible forecast triggers, directing prearranged cash transfers to vulnerable households and local response agencies while enabling critical equipment and supplies to be positioned before a disaster strikes. By acting early, governments could reduce human suffering and avoid costly emergency expenditure; the resulting fiscal savings could, in turn, help offset financing costs and limit additional debt accumulation. Advances in early-warning technologies and climate modeling make this opportunity increasingly achievable. Seizing it will require collective action and targeted policy shifts, including the following:

i) **Reframing Anticipatory Action as a Fiscal Investment.** Anticipatory action should not be treated as a stand-alone financing solution, but as one component of a broader disaster risk management and

financing strategy. From the perspective of ministries of finance, its value lies in helping governments manage recurrent disaster-related fiscal risks alongside complementary investments in risk reduction and resilience, contingency reserves, contingent credit, insurance, and post-disaster financing. Where hazards are sufficiently forecastable and early measures can reduce expected losses, anticipatory action can convert part of an uncertain and often costly contingent liability into a planned investment that protects lives and livelihoods while limiting emergency expenditure, crisis procurement costs, disruptive budget reallocations, additional borrowing, and pressure on public debt.

Embedding anticipatory action within the core fiscal framework is therefore essential. Governments should reflect expected program costs and associated financing needs in medium-term fiscal frameworks, debt sustainability analyses, and annual budget processes. This includes establishing clear budget classifications and appropriations and aligning forecast-based triggers with existing contingency funds, social protection systems, procurement arrangements, and disaster risk financing instruments. Such integration would allow ministries of finance to assess anticipatory action against other risk management options, plan for its recurrent costs, monitor its effects on fiscal exposure and debt dynamics, and evaluate performance in terms of both humanitarian outcomes and avoided fiscal losses. By moving anticipatory action from ad hoc or externally financed pilots into regular public financial management systems, governments can make it a predictable, accountable, and sustainable instrument for protecting fiscal space and development spending.

ii) **Establishing Predictable Budgets, Cross-Sectoral Ministerial Ownership, and Coordination Across Levels of Government to Make Anticipatory Action More Effective.** As natural disasters become more frequent and severe and forecasts become more accurate, medium-term fiscal frameworks and annual budgets should recognize predictable disaster response needs as contingent liabilities. An anticipatory action framework approved in advance across ministries could assign decision-making authority, spending authority, procurement flexibility, audit requirements, and responsibilities among the ministry of finance, disaster management authority, sector ministries, hydrometeorological service, and local governments. This would transform anticipatory action from an externally financed pilot into an established government function. Ministries of finance should view these allocations as investments that safeguard fiscal space, public debt sustainability, and essential development spending. Unlike insurance, which spreads costs over time by replacing large, potentially unaffordable losses with smaller, more manageable

payments, anticipatory action constitutes an investment because current spending generates greater benefits in the future.

Furthermore, improving coordination between national and local authorities brings anticipatory action closer to communities. National authorities could provide strategic direction, financing rules, common technical standards, and quality assurance, while local governments and community organizations could validate exposure, adapt action packages, and deliver assistance. Formal agreements could define mandates, reporting lines, data-sharing arrangements, and fiscal transfers across levels of government. Local contingency plans should be costed and linked to national triggers, and local institutions should receive predictable resources for preparedness, exercises, equipment, and surge staffing rather than receiving funding only upon activation.

For Small Island Developing States (SIDS), regional disaster preparedness and coordination mechanisms may offer greater operational efficiency than isolated national arrangements. By pooling resources and planning jointly, countries can relocate equipment, personnel, and emergency supplies across islands as risks evolve; establish shared logistics and pre-positioning hubs; and use prearranged procurement frameworks to aggregate demand, strengthen bargaining power, and achieve economies of scale. Such regional mechanisms can complement national systems by reducing duplication, expanding access to specialized capabilities, and enabling faster mutual assistance when a disaster exceeds the capacity of any single country.

iii) **Establishing Protected, Risk-Layered Anticipatory Financing Capacity.** Anticipatory action should occupy a clearly defined layer within the government's disaster risk financing strategy, with instruments matched to the frequency, severity, predictability, and fiscal consequences of different shocks. Budget provisions and resilience investments can address recurrent, lower-severity events; reserves, contingent credit, and anticipatory transfers can finance forecastable events that exceed routine response capacity; and insurance, catastrophe risk instruments, debt-pause clauses, and post-disaster financing can cover rarer or more severe residual risks. The expected cost of each layer, including recurrent program costs and potential trigger activations, should be reflected in medium-term fiscal planning and assessed against debt and liquidity constraints. This portfolio approach helps avoid gaps and duplication, clarifies when anticipatory funds should be used, and enables governments to select the least-cost combination of risk reduction, retention, financing, and transfer while protecting essential spending and fiscal sustainability.

iv) **Improving Data to Support Decision-Making, Even When Action Might Need to Begin Before the Evidence Is Complete.** Hydrometeorological

services require stable operating budgets for observation networks, maintenance, staffing, modeling, open data, and the communication of impact-based forecasts. Ministries of finance could work with technical agencies to maintain event-level fiscal databases that link hazard intensity and exposure to emergency transfers, procurement costs, infrastructure repairs, revenue losses, debt financing, and program costs. Anticipatory action frameworks with incomplete data or benefit-cost ratios below one should not necessarily be abandoned; instead, they should be subject to structured improvement plans focused on better triggers, lower delivery costs, more fiscally relevant actions, or more narrowly targeted geographic areas. Data are essential, but decisions cannot always wait for perfect information, and action must often begin before the evidence is complete.

v) **Establishing Clear and Transparent Triggers to Turn Forecasts into Timely Decisions.** Trigger protocols should specify the indicator, data source, threshold, geographic unit, lead time, validating authority, and precise funding and actions activated. Governments should back-test proposed triggers against historical events and report sensitivity, specificity, false-alarm rates, missed-event rates, and expected annual activation frequency. Thresholds could be reviewed after each activation and periodically thereafter, with safeguards against discretionary delays. Where model uncertainty is high, tiered triggers can release modest amounts of funding at an early readiness stage and larger amounts as forecast confidence increases.

vi) **Establishing Ready-to-Deploy Delivery Systems to Turn Early Warnings into Early Support.** Governments could link anticipatory action to adaptive social protection and disaster response systems, using interoperable social registries, georeferenced risk data, digital identification, payment platforms, and grievance mechanisms. Registries could cover households exposed to recurrent shocks—not only those experiencing chronic poverty—and allow for temporary horizontal expansion and vertical top-ups. Frameworks should be tested through simulations and should establish service standards for the time between trigger confirmation, fund release, and receipt of assistance by households or local authorities.

vii) **Building Capacity in Adaptive Social Protection to Make Anticipatory Action Operational and Sustainable.** Governments and development partners should invest in the skills, procedures, and institutional routines needed to translate forecasts into impact assessments, timely decisions, and accountable delivery. This includes training ministries of finance, disaster risk management agencies, sector ministries, hydrometeorological services, local governments, and community organizations in trigger protocols, impact-based forecasting, costed action

plans, procurement readiness, beneficiary targeting, payment delivery, monitoring, and post-activation learning. Regular simulations, peer learning, and after-action reviews can help ensure that anticipatory action is not treated as a one-off pilot but is embedded as a practical government capability that improves over time.

viii) **Establishing Prearranged Procurement Frameworks to Avoid Additional Costs.** Procurement costs often rise sharply once a disaster strikes. Sudden demand for food, fuel, medical supplies, shelter materials, transportation, and reconstruction services coincides with disrupted supply chains, limited supplier capacity, and intense time pressure. These conditions weaken competition and expose governments to scarcity premiums, expedited transportation charges, direct contracting, and poorer value for money. Emergency price increases are common because demand rises while supplies become scarce. Framework agreements, prequalified supplier rosters, agreed technical specifications, price ceilings, and ready-to-activate contracts allow governments to purchase rapidly without negotiating under conditions of scarcity. These arrangements can preserve competition, reduce emergency price premiums and costly air freight, and avoid delays that allow damage and public liabilities to escalate. Expanding framework agreements and streamlining supplier registration before emergencies are therefore recommended. Evidence on the pre-positioning of emergency stocks also indicates that placing supplies near potential crisis areas can reduce both response times and costs. Standard operating procedures should include beneficiary criteria, procurement arrangements, supplier rosters, transfer values, local delivery partners, and contingency options for disruptions to access or communications.

ix) **Accelerating Nationally Led Pre-Disaster Systems Through External Financing.** Over time, governments should increase domestic cofinancing and integrate recurrent costs into regular budgets. In the short and medium term, development partners, including multilateral development banks (MDBs), could finance system development, technical assistance, forecasting infrastructure, and independent evaluations. Regional organizations and multilateral institutions can support shared forecasting, risk pools, common standards, cross-country learning, and financing for shocks that exceed national capacity, provided these arrangements reinforce government-led systems rather than create parallel ones. MDBs are also well positioned to help governments strengthen their disaster resilience capacity by supporting long-term investments in risk reduction, resilient infrastructure, contingent credit, and post-disaster response for residual, unforecastable, or catastrophic risks.

x) **Strengthening MDB Leadership in Shifting the System from Disaster**

Response to Disaster Readiness. MDBs can support governments in implementing the shifts outlined above. They could also complement existing post-disaster facilities by making resources available once an objective forecast trigger is met but before a hazard reaches its peak impact. These instruments could include dedicated anticipatory financing windows within contingent credit lines and forecast-based drawdown options that could catalyze domestic financing. Eligibility could require pre-agreed triggers, costed action plans, clearly assigned implementation responsibilities, and established procurement and delivery arrangements. Disbursement should be automatic or expedited once the contractual trigger is verified, enabling targeted measures such as early cash transfers, protection of public assets, pre-positioning of essential supplies, and continuity of critical services. MDBs could also help countries assess performance in terms of both humanitarian outcomes and measurable fiscal savings, including avoided emergency spending, lower crisis procurement costs, and reduced reliance on disruptive budget reallocations or costly borrowing.

1 Introduction

Latin American and Caribbean governments spend billions of dollars each year responding to climate-related disasters after they occur. The fiscal impact of a disaster reflects the changes in government expenditure and revenue it triggers: governments are often expected, and sometimes legally obligated, to finance the response. These obligations constitute contingent fiscal liabilities in their own right. Emergency relief, reconstruction, and transfer payments come too late to prevent asset destruction, are disbursed under crisis conditions that inflate procurement costs by 30–50 percent (OECD 2019), and generate debt-service obligations that compound the fiscal burden for years (Clarke and Dercon 2016). Global evidence indicates that disasters lead to a 1–2 percent decline in GDP growth. Public debt service rises by 2.5 percentage points of GDP, growth slows, tax revenue falls, and spending increases—effects that extend beyond direct damage (Duenwald et al. 2022; Nishizawa et al. 2019; Wiyanti and Halimatussadiah 2021). The question is whether governments can reduce this burden by acting before disasters strike, as well as afterward.

Anticipatory action (AA) complements post-disaster response by establishing a pre-crisis financing and action mechanism. Under an AA framework, financing is prearranged and released automatically when a forecast-based trigger—a measurable signal, such as a water level crossing a specified threshold before a flood—indicates that a disaster is likely. The released funds enable protective measures before the disaster strikes: cash transfers that allow households to protect livestock and stored grain, pre-positioning of emergency supplies at non-crisis prices, and early-warning systems that trigger evacuations. The fiscal proposition is straightforward: if early action reduces the damage a government must subsequently repair, the avoided expenditure constitutes a fiscal saving. Whether the expected savings outweigh the costs of maintaining the forecasting system and absorbing false alarms—instances when the trigger is activated but no disaster materializes—is the question this report addresses. Existing evidence establishes that AA improves household welfare: food security scores are 3–28 percent higher among recipients of anticipatory cash transfers than among control groups receiving post-shock assistance (Pople et al. 2024, 2025; Balana et al. 2023). Program-level benefit-cost ratios range from 1.2 in Lesotho to 7.0 in Nepal (de Brauw 2025; WFP 2020). These studies measure welfare returns on program spending. They do not measure fiscal savings to government budgets because only a fraction of the reduction in household-level damage translates into lower government expenditure. A household that retains its livestock through a drought experiences a welfare gain; the government's fiscal savings depend on whether it would otherwise have compensated that household and at what cost. Translating welfare gains into avoided public expenditure—and identifying the conditions under which those savings exceed program costs—is the gap this report seeks to fill. The Centre for Disaster Protection has examined this question, developing frameworks for policymakers to assess vulnerabilities, contingent liabilities, and fiscal risks (Weingärtner 2021; Weingärtner and Wilkinson 2019). This report contributes to that body of work.

We develop a model that captures the optimal AA design from the perspective of a social planner. For the empirical analysis presented in this report, we distill this model into a simplified expression of expected government savings from AA as a function of four parameters:

$$\Delta F = \alpha \cdot \delta \cdot p \cdot G_0$$

In other words, expected fiscal savings equal the probability that a disaster occurs (p), multiplied by the probability that the forecast correctly triggers early action (α, the "hit rate," or, in statistical terms, sensitivity), multiplied by the share of government emergency expenditure avoided through early action (δ), multiplied by the government's baseline fiscal expenditure per disaster event (G_0). We convert these annual savings into a 10-year net present value (NPV)—the total savings expressed in today's dollars—using a 5 percent discount rate and compare them with the present value of program costs to calculate a benefit-cost ratio (BCR): the amount of fiscal savings generated per dollar of program costs. The preferred specification accounts for the additional costs governments incur when financing emergency expenditure under crisis conditions, estimated at US$0.40 per dollar reallocated (Allan and Bayley 2023). We also report a direct-cost specification (without the financing-friction adjustment) as a conservative sensitivity check. We calibrate the model across 11 country-hazard AA frameworks in four Latin American and Caribbean (LAC) subregions: Central America (droughts, floods, and storms), the Andes (floods), the Caribbean (storms), and the Southern Cone (droughts).

Data scarcity means that many of the parameters used in this report are based on assumptions rather than direct estimates. The fiscal effectiveness of AA, denoted δ, is the least well-identified parameter in the model. We set δ at a central value of 0.20, meaning that early action reduces government emergency expenditure by 20 percent in years when the forecast correctly triggers. This is below the 30 percent welfare effectiveness reported in the evaluation literature, reflecting the difference between household welfare gains and avoided government expenditure. We also report results using a conservative value of 0.10 and an optimistic value of 0.30.

Drought frameworks appear to have better data coverage in the dataset we compiled. The Honduras drought framework has the most complete country-specific data for all central parameters and yields a BCR of 1.69 when AA is assumed to reduce government emergency expenditure by 20 percent under the preferred specification, which includes financing frictions. In other words, the framework generates US$1.69 in fiscal savings for every US$1 of program costs. The direct-cost specification (λ = 0, where λ denotes the fiscal friction rate, or the additional cost governments incur when financing emergency expenditure under crisis conditions) produces a BCR of 1.21. At the conservative δ = 0.10, the BCR including financing frictions falls to 0.84, meaning that AA does not cover its costs under the most pessimistic assumption. At δ = 0.30, the BCR reaches 2.53. The break-even threshold (the minimum δ at which fiscal savings equal program

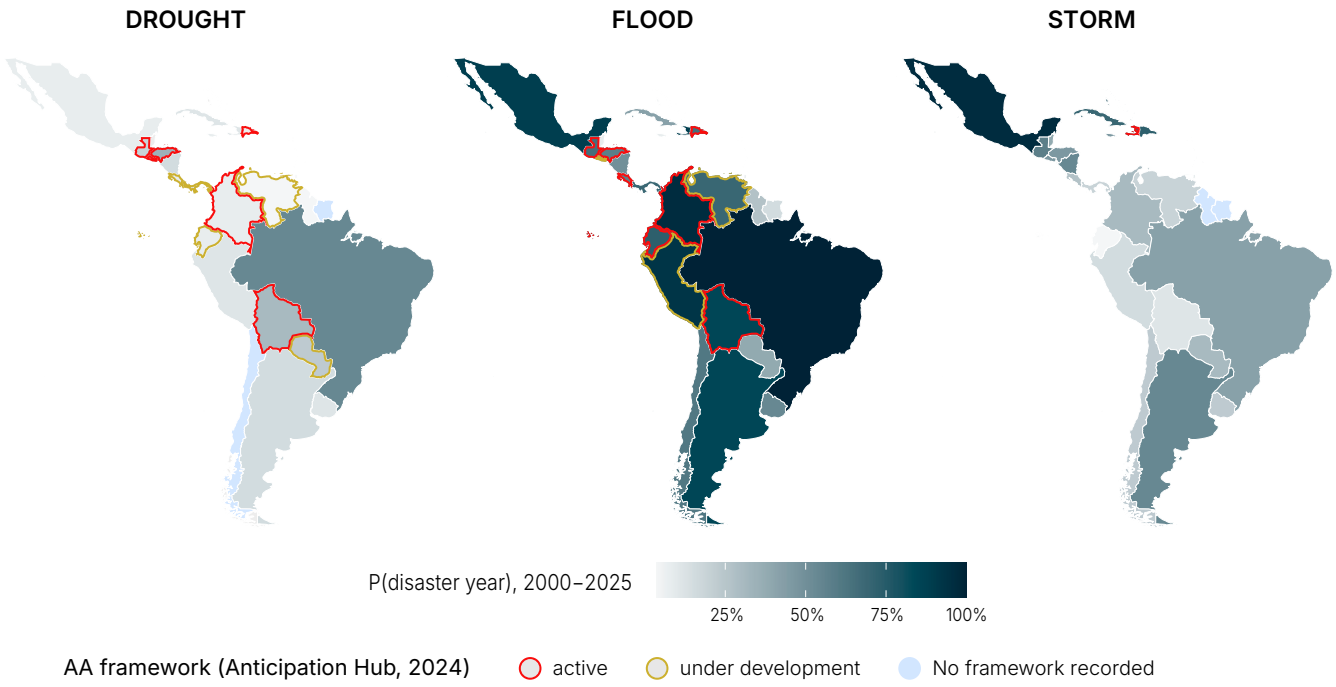
costs) is 0.119, or approximately 12 percent. The framework pays for itself if it reduces government emergency expenditure by at least 12 percent in correctly triggered disaster years.

The Guatemala drought framework (BCR = 0.78) and El Salvador drought framework (BCR = 0.93) approach break-even under the preferred specification. Under the conservative direct-cost specification ($\lambda = 0$), these BCRs fall to 0.56 and 0.67, respectively. Other country-hazard combinations—such as floods in the Andes and droughts in Brazil—generate positive gross savings under all assumptions but lack the program cost data needed to calculate BCRs. This report contributes a transparent, reproducible framework for evaluating the fiscal case for AA. The model, data, and code are published in an open-access repository. The framework identifies the conditions under which AA pays for itself and the data investments—particularly event-level fiscal tracking and country-specific trigger back-tests—needed to evaluate those conditions with greater precision.

The estimates are only as robust as the underlying data, which vary considerably across cases. Of the 11 country-hazard frameworks, one (Honduras drought) has country-specific observations for all central parameters; four others have country-specific forecast hit rates but rely on pooled fiscal exposure proxies; and the remaining six have fiscal exposure data but no trigger back-tests. These constraints are themselves a finding: the same gaps that limit estimation precision also identify where investments in data infrastructure would most improve the credibility of fiscal calculations for AA. Section 5 documents the sources of the parameters using a three-tier system—country-specific, pooled or literature-based, and missing or assumed—so that readers can assess the evidentiary basis for each case.

Section 2 develops the fiscal case for AA. Section 3 states the project objectives. Section 4 presents the model. Section 5 describes data sources and quality. Section 6 reports diagnostic tests. Section 7 presents results by region and disaster type. Section 8 examines the Honduras drought framework in detail. Section 9 draws policy lessons, including on the data gaps that constrain confidence in the estimates. Section 10 concludes. Appendix A presents the full decision model and its reduction to the calibrated identity.

FIGURE 1 Disaster Exposure and AA Coverage in LAC



Sources: EM-DAT; Anticipation Hub.

Note: Fill shows own-country disaster-year frequency, P(disaster year), 2000–2025. Outline shows framework status recorded by the Anticipation Hub (2024): active, under development, or no framework recorded. Framework status is what the registry records; absence of a record is not proof that no framework exists.

2 Motivation

2.1 How Disasters Affect Government Spending

Disasters impose fiscal costs through multiple channels that differ in timing, magnitude, and visibility. The fiscal burden varies by hazard type, and understanding the composition of these costs is necessary to identify which channels anticipatory action (AA) can mitigate.

Droughts generate fiscal costs primarily through losses in crop yields and livestock production, which create a need for agricultural support programs, food distribution, and water trucking to affected communities. In agriculture-dependent economies, drought-induced contractions in gross domestic product (GDP) reduce tax revenue, compounding the direct expenditure burden (Devereux 2007; Duenwald et al. 2022). Fuje et al. (2023) find that public debt as a percentage of GDP rises by approximately 2.5 percentage points in disaster years due to lower growth, reduced tax revenue, and higher spending (see Section 2.3, which simulates these effects on the debt-to-GDP ratio). Droughts in Honduras are associated with government fiscal exposure of G_0 = US$201.6 million per event, reflecting the scale of planned emergency budgets for agricultural crises.

Drought costs tend to be distributed across transfer programs and in-kind assistance rather than concentrated in infrastructure, making them more responsive to early intervention. AA can reduce the scale of these transfers by protecting household assets before they are destroyed; the fiscal effectiveness of AA (δ) is therefore likely to be highest for drought programs.

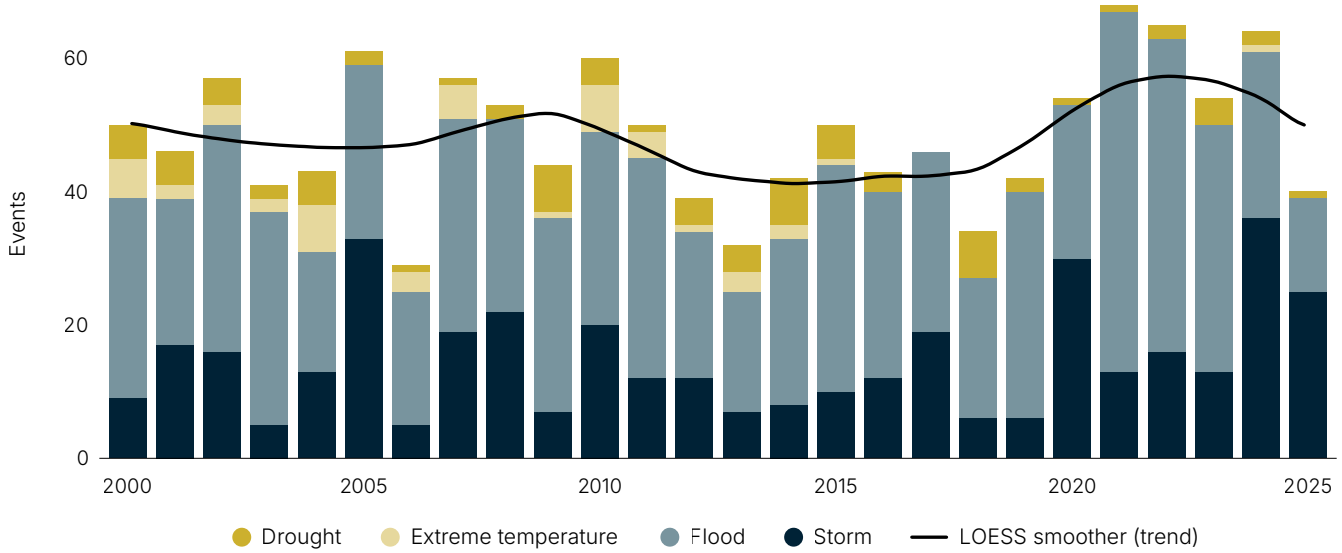
Floods impose fiscal costs through infrastructure destruction (roads, bridges, and health facilities) requiring capital replacement, as well as emergency shelter, debris clearance, and displacement management (Allaire 2018; Rentschler et al. 2022). El Niño and La Niña weather phenomena also have significant effects on flood frequency and intensity, increasing the resulting damage. Infrastructure costs are substantial and largely unaffected by AA—a destroyed road must be replaced regardless of whether households received early warnings. Flood disasters in Guatemala, with G_0 = US$74.3 million per event (the median of two disaster events recorded in PostShock, an internal database on post-disaster government expenditure compiled from national budget records, multilateral donor reports, and post-disaster needs assessments), illustrate the scale of flood-related fiscal exposure in Central America. Fiscal savings from AA in flood contexts arise primarily from reduced emergency response costs and lower household asset losses that would otherwise require government transfer programs. Procurement costs also tend to be high during these periods, and governments have sought to reduce them by pre-positioning equipment before disasters. Because a large share of flood-related government expenditure goes toward infrastructure reconstruction that AA cannot prevent, the fiscal effectiveness of AA is likely lower for floods than for droughts.

Storms combine emergency response and reconstruction costs, with infrastructure damage accounting for most of the fiscal burden (Lingle et al. 2018; Nishizawa et al. 2019). Caribbean Small Island Developing States are particularly exposed: high disaster frequency, combined with limited fiscal buffers, means that storm-related costs consume a large share of government revenue. Storm-related fiscal exposure in our sample is lower per event than for droughts or floods (G_0 ranges from US$31.3 million for storms in Honduras to US$36 million for storms in Guatemala), but high recurrence rates generate substantial cumulative exposure. As with floods, the infrastructure-intensive composition of storm-related costs limits the share of government expenditure that AA can reduce. Protecting household assets reduces the scale of government transfer programs, but a destroyed school or road must be replaced regardless of whether early action was taken.

Indirect fiscal costs emerge with a lag and can exceed direct expenditure in cumulative terms. Economic activity contracts (Nishizawa et al. 2019); planned public investment is deferred or canceled to finance emergency spending (Bevan and Cook 2015); and debt-service obligations associated with emergency borrowing accumulate for years after the event. Fiscal buffer analysis in Pacific Island countries finds that disasters result, on average, in cumulative fiscal costs ranging from 13.8 to 20.6 percent of GDP over a three-year period, with spending increasing by approximately 6.4 percent of GDP in the initial year, followed by additional costs of 6.8–7.4 percent of GDP in subsequent years. To reduce this burden, governments should save 1.0–1.5 percent of GDP annually to build fiscal buffers (Nishizawa et al. 2019). The G_0 parameter in our model captures only direct government emergency expenditure, meaning that the total fiscal burden of disasters exceeds what we measure.

Financing frictions are greatest under the post-shock status quo. Unplanned emergency spending forces governments to use costly financing channels: borrowing on unfavorable terms, reallocating funds from planned programs (health, education, and infrastructure maintenance), or drawing down fiscal reserves. Allan and Bayley (2023) estimate that the opportunity cost of budget reallocations during the COVID-19 pandemic averaged 40 percent of the reallocated amount—that is, US$1 of emergency spending imposed a total fiscal burden of US$1.20–US$1.60, or US$1.40 on average, when forgone returns on displaced expenditure are taken into account. This 40 percent estimate applies specifically to the post-shock mobilization of resources. Ramey and Shapiro (1998) model the costly reallocation of capital across sectors. AA shifts a portion of disaster financing from this high-friction channel to prearranged financing available before the crisis, potentially at a lower marginal cost. We represent this friction as a wedge (λ) applied to direct fiscal savings (Section 4.3).

FIGURE 2. **Disaster Occurrence in Latin America and the Caribbean, 2000–2025**



Source: EM-DAT.

Note: The trend illustrates the scale of recurring fiscal exposure that disaster risk financing instruments, such as reserves, contingent credit, and anticipatory action (AA), are designed to address.

2.2 How AA Reduces Government Spending

AA can reduce government post-disaster expenditure through several mechanisms, each operating at a different point in the disaster timeline and affecting different components of fiscal exposure.

Pre-positioned supplies and financing reduce procurement and reallocation costs. Emergency procurement under crisis conditions is expensive: unit costs for tents, food rations, and water purification equipment are 30–50 percent higher when purchased on an emergency basis than through prenegotiated framework agreements (OECD 2019). AA enables procurement before a crisis, at non-crisis prices. More broadly, AA pre-positions financing so that governments do not have to mobilize resources urgently under crisis conditions. In the absence of AA, the government faces the full range of post-shock financing frictions: emergency borrowing, budget reallocations, and reserve drawdowns. With AA, spending in triggered disaster years is partially prefinanced at a lower marginal cost. Allan and Bayley (2023) document the costs of mobilizing resources after a shock; AA avoids a portion of these costs by design. Section 4.3 quantifies this mechanism through a fiscal friction wedge (λ) applied to direct fiscal savings. This mechanism operates across all hazard types and reduces the per-unit cost of government response, independently of damage reduction.

Early cash transfers protect productive assets. Households that receive anticipatory cash transfers can protect productive assets—livestock, stored grain, and agricultural tools—that would otherwise be destroyed or sold at distress prices during a disaster (Pople et al. 2025; Mogge et al. 2025; Christian et al. 2025; Balana et al. 2023; Gros et al. 2019). The fiscal implications depend on asset type and hazard context. Livestock losses during droughts trigger government restocking programs or extended food assistance, while the destruction of tools and seeds increases future dependence on government agricultural support. Evidence from anticipatory cash transfer programs in Bangladesh, Ethiopia, and Mozambique indicates that treated households retain an additional 0.2–0.4 head of livestock per household and are 15–25 percentage points less likely to sell productive assets than control groups receiving post-shock assistance (Pople et al. 2025; Mogge et al. 2025). Government expenditure on reconstruction and ongoing transfers is lower when fewer productive assets need to be replaced.

Early warnings enable evacuations. Forecast-triggered evacuations before floods or storms reduce casualties and the immediate emergency response burden. Search-and-rescue operations, emergency medical care, and temporary shelter provision are all less costly when populations have moved to safety before a disaster occurs (Jagnani and Pande 2024). This mechanism is particularly relevant for floods and storms, where rapid-onset events create the greatest differences in response costs between populations that receive advance warnings and those that do not.

Translating social benefits into fiscal savings. Micro-level evidence measures welfare returns through indicators such as food security scores, asset indices, and coping strategy indices. Only a fraction of these welfare gains translates into reduced government expenditure. Three factors explain the difference between welfare effectiveness ($\delta_{welfare}$) and fiscal effectiveness (δ): incomplete coverage of government programs, shifts toward expenditure categories that AA does not affect (infrastructure and debt service), and measurement gaps between welfare outcomes and fiscal accounts. Section 4.4 develops this argument and calibrates the corresponding distributional assumption.

2.3 The Relationship Between Disaster Response and Debt-to-GDP Ratios

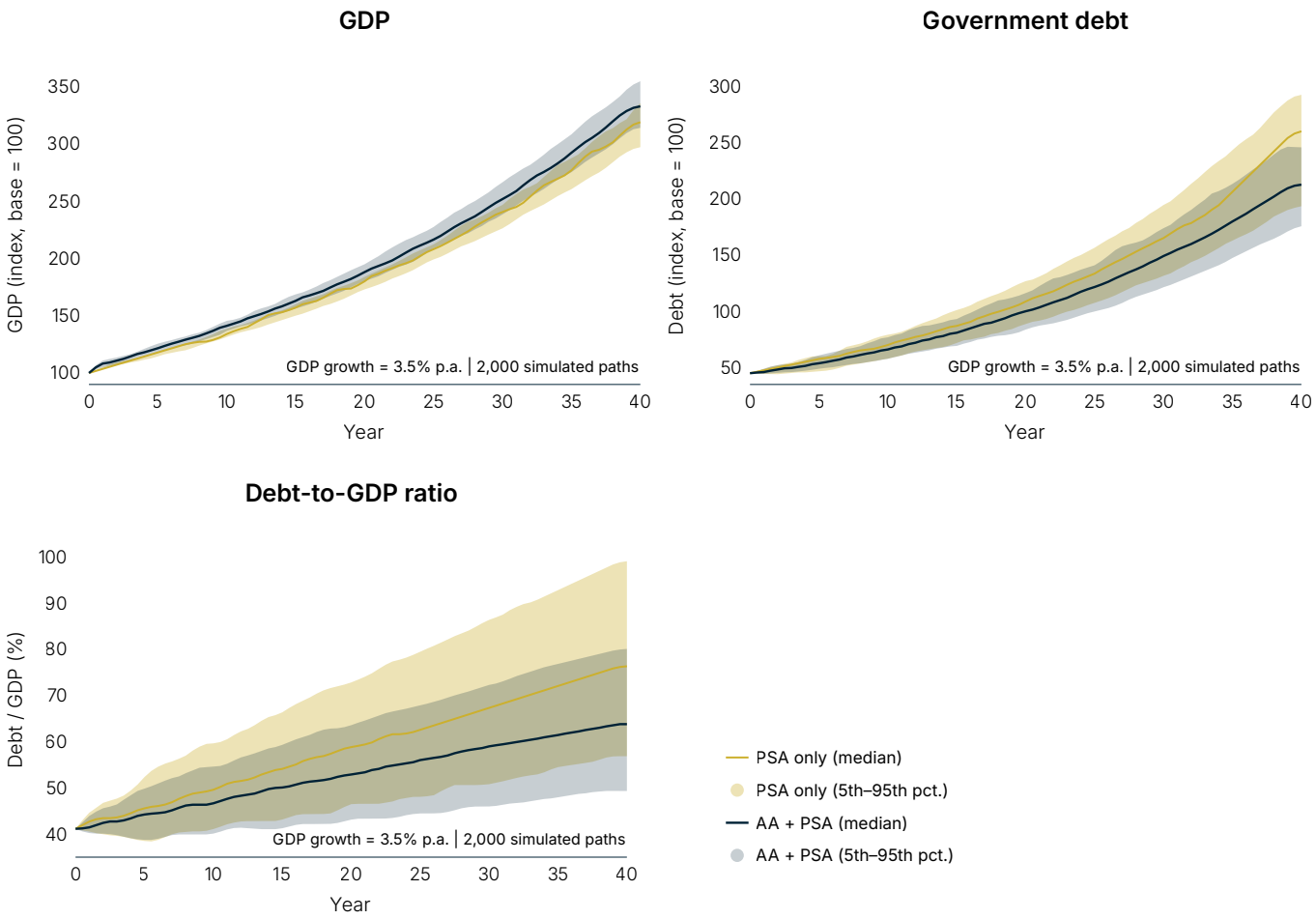
Disasters do not merely impose one-time fiscal costs; they alter the trajectory of public debt. Cross-country evidence from emerging markets and developing economies (EMDEs) documents a contemporaneous decline in output growth of approximately 1.4 percentage points following a major disaster (Fuje et al. 2023; Milivojević 2023). This finding is further supported by Fan et al. (2023), whose model shows that public debt grows by 2.3–3.6 percentage points per year more than in non-disaster control cases for approximately three years after the event. Severe individual

events can produce larger shifts—simulation exercises calibrated to the 2020 Zagreb earthquake suggest an increase in the debt-to-GDP ratio of approximately 20 percentage points (Draganić et al. 2025). These debt increases arise through three channels: direct emergency expenditure financed by borrowing; revenue losses as GDP contracts and the tax base shrinks (Fuje et al. 2023; Delgado et al. 2021; Bello 2017); and rising debt-service costs as sovereign yields increase after disasters. Regarding the third channel, Anyfantaki et al. (2025) find that storms raise 10-year sovereign bond yields by approximately 140 basis points for highly indebted emerging-market borrowers over a two-year horizon—a cost-of-capital penalty that compounds the original fiscal shock.

Earlier studies establish that disasters reduce output in developing countries by 0.6–1.0 percent of GDP in the short run (Noy 2009; Raddatz 2009), with effects varying by disaster type and sector (Loayza et al. 2012). Post-disaster government expenditure in EMDEs is insufficient to offset output losses, unlike in advanced economies (Nguyen et al. 2025). The combination of rising debt and falling output creates an upward ratchet effect on the debt-to-GDP ratio: each disaster produces a persistent increase in the ratio, and repeated disasters generate cumulative divergence from the pre-disaster trajectory.

AA affects both the numerator and the denominator of the ratio. On the numerator side, AA reduces the magnitude of each spike in emergency borrowing and, by mitigating the fiscal shock, lowers the post-disaster sovereign yield premium that increases debt-servicing costs. On the denominator side, AA mitigates the contraction in GDP. Figure 3 presents a 40-year simulation calibrated to droughts in Honduras, with each parameter drawn from an estimate already used elsewhere in this report rather than selected solely for illustrative purposes (see Box 1 for more detail). The annual disaster probability is based on the Honduras drought parameter $p = 0.346$ (Section 4.6); the output shock is −1.5 percent, the midpoint of the 1–2 percent range reported by Duenwald et al. (2022); the disaster-year increase in public debt is 2.5 percent of GDP, following Fuje et al. (2023); the post-disaster yield premium of 140 basis points for three years is an assumption, motivated by evidence that disasters raise borrowing costs in highly indebted economies (Anyfantaki et al. 2025); the AA effectiveness parameter is the report's central assumption of $\delta = 0.20$; and the annual program cost is Honduras's observed US$8.0 million, expressed as a share of GDP, equivalent to 0.02 percent. The starting debt-to-GDP ratio is 41.1 percent, based on the International Monetary Fund (IMF) general government debt as a percentage of GDP for Honduras (IMF 2026b). Disasters are simulated as annual Bernoulli events rather than imposed on a fixed schedule, and the simulation is run across 2,000 paths. The figures therefore report the median trajectory together with the 5th–95th percentile range across simulated paths.

FIGURE 3. Simulation of GDP, Government Debt, and Debt-to-GDP Ratio Under Disaster Scenarios



Note: Honduras drought parameters: annual disaster probability p = 0.346 (Bernoulli draws, 2,000 simulated paths); GDP shock of −1.5 percent (Duenwald et al. 2022); debt increase of 2.5 percent of GDP (Fuje et al. 2023); δ = 0.20; AA cost of 0.02 percent of GDP (Honduras E_{cost}/GDP); post-disaster yield premium of 140 basis points for three years (see Box 1); starting debt-to-GDP ratio of 41.14 percent (IMF 2026b). PSA = post-shock assistance; AA = anticipatory action. Shaded bands show the 5th–95th percentile range across simulations.

Each disaster-year GDP contraction is smaller under AA, and compounding from a higher base produces a widening divergence over time, although the effect on the output trajectory is modest. By year 40, the median AA trajectory is approximately 4.4 percent above the median trajectory under post-shock assistance (PSA) alone in this simulation, a relatively small difference because the underlying output shock estimated in the cross-country literature is itself small. Thus, the fiscal divergence reported below is driven primarily by debt rather than output.

The debt trajectories illustrate the trade-off at the core of anticipatory financing (Figure 3). The AA scenario incurs a steady annual cost, but at 0.02 percent of GDP, that cost is negligible relative to disaster exposure. In exchange, AA reduces disaster-year debt spikes and attenuates the post-disaster interest rate premium. The PSA-only scenario avoids the annual cost but absorbs the full increase in debt and the higher debt-servicing costs, producing a steeper debt trajectory over repeated disaster cycles.

The debt-to-GDP ratio captures both effects (Figure 3). By year 40, the median PSA-only trajectory reaches 75.8 percent of GDP, compared with 63.5 percent under AA—a difference of 12.3 percentage points. The dispersion is wide, and the two ranges overlap substantially: the PSA-only 5th–95th percentile range spans 55.8–99.3 percent, while the AA range spans 48.9–80.3 percent. We therefore interpret the result as distributional rather than deterministic. AA shifts the distribution of fiscal outcomes downward, but it does not guarantee a lower debt ratio in any particular simulation path because a country that experiences few disasters performs well under either scenario. Moreover, the difference between the two scenarios is most pronounced in the upper tail of the distribution, where the PSA-only debt-to-GDP ratio approaches 100 percent at the 95th percentile, compared with approximately 80 percent under AA. Thus, the value of AA in this simulation lies not only in lowering the median but also in limiting the severity of adverse outcomes, particularly where financing constraints are most likely to become binding.

BOX 1

ASSUMPTIONS AND ESTIMATION OF DEBT-TO-GDP RATIO TRAJECTORIES

The report uses a reduced-form debt trajectory based on the IMF's Debt, Investment, Growth, and Natural Disasters (DIGNAD) model, in which pre-disaster investment reduces the effects of a disaster on output and public debt. In this stylized exercise, the ex ante investment takes the form of an anticipatory action program, and the model is simplified to two equations. Output and the public debt stock evolve as follows:

$$Y_t = Y_{t-1}(1+g)(1-sD_t), \quad B_t = B_{t-1}(1+r+\varphi P_t) + kY_tD_t + cY_t$$

where Y_t is real GDP in year t, B_t is the stock of public debt, g is real GDP growth, s is the share of output lost in a drought year, D_t equals one in a drought year and zero otherwise, r is the debt-accumulation rate, φ is the yield premium following a drought, P_t equals one in the three years following a drought, k is the increase in debt in a drought year as a share of GDP, and c is the annual cost of the anticipatory action program as a share of GDP. The reported ratio is $d_t = B_t/Y_t$, with an initial value of d_0 = 41.1%. Droughts are drawn as $D_t \sim$ Bernoulli(p), with p = 0.346, once per year and shared by both scenarios.

The baseline assumptions underlying the no-shock trajectory are that real GDP grows at g = 3.5% per year, and the real debt-accumulation rate is r = 2.0% per year.

Because debt grows more slowly than GDP, the no-shock ratio declines from 41 percent to approximately 23 percent of GDP over 40 years, meaning that the increase in Figure 3 is driven entirely by the disaster terms. These include an output loss s = 0.015 (Duenwald et al. 2022), a debt increase k = 0.025 of GDP (Fuje et al. 2023), and a sovereign yield premium φ = 0.014 lasting three years. The yield premium is an assumption, motivated by evidence that disasters raise borrowing costs in highly indebted economies. Under anticipatory action, s, k, and φ are each multiplied by (1 – δ), with δ = 0.20, and the program premium c = 0.0002 of GDP is paid every year and charged to the government, as it would be under a government-funded framework. Two thousand drought sequences are drawn; Figure 3 reports the median and the 5th–95th percentile range under each scenario.

This is a first-stage specification, and its simplifications may overstate the effect of anticipatory action. In particular, the primary balance is incorporated through the debt-accumulation rate, expressed as a share of the debt stock rather than as a share of GDP, which explains why the no-shock ratio declines. The specification also works in real terms throughout, with r representing an implicit real rate rather than a nominal interest rate adjusted for inflation, and it does not distinguish between the debt refinanced each year and the total debt stock.

Using the identity $d_t = d_{t-1}(1 + i)/[(1 + g)(1 + \pi)] - pb_t$, where i is the nominal effective interest rate, π is inflation, and pb is the primary surplus as a share of GDP, calibrated to Honduras and with δ applied only in triggered years, would result in a narrower gap between the scenarios. The first-stage specification establishes the direction and pattern of the effect. Borrowing incurred in one drought year remains outstanding when the next drought occurs, so the difference between the two scenarios accumulates over time and is greatest when droughts occur in clusters.

2.4 Uncertainty Deters Government Commitment

A finance ministry that funds an AA framework from its own contingency budget answers publicly for every activation. When the trigger fires, the prearranged funds are disbursed for early action whether or not the disaster then occurs, so in a false-alarm year the government has paid for transfers and supplies against a shock that did not arrive. That expenditure is recorded in the budget, audited, and open to criticism. When the trigger fires correctly, the benefit is damage that did not occur. Avoided losses are counterfactual, spread across many households, and difficult to attribute to a single intervention. Political incentives therefore favor reactive spending: post-shock response may cost more per dollar of loss avoided, but its costs become visible at the same time as the need it addresses. Under the donor-funded frameworks currently operating in LAC, false-alarm costs fall on donors (Section 4.1); the asymmetry binds once governments take on the financing.

This asymmetry interacts with the limitations of the existing evidence base. Program-level evaluations report cost-effectiveness ratios for individual frameworks but do not translate household welfare gains into avoided public expenditure, and the cases studied typically involve correctly triggered activations (de Brauw 2025; Pople et al. 2025). A ministry of finance asked to commit budgetary resources to AA therefore faces an evidence base that is informative about welfare returns under successful activation but provides little information about the unconditional fiscal return, which accounts for false alarms and missed disasters. Producing fiscal estimates expressed in budgetary terms, with the data quality of each input made explicit, would strengthen the case for moving AA from a humanitarian instrument to a finance-ministry tool.

Alongside stronger data and forecasting systems, effective anticipatory action requires a robust institutional and operational framework capable of converting early warnings into the timely disbursement of funds. Wherever possible, financing should be channeled through established national systems—such as existing social protection and cash transfer mechanisms—to enable rapid, accountable, and scalable support. This framework should define objective, pre-agreed

activation triggers, eligible expenditures, spending limits, implementation responsibilities, and reporting requirements. It should also include clear reconciliation and reimbursement provisions so that any unspent or recoverable funds can be returned to the original financing source when a trigger proves to be a false positive (Box 2).

BOX 2

CASE STUDY: MOZAMBIQUE—ACTIVATION WITHOUT HEAVY CYCLONE LANDFALL

In early February 2026, forecasts indicated that Cyclone Gezani, after crossing Madagascar and causing significant damage, would regain strength and make landfall in southern Mozambique. The government estimated that more than a million people could be affected. On February 9, the OCHA-facilitated anticipatory action framework for cyclones was activated based on these forecasts. Under the framework, five UN agencies had approximately US$6 million available (US$4.5 million in prearranged financing through the Central Emergency Response Fund [CERF] and more than US$1 million in cofinancing from partners) to help more than 300,000 people prepare for the shock.

Despite the trigger thresholds being crossed, Cyclone Gezani instead turned and passed offshore. Its impact in Mozambique remained far below projections. Most planned food, kits, and services were linked to government-designated accommodation centers. Accommodation centers were opened late in the anticipatory action window, and because the cyclone did not make landfall, few people used them.

Approximately 87 percent of the CERF prearranged funding remained unspent and was returned at the end of the cyclone season. These funds could be returned because CERF's financing arrangements explicitly provide for this possibility. CERF's letters of understanding with recipient agencies require them to return unspent grant balances. For anticipatory action, CERF also specifies this requirement in its approval letters. If only a readiness trigger is reached, agencies may use only the funding allocated to readiness activities. If the action trigger is not reached, the funds allocated to action activities, along with any unspent readiness funding, "must be reimbursed to CERF as soon as possible."

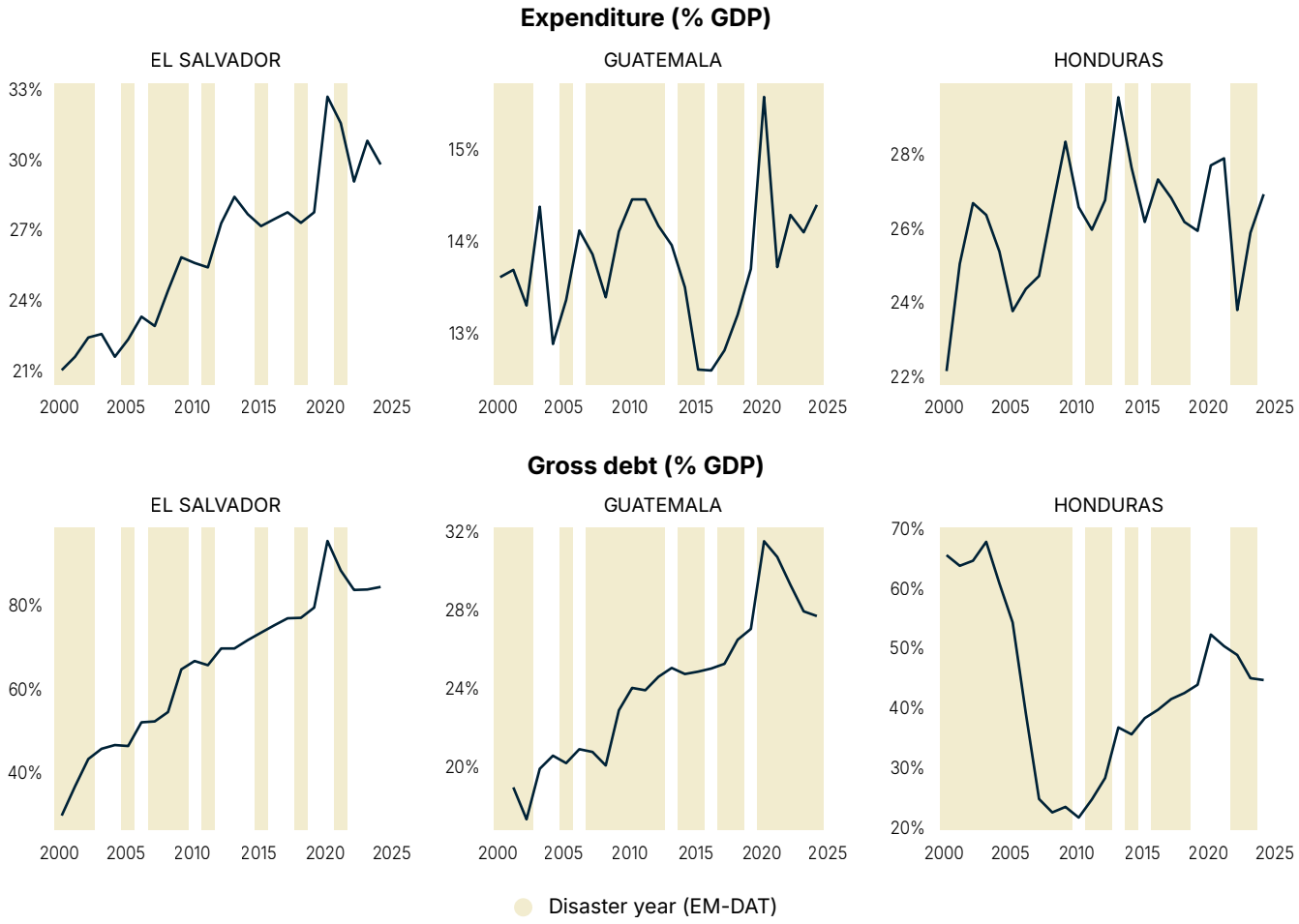
The lesson is that activating a trigger without the forecast hazard materializing does not necessarily require spending the entire prearranged funding envelope. Two-stage triggers, defined spending limits, and pre-agreed reimbursement clauses helped contain costs in this case and could serve a similar purpose in sovereign-level anticipatory financing instruments.

2.5 Anticipatory Action Alongside Traditional Reactive Responses

AA does not replace post-disaster response; it reduces the scale and cost of the response that remains necessary. Infrastructure repairs, search-and-rescue operations, and reconstruction of public facilities require post-event action regardless of whether anticipatory measures were implemented. A government that pre-positions emergency supplies, distributes anticipatory cash transfers, and initiates early evacuations still faces post-disaster expenditure—but at a lower level and under less fiscal pressure because the most time-sensitive and costly procurement components of the response have already been addressed.

The portfolio approach follows from the structure of disaster costs described in Section 2.1. Droughts impose costs primarily through transfer programs and agricultural support—areas where anticipatory cash transfers and early warnings are most effective. Floods and storms impose costs primarily through infrastructure destruction—an area where post-event reconstruction is unavoidable. A government that deploys AA where forecast certainty is highest (slow-onset droughts with lead times of weeks to months) preserves fiscal space for reactive responses where they are most needed (rapid-onset events causing infrastructure damage). The simulation in Section 2.3 labels its scenarios “PSA only” and “AA + PSA” precisely because both include post-shock assistance; the question is whether anticipatory action complements it.

FIGURE 4. Fiscal Pressure in Disaster Years for Selected LAC Economies



Sources: IMF Fiscal Monitor; EM-DAT.

The two instruments are structurally complementary. Each dollar of anticipatory spending reduces the marginal cost of post-disaster response by mitigating the fiscal shock, lowering post-disaster sovereign yield premiums (Anyfantaki et al. 2025), and shifting a portion of emergency financing from high-friction reactive channels to prearranged disbursements at non-crisis prices (Allan and Bayley 2023). Framing AA as a substitute for post-disaster response mischaracterizes the fiscal mechanism. The fiscal case for AA rests not on eliminating reactive spending but on reducing its volume and unit cost so that total government disaster expenditure—anticipatory and reactive combined—is lower than expenditure under a reactive-only approach.

3 Project Objectives

The project pursues three interrelated objectives.

3.1 Compile a Parameter Dataset for LAC Anticipatory Action Frameworks

Assemble a dataset linking AA framework design parameters—trigger probabilities, activation costs, and forecast hit rates—to government fiscal exposure and welfare estimates from the evaluation literature. The dataset covers 33 LAC countries and three hazard types (droughts, floods, and storms) and draws on the Emergency Events Database (EM-DAT), maintained by the Centre for Research on the Epidemiology of Disasters (CRED) at UCLouvain (CRED 2025); the Anticipation Hub framework registry; the PostShock fiscal tracking database; and OCHA's evaluation literature. The source and quality of each parameter-country pair are documented.

3.2 Develop a Calibrated Fiscal Savings Model

Adapt the model developed by Anand (2023) to estimate fiscal savings through empirical calibration using available data. The resulting expected-value formula has four parameters, $\Delta F = \alpha \cdot \delta \cdot p \cdot G_0$, and is extended to a 10-year net present value (NPV) framework. The model is calibrated for 11 country-hazard pairs across four subregions, with Monte Carlo analysis.

3.3 Publish the Model, Code, and Data as a Public Good

The calibration will improve as better data become available. The model, data processing scripts, and case study inputs are published in an open-access repository so that users can update estimates as new data emerge.

4 The Fiscal Savings Model

4.1 Core Identity

The government faces recurring disaster risk. In any given year, a disaster of a given type occurs with probability p. When it occurs, the government spends G_0 on emergency response. Without AA:

$$E[\text{govt spend} \mid \text{no AA}] = p \cdot G_0$$

With an AA framework, there are four possible states in any given year, depending on whether a disaster occurs and whether the forecast trigger is activated. Let q denote the probability that the trigger is activated conditional on no disaster occurring (the false-alarm rate), and α the probability that the trigger is activated conditional on a disaster occurring (the hit rate):

STATE	PROBABILITY	GOVT EMERGENCY SPEND	INTERPRETATION
No disaster, trigger silent	(1 – p)(1 – q)	0	Normal year
No disaster, trigger fires	(1 – p)q	0	False alarm
Disaster, trigger fires	pα	$G_0(1 - \delta)$	AA reduces cost
Disaster, trigger silent	p(1 – α)	G_0	Full post-shock bill

In the current calibration, we assume that the government incurs no costs when the trigger is activated but no disaster occurs. This assumption is also consistent with existing donor-funded AA frameworks in LAC ($c_{\tau,govt} = 0$).[1] Taking the difference yields:

$$E[\text{govt spend} \mid \text{AA}] = p\alpha \cdot G_0(1 - \delta) + p(1 - \alpha) \cdot G_0 = p \cdot G_0 \cdot (1 - \alpha\delta)$$

$$\Delta F = \alpha \cdot \delta \cdot p \cdot G_0$$

This represents the expected annual fiscal savings. Two financing scenarios are considered:

- *Donor-funded scenario:* The government's net fiscal savings equal ΔF, with no direct program costs borne by the government.
- *Long-run (government-funded) scenario:* Net fiscal savings equal $\Delta F - E_{cost}$, with the benefit-cost ratio (BCR) calculated as $\Delta F/E_{cost}$.

1. Note that q has dropped out. The false-alarm rate governs how often the framework activates without a disaster, but under $c_{\tau,govt} = 0$ those activations cost the government nothing, so they leave the fiscal saving unchanged. The false-alarm rate is a cost to the donor here, not to the government. A framework that fires twice as often on non-disaster years is twice as expensive to fund and no less valuable to the finance ministry. This is why q appears in the state table above but in none of the results that follow: we have an asymmetry of ledgers. The quantity that disciplines trigger design sits on the donor's books, not the government's. Under a government-funded framework, the q term returns, and trigger specificity becomes a fiscal question rather than a financing one.

4.2 NPV Extension

Government budgets are planned over multiyear horizons, and a single year of savings understates the cumulative fiscal case for AA. Moreover, disaster-related fiscal pressures extend into subsequent years: Nishizawa et al. (2019) find that subsequent costs reach 6.8–7.4 percent of GDP in the years following the initial shock. To capture the long-term value of AA, we use a simple net present value (NPV) specification with a 10-year horizon and a 5 percent discount rate (ρ). The theory of change underlying this extension is that AA frameworks involve upfront setup costs (trigger development, institutional arrangements, and supply pre-positioning) and recurring program costs, which are amortized against recurring expected savings over the framework's operational life. Assuming that annual expected savings and costs remain constant over time, the annuity factor is:

$$\mathrm{AF} = \frac{1-(1+\rho)^{-T}}{\rho} = \frac{1-(1.05)^{-10}}{0.05} \approx 7.722$$

The 10-year NPV of expected fiscal savings is NPV(ΔF) = ΔF · AF. Similarly, the NPV of program costs is NPV(E_{cost}) = E_{cost} · AF. The NPV converts recurring annual savings into a present-value lump sum that is directly comparable to the present value of program costs.

4.3 Fiscal Friction Wedge

Unplanned post-disaster spending is costlier per dollar than planned spending. Governments responding to disasters without prearranged financing must borrow on unfavorable terms, reallocate funds from health and education programs (forgoing the returns those programs would otherwise have generated), or draw down fiscal reserves that serve a precautionary function. Allan and Bayley (2023) estimate that the opportunity cost of budget reallocations during the COVID-19 pandemic averaged 40 percent of the reallocated amount. Evidence from OCHA's 2020 anticipatory action pilot in Bangladesh supports a comparable magnitude of cost savings through a different mechanism: pre-crisis procurement enabled assistance to be delivered at US$13 per person, compared with US$26 per person under a reactive response—a 50 percent cost reduction associated with the ability to procure supplies at non-crisis prices (OCHA 2021). The direct-cost specification (λ = 0) assumes that post-disaster spending costs the government its face value, excluding these documented financing frictions. The specification that includes financing frictions is the more realistic baseline; the direct-cost specification provides a conservative lower bound.

The preferred specification adjusts direct fiscal savings by the friction rate:

$$\Delta F_{\lambda} = \Delta F_{\mathrm{direct}} \cdot (1+\lambda)$$

where λ = 0.40 is the central value. This specification assumes that AA avoids financing frictions in proportion to the damage it reduces: each dollar of avoided emergency expenditure also avoids the US$0.40 opportunity cost of financing that expenditure under crisis conditions. The direct-cost specification (λ = 0) is reported as a conservative sensitivity check, assuming that emergency spending costs the government its face value.

The 40 percent estimate is drawn from the fiscal responses to the COVID-19 pandemic in four countries, none of which are in Latin America, and from a crisis that was not a natural disaster. Although this may appear to be a limitation, the relevant finding from the literature concerns a mechanism rather than a specific context. Allan and Bayley (2023) measure the opportunity cost of rapidly and unexpectedly reallocating funds from planned programs, a mechanism determined by the suddenness and scale of the reallocation rather than by the event that triggers it. A pandemic and a hurricane are therefore different events that can require the same budgetary response, making the estimate potentially transferable despite its original context. The estimate would be less transferable if the relevant mechanism were epidemiological, but the mechanism considered here involves a ministry of finance reallocating funds it had not planned to move. In addition, evidence from disaster contexts supports a comparable magnitude of additional costs, although through a related but distinct mechanism. The OECD (2019) reports emergency procurement unit costs 30–50 percent higher than those under prenegotiated agreements, while OCHA's Bangladesh pilot delivered anticipatory flood assistance at US$13 per person, compared with US$26 per person under a reactive response (OCHA 2021). These estimates measure procurement premiums rather than the opportunity cost of budget reallocations, so we do not treat them as independent measurements of the same parameter. Nevertheless, they demonstrate that additional costs of a comparable magnitude arise under crisis conditions in disaster contexts, suggesting that applying a 40 percent financing-friction adjustment is plausible. Moreover, cases such as the Honduras drought framework break even without the financing-friction adjustment, yielding a benefit-cost ratio of 1.21 at λ = 0 and 1.33 at the low λ = 0.10, while the central friction adjustment increases the ratio from 1.21 to 1.69.

4.4 Delta Reinterpretation: Fiscal vs. Social Effectiveness

The OCHA evaluation literature reports welfare returns to AA with δ ≈ 0.30, measured through food consumption scores, asset indices, and dietary diversity (Pople et al. 2024, 2025; Balana et al. 2023; Mogge et al. 2025; Gros et al. 2019). The δ relevant to this fiscal model represents the proportional reduction in government emergency expenditure, not the proportional improvement in household welfare.

The two are related but not equivalent. A household that maintains food security through anticipatory cash transfers experiences a welfare gain, but the government's fiscal savings depend on whether, in the absence of AA, the government would have compensated that household for its consumption loss—and at what cost. Three factors explain the difference between welfare effectiveness ($\delta_{welfare}$) and fiscal effectiveness (δ):

1. *Coverage gap:* Government post-disaster programs do not reach all affected households. Welfare gains among households not covered by government programs do not generate fiscal savings.
2. *Substitution:* Some post-disaster government expenditure goes toward infrastructure reconstruction, debt service, and administrative costs that AA does not directly reduce.
3. *Measurement:* Welfare evaluations measure food security and asset protection, whereas the corresponding fiscal outcomes involve avoided procurement, logistics, and transfer costs, which are not measured directly.

Estimating fiscal δ directly would require tracking government expenditure before and after AA activation at the event level—data that are not yet available. We therefore adopt a distributional assumption:

$$\delta \sim \text{Triangular}(0.10, 0.20, 0.30)$$

where 0.10 represents a pessimistic scenario (AA reduces government expenditure by 10 percent in triggered disaster years), 0.20 is the central estimate, and 0.30 represents an optimistic scenario that assumes a strong transmission of household welfare gains into fiscal savings.

A note on the upper bound: at $\delta = 0.30$, the fiscal effectiveness parameter approaches the welfare effectiveness reported in the evaluation literature. This implies that the three sources of divergence (coverage gaps, substitution, and measurement differences) are collectively small—an assumption that is more plausible for well-targeted drought programs, where government spending is concentrated in transfer programs that AA directly reduces, than for infrastructure-intensive storm or flood responses, where a large share of government expenditure goes toward reconstruction that AA does not affect. Results at $\delta = 0.30$ should therefore be interpreted as an upper bound on plausible fiscal savings.

4.5 Parameters

Table 3 presents the model parameters, their primary data sources and fallbacks, and their distributional assumptions.

TABLE 3. Model Parameters, Sources, and Distributional Assumptions

PARAMETER	PRIMARY SOURCE	FALLBACK	DISTRIBUTIONAL ASSUMPTION
p (disaster probability)	EM-DAT[a] (2000–2025), ISO3 × hazard	—	Beta posterior
α (hit rate)	Country-specific forecast back-tests[b]	Subregional → hazard pool → 0.50	Beta posterior
G_0 (fiscal exposure)	PostShock[c] (actual > planned > PDNA[d])	Hazard-pooled median	Log-normal
δ (fiscal effectiveness)	Literature-informed assumption[e]	—	Tri(0.10, 0.20, 0.30)
λ (fiscal friction)	Allan and Bayley (2023)[f]	—	Tri(0.10, 0.40, 0.70)
E_{cost} (program cost)	Actuarial expected allocations	Proxy flagged	Log-normal

[a] Emergency Events Database (EM-DAT), maintained by the Centre for Research on the Epidemiology of Disasters (CRED) at UCLouvain. Disaster frequency is calculated as the proportion of years with at least one recorded event for each country-hazard pair.

[b] Central American Dry Corridor (CADC) forecasting system for droughts; national trigger back-tests for Caribbean storms. Where data are unavailable, the following hierarchy is applied: subregional pool → hazard pool → assumed value of 0.50 (i.e., a hit rate equivalent to random prediction).

[c] PostShock fiscal tracking database, an internal database of post-disaster government emergency expenditure compiled by the project team from national budget records, multilateral donor reports, and post-disaster needs assessments. The following priority order is applied: actual expenditure → planned budget → Post-Disaster Needs Assessment (PDNA) public needs → appeal requirements.

[d] Post-Disaster Needs Assessments (PDNAs), conducted jointly by the World Bank, the United Nations (UN), and the European Union (EU).

[e] Informed by the range of welfare-effectiveness estimates, adjusted downward to reflect the partial translation of welfare gains into fiscal savings.

f Opportunity cost of budget reallocations estimated at 40 percent, based on a cross-country analysis of fiscal responses to the COVID-19 pandemic by the Centre for Disaster Protection.

4.6 Illustrative Example

For the Honduras drought framework, the four central parameters are: p = 0.346 (9 drought years out of 26, based on EM-DAT), G_0 = US$201.6 million (PostShock planned emergency budget), α = 0.691 (Central American Dry Corridor forecasting system back-test), and E_{cost} = US$8.0 million/year (actuarially expected allocations). We trace the calculation through each specification.

1. Preferred (friction-inclusive) savings at δ = 0.20. The direct annual fiscal savings are:

$$\Delta F_{\text{direct}} = 0.691 \times 0.20 \times 0.346 \times \text{US\$201.6 million} \approx \text{US\$9.65 million/year}$$

Applying the fiscal friction wedge: ΔF_λ = 9.65 × 1.40 ≈ US$13.5 million/year. Over 10 years at a 5 percent discount rate, the NPV is approximately US$104.3 million. With E_{cost} = US$8.0 million/year, NPV($E_{cost}$) ≈ US$61.8 million, yielding a BCR of approximately 1.69. In other words, the framework generates US$1.69 in fiscal savings for every US$1 of program costs.

2. Direct savings (sensitivity analysis, λ = 0) at δ = 0.20. Without the financing-friction adjustment, annual fiscal savings are US$9.65 million, with an NPV of approximately US$74.5 million and a BCR of approximately 1.21. This conservative specification assumes that post-disaster emergency spending costs the government its face value.

3. Low delta (δ = 0.10). Under the preferred specification, which includes financing frictions, annual fiscal savings are approximately US$6.76 million, with an NPV of approximately US$52.2 million and a BCR of approximately 0.84. Under the direct-cost specification, the NPV is approximately US$37.3 million, with a BCR of approximately 0.60. AA does not cover its costs under this conservative assumption in either specification.

4. High delta (δ = 0.30). Under the preferred specification, annual fiscal savings are approximately US$20.3 million, with an NPV of approximately US$156.5 million and a BCR of approximately 2.53. Under the direct-cost specification, the BCR is approximately 1.81. This upper bound should be interpreted with caution: at δ = 0.30, fiscal effectiveness approaches welfare effectiveness, implying that the gap between welfare gains and fiscal savings is small.

5. Break-even delta. Under the preferred specification, which includes financing frictions:

$$\delta_\lambda^* = \frac{E_{\text{cost}}}{\alpha \cdot p \cdot G_0 \cdot (1+\lambda)} = \frac{8.0}{0.691 \times 0.346 \times 201.6 \times 1.40} \approx 0.119$$

Under the direct-cost specification (λ = 0), the break-even threshold is δ^* ≈ 0.166. The preferred threshold falls within the central range of the triangular distribution, Tri(0.10, 0.20, 0.30). The framework covers its costs if it reduces government emergency expenditure by at least 12 percent in correctly triggered disaster years.

5 Data Sources and Quality

5.1 Parameter-to-Source Mapping

Each model parameter is estimated using a primary data source, with documented fallback hierarchies where primary data are unavailable. Table 3 in Section 4.5 maps data sources to parameters.

The data sources differ in what they measure. An internal fiscal tracking database (PostShock) was compiled from national budget records, multilateral donor reports, and post-disaster needs assessments. It records government emergency expenditure by disaster event—what governments actually spent or planned to spend in response to specific disasters—but coverage is uneven across countries and hazard types. Post-Disaster Needs Assessments (PDNAs), conducted jointly by the World Bank, the United Nations, and the European Union, estimate total recovery and reconstruction needs rather than actual government expenditure. PDNA figures are used as a fallback where PostShock data are unavailable but tend to exceed actual government spending because they include private-sector needs and aspirational recovery targets. The Emergency Events Database (EM-DAT), maintained by the Centre for Research on the Epidemiology of Disasters at UCLouvain, records disaster occurrence and total economic damage but does not distinguish government fiscal exposure from private losses. The DesInventar disaster inventory system, maintained by the United Nations Office for Disaster Risk Reduction (UNDRR), provides subnational loss records that we use for cross-validation rather than primary estimation. The multihazard Average Annual Loss (AAL) estimates maintained by UNDRR represent expected annual losses over the long term and may overestimate the losses relevant to government fiscal exposure. AAL represents the annual amount a country would need to set aside to cover expected long-term losses from the relevant hazards (HDX 2020).

For the expanded case set covering four subregions, data availability varies substantially. Central America drought cases (Honduras, Guatemala, El Salvador) benefit from Central American Dry Corridor (CADC) forecast back-tests that provide country-specific α values. The Caribbean storm cases (Cuba, Haiti) have country-specific α from national trigger back-tests but lack PostShock-grade G_0. The Andean flood cases (Bolivia, Ecuador) have the reverse: PostShock G_0 but no flood-specific trigger back-test, requiring an assumed $\alpha = 0.50$. Brazil drought has a large G_0 from PostShock but no country-specific α. To make this variation transparent, we indicate the source and quality of each input throughout the case study tables using a three-tier classification (Figure 6): country-specific (green), pooled or literature-based (amber), and missing or assumed (red).

5.2 G_0 Priority Rule

Government fiscal exposure (G_0) is sourced from the PostShock database using a transparent priority rule: actual government expenditure → planned government budget → Post-Disaster Needs Assessment (PDNA) public needs → appeal requirements. The rationale is that actual expenditure reflects the fiscal burden more accurately than planned budgets, which may be revised during implementation, or PDNA estimates, which may include nongovernmental needs. When multiple disaster events are available for a country-hazard pair, we use the median across events. Where no PostShock data are available for a country-hazard pair, the hazard-pooled median across all countries with data is used as a fallback and explicitly flagged.

5.3 Subregional Pooling

The Bayesian prior for p (disaster probability) is pooled within four subregions: Central America, the Andes, the Caribbean, and the Southern Cone. Pooling across all 33 LAC countries would distort the priors: estimates for drought-prone Central American countries would be pulled toward zero by Caribbean and Southern Cone countries with minimal drought exposure, and vice versa. The subregional prior is then updated using each country's observed disaster frequency from EM-DAT (2000–2025) to produce a posterior distribution.

The same subregional structure applies to α: when a country lacks a trigger back-test, the subregional pool of countries with back-tests for the same hazard is used first. If no subregional data are available, the global hazard-level pool serves as a fallback.

5.4 Limitations

Four structural limitations apply across all cases. First, G_0, derived from PostShock and PDNA records, captures direct government emergency expenditure but not the indirect fiscal costs (revenue losses, deferred investment, and debt service) documented in Section 2.1. Total fiscal exposure therefore exceeds what G_0 measures, and the model's savings estimates are conservative relative to the full fiscal burden of disasters. Second, δ is an assumption, not an estimate. The triangular distribution Tri(0.10, 0.20, 0.30) is informed by the evaluation literature but cannot be validated against fiscal data until event-level government expenditure tracking becomes available. Third, the 2000–2025 observation period may not capture nonstationary changes in disaster frequency associated with climate change. Fourth, aggregate fiscal variables change for many reasons—macroeconomic cycles, policy changes, and commodity prices—making causal

attribution of fiscal costs to specific disaster events difficult even where government expenditure and debt data are comprehensive. The micro-calibration model addresses this identification problem by using event-level expenditure records rather than aggregate fiscal series.

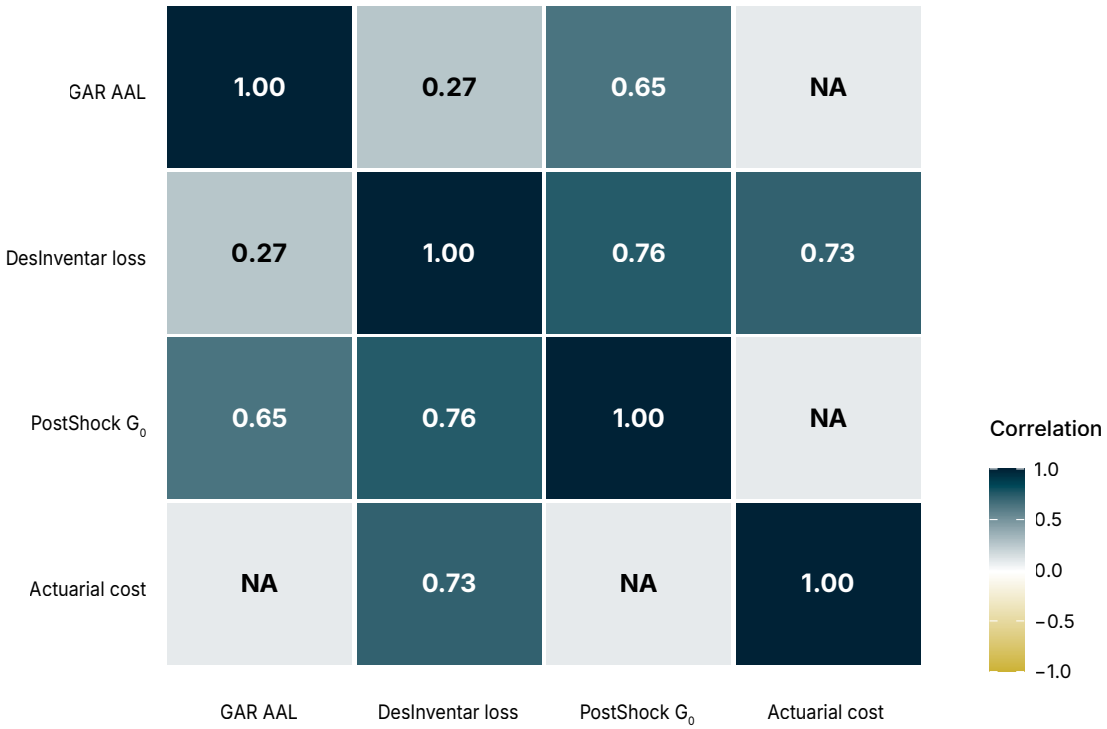
5.5 Correlation of G_0 Across Sources

No single data source measures government fiscal exposure (G_0) definitively, so we cross-validate the estimates by comparing four independent sources. The Global Assessment Report Average Annual Loss (GAR AAL) is a modeled estimate of expected annual disaster losses produced by the United Nations' Global Assessment Report on Disaster Risk Reduction; it captures simulated long-run averages rather than observed expenditure. DesInventar is a subnational disaster loss database maintained by the United Nations Office for Disaster Risk Reduction (UNDRR) that records individual disaster events and damage estimates, providing an observational counterpart to the GAR model. PostShock is the project's internal fiscal tracking database, which records government emergency expenditure by event and serves as the primary source for G_0 in our model, as described in Section 5.2. The actuarial expected cost is the expected annual program disbursement based on trigger activation probability and allocation size, measuring program costs rather than disaster losses.

These four sources measure related but distinct constructs: modeled expected losses, observed subnational damage, actual government spending, and program costs. If the PostShock G_0 values we use in the model are capturing real fiscal exposure, they should correlate with independent measures of disaster losses. However, the analysis is substantially constrained by limited overlap. Correlations can be calculated only where two sources cover the same country-hazard pair, and their country coverage differs.

Moderate-to-high correlations across sources increase confidence that our G_0 estimates reflect actual fiscal exposure rather than measurement artifacts, although the small samples limit the strength of this evidence. Figure 5 reports pairwise correlations for overlapping country-hazard observations. The correlation between DesInventar losses and PostShock G_0 (0.76) and that between DesInventar losses and actuarial costs (0.73) provide some evidence that different data sources capture related concepts. The weaker correlation between GAR AAL and DesInventar (0.27) may reflect differences in methodology: AAL is a modeled estimate, whereas DesInventar provides observational records.

FIGURE 5. Pairwise Correlations Across G_0 Measures for Overlapping Country-Hazard Observations



6 Taking the Model to Data—Diagnostic Tests

6.1 Prior Predictive Checks

Before estimating fiscal savings, we verify that the model's distributional assumptions are consistent with observed data. The purpose is to confirm that our assumed distributions generate realistic predictions before using them to estimate savings. For each country-hazard pair, we simulate 3,000 random draws from the assumed prior distributions for disaster probability (p) and hit rate (α), then assess whether the observed disaster frequency and, where available, trigger performance fall within the simulated 90 percent intervals.

The priors are derived from two sources. Disaster probability (p) uses a beta prior constructed by pooling EM-DAT disaster records within each subregion (Section 5.3), then updating it with the country's observed disaster frequency. The hit rate (α) uses a beta prior derived from country-specific forecast back-tests where available (5 of 11 cases); for the remaining cases, the subregional or hazard-level pool provides the prior.

Across all 11 cases, the observed values fall within the simulated 90 percent intervals, indicating that the assumed distributions are consistent with the observed data and adequately calibrated for the savings estimation that follows.

6.2 Deterministic Case Studies

Table 4 reports the deterministic (point-estimate) results for all 11 cases. BCRs are presented under three fiscal effectiveness (δ) scenarios for cases with sufficient program cost data to calculate them. The NPV of gross fiscal savings at δ = 0.20 is reported for all cases.

TABLE 4. Deterministic Fiscal Savings and Benefit-Cost Ratios: 11 Cases, Three δ Scenarios

Case	Region	p	α	G_0	$NPV_{\delta=0.20}$	E_{cost}	$BCR_{\delta=0.10}$	$BCR_{\delta=0.20}$	$BCR_{\delta=0.30}$	Data
Honduras drought	C. America	0.346	0.691	201.6	104.3	8.0	0.84	1.69	2.53	Full
Guatemala drought	C. America	0.192	1.000	115.7*	48.1	8.0	0.39	0.78	1.17	α only
El Salvador drought	C. America	0.154	0.938	115.7*	36.1	5.0	0.47	0.93	1.40	α only
Guatemala flood	C. America	0.654	0.500†	74.3	52.5	—	—	—	—	G_0 only
Guatemala storm	C. America	0.577	0.759*	36.0	34.0	—	—	—	—	G_0 only
Honduras storm	C. America	0.462	0.759*	31.3	23.7	—	—	—	—	G_0 only
Bolivia flood	Andean	0.846	0.500†	25.9	23.7	—	—	—	—	G_0 only
Ecuador flood	Andean	0.731	0.500†	27.2	21.5	—	—	—	—	G_0 only
Cuba storm	Caribbean	0.692	0.811	33.6*	40.8	8.2	0.32	0.65	0.97	α only
Haiti storm	Caribbean	0.692	0.706	33.6*‡	35.5	7.8	0.29	0.59	0.88	α only
Brazil drought	S. Cone	0.538	0.876*	187.6	191.4	—	—	—	—	G_0 only

Note: G_0 and NPV in US$ millions. NPV reports the 10-year present value of gross fiscal savings at δ = 0.20 under the preferred friction-inclusive specification (λ = 0.40). BCR = NPV of gross savings divided by NPV of program costs, reported at three fiscal effectiveness levels. Direct estimates (λ = 0) are 29% lower; see Section 4.3 for derivation. * indicates pooled or proxy value. † indicates assumed α = 0.50 (no trigger back-test). "Data" column indicates which parameters are country-specific: Full = all; α only = trigger back-test but no PostShock G_0; G_0 only = PostShock data but no trigger back-test. BCR computed only where E_{cost} is available.

The Honduras drought framework is the only case with a benefit-cost ratio (BCR) above 1.0 under the central fiscal effectiveness assumption: BCR = 1.69 under the preferred specification, which includes financing frictions, meaning that every dollar of program costs generates US$1.69 in fiscal savings. At the conservative δ = 0.10, the BCR falls to 0.84; at the optimistic value of δ = 0.30, it reaches 2.53. The Guatemala drought framework (BCR = 0.78 at δ = 0.20) and the El Salvador drought framework (BCR = 0.93) approach break-even under the central fiscal effectiveness assumption but exceed 1.0 at δ = 0.30 (1.17 and 1.40, respectively). The six cases without observed E_{cost} generate positive gross fiscal savings but cannot be evaluated against program costs. The "Data" column in Table 4 reveals a gradient in data quality that limits the interpretation of the results. The Honduras drought framework has "Full" data—country-specific values for all four central parameters—and is the only case in which the BCR estimate relies on direct observations rather than proxy values. The Guatemala and El Salvador drought frameworks and the Cuba

and Haiti storm frameworks have country-specific hit rates (α) from trigger back-tests but rely on hazard-pooled fiscal exposure (G_0), introducing uncertainty about the actual government expenditure these frameworks could reduce. The remaining cases—those classified as "G_0 only"—have PostShock fiscal data but no trigger back-tests, requiring assumed or pooled hit rates. BCRs can be calculated for only 5 of the 11 cases because program cost data (E_{cost}) are available only for the three Central American drought frameworks (Honduras, Guatemala, and El Salvador) and the two Caribbean storm frameworks (Cuba and Haiti). For the other six cases, the estimated gross fiscal savings are positive under all δ scenarios, but net returns cannot be quantified.

6.3 Program Cost Dynamics

Of the five cases with observed program costs, four yield a benefit-cost ratio (BCR) below 1.0 under the central fiscal effectiveness assumption (δ = 0.20) and the preferred specification, which includes financing frictions: Guatemala drought (0.78), El Salvador drought (0.93), Cuba storm (0.65), and Haiti storm (0.59). Only Honduras drought (1.69) exceeds 1.0. Based on the point estimates, anticipatory action does not pay for itself in four of the five frameworks for which cost data are available.

The result is driven by the cost denominator rather than the fiscal saving. A benefit-cost ratio is the present value of avoided expenditure divided by the present value of program cost, so a high cost base depresses the ratio even where gross savings are large. The program costs recorded for these frameworks combine two components that differ in their time profile. Setup costs establish the system: developing and calibrating the forecast trigger, building the institutional and disbursement arrangements, and pre-positioning the initial stock of supplies. Recurring costs cover system operations: monitoring triggers, periodic recalibration, and disbursements in activation years. Setup costs are incurred once, whereas recurring costs arise throughout the framework's operational life. The recurring component is assumed to be smaller because the fixed investment in forecasting infrastructure and institutional capacity does not need to be repeated each year.

The cost data do not separate these components. The observed E_{cost} figures record total annual disbursements from donor accounting systems, without distinguishing one-time establishment costs from recurring maintenance, so we cannot bring this distinction to the data. Our estimates therefore treat the full observed amount as a constant annual cost, amortized over the 10-year horizon (Section 4.2). This treatment is conservative: it charges every year of the horizon with a share of costs that, for the setup component, are incurred only at the outset.

Once setup costs have been incurred, they do not recur, so the effective annual cost of an established framework should fall below the figures used here as its cost base shifts from

establishment to maintenance. Because the benefit-cost ratio is inversely proportional to program cost, we expect the ratios reported above to understate the long-run fiscal return, and we expect them to trend upward as frameworks mature.

On this reasoning, the costed cases now below break-even should settle above 1.0 over their operational life, and the four ratios below 1.0 reflect the front-loaded cost of systems that are still young rather than a standing fiscal shortfall. Confirming this pattern requires cost records that separate setup from recurring expenditure, which do not yet exist; until they do, the expectation rests on the time profile of program costs rather than on measured maintenance-phase ratios.

6.4 Robustness

We also conducted a Monte Carlo simulation, drawing disaster probability and hit rates from beta posterior distributions and fiscal exposure, fiscal effectiveness, and the financing-friction wedge from the distributional assumptions presented in Table 3. The simulation reproduced the ordering of the deterministic estimates but yielded wide intervals and low precision, reflecting the nonlinear compounding of parameter uncertainty. These results reinforce the need for better data.

7 AA by Region and Disaster Type

7.1 Central America: Droughts

Droughts in Central America present the strongest case in our dataset. Three countries—Honduras, Guatemala, and El Salvador—have country-specific forecast hit rates from the Central American Dry Corridor (CADC) drought trigger back-test, with hit rates (α) of 0.691, 1.000, and 0.938, respectively. These high hit rates are consistent with the nature of the hazard: droughts are slow-onset events that develop over weeks to months, making them generally easier to forecast than rapid-onset floods or storms. The CADC forecasting system takes advantage of this characteristic by tracking cumulative rainfall deficits against historical thresholds.[2]

Honduras drought is the best-documented case, with country-specific data for all four central parameters. Section 4.6 presents the full calculation. Under the preferred specification, which includes financing frictions, at $\delta = 0.20$, the BCR is 1.69; under the direct-cost specification ($\lambda = 0$), the BCR is 1.21. The break-even threshold is $\delta^* \approx 0.119$—the framework covers its costs if it reduces government emergency expenditure by at least 12 percent in correctly triggered disaster years.

Guatemala drought has a perfect hit rate ($\alpha = 1.00$) from the CADC back-test but a lower disaster probability ($p = 0.192$). Fiscal exposure (G_0) is a hazard-pooled value (US$115.7 million) because no country-specific PostShock drought data are available for Guatemala. Under the preferred specification, which includes financing frictions, at $\delta = 0.20$, the BCR is 0.78. Under the direct-cost specification ($\lambda = 0$), the BCR is 0.56.

El Salvador drought has a hit rate $\alpha = 0.938$ and a disaster probability $p = 0.154$. Fiscal exposure (G_0) is also estimated using a hazard-pooled value. With lower annual program costs (E_{cost} = US$5.0 million), the BCR is 0.93 under the preferred specification, which includes financing frictions, at $\delta = 0.20$, approaching break-even. Under the direct-cost specification ($\lambda = 0$), the BCR is 0.67.

2. Honduras and El Salvador each have two Central American Dry Corridor (CADC) forecasting windows, Primera and Postrera. The hit rates reported above combine these windows under the assumption that their triggers operate independently. To test the sensitivity of this assumption, we relax the independence condition, obtaining $\alpha = 0.556$ for Honduras rather than 0.691 and 0.750 for El Salvador rather than 0.938. Since savings are linear in α, the independence calibration raises Honduras's estimated saving by roughly a quarter, lowering its break-even threshold from $\delta^* = 0.147$ to 0.119; under the relaxed calibration, Honduras still returns a benefit-cost ratio of 1.36 at $\delta = 0.20$.

7.2 Central America: Storms and Floods

The Guatemala flood framework (fiscal exposure G_0 = US$74.3 million per event, the median of two PostShock events) has no trigger back-test, so we assume a hit rate (α) of 0.50. The absence of back-test data reflects the lack of a defined trigger system: a trigger must be established before it can be back-tested. The substantial fiscal exposure in this case strengthens the argument for government investment in developing flood triggers, as the potential fiscal savings could justify the upfront costs of trigger design and calibration. Annual fiscal savings, including financing frictions, at fiscal effectiveness δ = 0.20 are US$6.8 million (NPV of US$52.5 million). Without program cost data, the BCR cannot be calculated, but the substantial fiscal exposure suggests that even moderate trigger performance and fiscal effectiveness could generate meaningful savings.

The Guatemala and Honduras storm frameworks have comparable fiscal exposure values (US$36.0 million and US$31.3 million, respectively) and rely on a hazard-pooled hit rate (α = 0.759). The corresponding fiscal savings have 10-year NPVs of US$34.0 million and US$23.7 million, respectively, under the preferred specification, which includes financing frictions, at δ = 0.20.

7.3 Andean Floods

Bolivia (disaster probability p = 0.846, fiscal exposure G_0 = US$25.9 million) and Ecuador (p = 0.731, G_0 = US$27.2 million) both experience frequent floods and have PostShock fiscal data. Neither has a flood-specific trigger back-test, so the hit rate (α) is assumed at 0.50. Under the preferred friction-inclusive specification at δ = 0.20, Bolivia's 10-year NPV of fiscal savings is US$23.7 million, while Ecuador's is US$21.5 million. The key constraint is the assumed hit rate: if a country-specific flood trigger were developed and achieved α = 0.70, estimated savings would increase by 40 percent.

7.4 Caribbean Storms

Cuba (hit rate α = 0.811) and Haiti (α = 0.706) have country-specific storm trigger back-tests but lack fiscal exposure (G_0) data of comparable quality to those in PostShock. We use the hazard-pooled storm fiscal exposure of US$33.6 million as a fallback. Under the preferred specification, which includes financing frictions, at δ = 0.20, Cuba's estimated fiscal savings have a 10-year NPV of US$40.8 million, while Haiti's have an NPV of US$35.5 million. These estimates yield benefit-cost ratios of 0.65 and 0.59, respectively, based on observed annual program costs of US$8.2 million and US$7.8 million.

These cases are best interpreted conditionally: if the government's emergency expenditure per storm event is X, the corresponding fiscal savings are Y. For Cuba, with a high hit rate and high disaster probability, the fiscal return is proportional to fiscal exposure. For Haiti, the binding constraints are both fiscal exposure uncertainty and the broader state capacity to deploy anticipatory measures.

7.5 Southern Cone: Brazil Drought

Brazil has the largest fiscal exposure (G_0) in the dataset (US$187.6 million from actual government spending records) and high drought frequency (disaster probability p = 0.538). The hit rate (α) is hazard-pooled at 0.876. Under the preferred friction-inclusive specification at δ = 0.20, the annual saving is US$24.8 million (NPV of US$191.4 million).

FIGURE 6. **Data Quality Across Parameters and Cases**



Note: Green = country-specific data; amber = pooled or literature-based; red = missing or assumed. The pattern of green, amber, and red cells identifies where investment in data infrastructure would most sharpen fiscal estimates.

8 Case Study: Honduras Drought

AT A GLANCE			
Disaster probability (p)	0.346 (9 years in 26)	Fiscal exposure (G_0)	US$201.6 million per event
Forecast hit rate (α)	0.691 (CADC back-test)	Program cost (E_{cost})	US$8.0 million per year
Benefit-cost ratio	1.69 (friction-inclusive)	Break-even δ	0.119 (12%)

How exposed is Honduras? Between 2000 and 2025, Honduras recorded 77 disasters according to the Emergency Events Database (EM-DAT), of which 52 were droughts, floods, or storms. The cumulative number of people affected over this period reached 10.2 million, approximately equivalent to the country's entire population, although this figure reflects repeated exposure among the same communities rather than a single event affecting everyone. Droughts occurred in 9 of the 26 years, representing a recurrence frequency high enough that the fiscal question is not whether the government will need to respond again, but when. Government expenditure has remained near 27 percent of GDP since 2010, while revenue has remained near 25 percent, leaving limited routine fiscal flexibility (IMF 2026a). Public debt has increased substantially, with gross debt rising from 21.7 percent of GDP in 2010 to 44.6 percent in 2024 (IMF 2026b). Thus, while disaster exposure has remained broadly constant, the fiscal space available to absorb shocks has narrowed considerably.

Against this fiscal backdrop, the cost of drought response is substantial but not catastrophic. At US$201.6 million, a single drought response represents 0.54 percent of GDP and approximately 2.1 percent of annual government expenditure. Multiplying this amount by the probability of occurrence yields an expected annual drought expenditure of approximately US$70 million, or 0.7 percent of annual government expenditure. This represents a recurring fiscal exposure comparable in magnitude to the budget of a midsized line ministry, yet one that is not explicitly reflected in the budget until a disaster occurs.

An implicit liability, and why the distinction matters. Some governments hold disaster exposure as an explicit contingent liability. New Zealand, France, and Japan each operate publicly backed disaster insurance arrangements in which the state's obligation is defined in statute, funded by premiums or levies, layered with reinsurance, and backstopped by a treasury guarantee that specifies when the government must step in (OECD 2019). The liability is therefore priced, reserved against, and disclosed.

Honduras has no such instrument for drought, so its exposure is implicit: the state is expected to respond and does so, but no specific statute mandates that response, no dedicated premium finances it, and no corresponding reserve is maintained. The obligation appears in fiscal accounts only after the event, as expenditure. The practical consequence is that the expected annual cost of approximately US$70 million remains largely outside the budgetary planning process that would

otherwise account for it. This creates both an opportunity for anticipatory financing and a challenge in making the case for committing resources in advance.

The Central American Dry Corridor (CADC) forecasting system monitors cumulative rainfall deficits against historical thresholds across two cropping seasons, Primera and Postrera. When a threshold is crossed in either season, prearranged financing is released before harvest losses materialize rather than afterward. Back-testing the triggers against recorded drought years yields a hit rate of $\alpha = 0.691$, meaning that approximately seven out of ten droughts are correctly forecast. Slow-onset hazards are particularly well suited to this approach because rainfall deficits accumulate over weeks, whereas storms may provide only days of advance warning.

The fiscal arithmetic. Under the central fiscal effectiveness assumption ($\delta = 0.20$), the framework avoids an expected $0.691 \times 0.20 \times 0.346 \times$ US$201.6 million $\approx$ US$9.65 million in emergency expenditure annually. Applying the financing-friction adjustment increases estimated annual fiscal savings to US$13.5 million. Against annual program costs of US$8.0 million, this yields a benefit-cost ratio of 1.69.

The ratio of anticipatory to post-disaster spending is particularly relevant. The program costs US$8.0 million annually, equivalent to 0.08 percent of government expenditure, compared with fiscal exposure of US$201.6 million per drought event. Thus, the government spends approximately US$0.04 annually on anticipatory action for every US$1 of potential expenditure per disaster event. This difference in scale, rather than the precision of any single parameter, strengthens the fiscal case for anticipatory action. The break-even threshold is $\delta^* = 0.119$, meaning that the framework covers its costs if early action reduces government emergency expenditure by at least 12 percent in correctly triggered disaster years.

9 Lessons Learned

Three main lessons emerge from the case studies.

9.1 AA Can Pay for Itself Under the Right Conditions

The Honduras drought framework yields a benefit-cost ratio (BCR) of 1.69 under the preferred specification, which includes financing frictions, at our central estimate of fiscal effectiveness (δ = 0.20). Every dollar of program costs generates US$1.69 in fiscal savings. Under the conservative direct-cost specification (λ = 0), the BCR is 1.21. The break-even threshold under the preferred specification is approximately 12 percent: if early action reduces government emergency expenditure by at least this amount in correctly triggered disaster years, the program covers its costs. This threshold is well below the welfare effectiveness estimates reported in the evaluation literature ($\delta_{welfare} \approx 0.30$), suggesting that fiscal break-even may be attainable even after accounting for the difference between welfare gains and avoided government expenditure. The Guatemala drought framework (BCR = 0.78) and the El Salvador drought framework (BCR = 0.93) approach break-even under the preferred specification. Under the direct-cost specification, these BCRs fall to 0.56 and 0.67, respectively. The threshold for fiscal break-even under the preferred specification depends on five parameters:

$$\delta_{\lambda}^{*} = \frac{E_{\text{cost}}}{\alpha \cdot p \cdot G_0 \cdot (1+\lambda)}$$

In other words, the minimum fiscal effectiveness (δ^{*}_{λ}) at which savings equal costs is the ratio of program cost (E_{cost}) to the product of the hit rate (α), disaster probability (p), fiscal exposure (G_0), and the fiscal friction factor (1 + λ). Under the direct-cost specification (λ = 0), the denominator excludes the financing-friction adjustment, resulting in a higher break-even threshold. Cases are more likely to generate positive fiscal returns when forecast triggers perform well, disasters occur frequently, government expenditure per event is substantial, and program costs are low.

9.2 Post-Disaster Financing Is Expensive

Governments that finance emergency spending after a disaster incur costs beyond the face value of the funds disbursed. Budget reallocations divert resources from health, education, and infrastructure maintenance; emergency borrowing may involve unfavorable terms; and reserve drawdowns reduce the fiscal buffers available for future shocks. Allan and Bayley (2023) estimate that the opportunity cost of budget reallocations during the COVID-19 pandemic averaged US$0.40 per dollar reallocated—that is, US$1 of emergency spending imposed a total fiscal burden of

US$1.40. Evidence from OCHA's 2020 anticipatory action pilot in Bangladesh indicates additional costs of a comparable magnitude through a different mechanism: pre-crisis procurement enabled assistance to be delivered at US$13 per person, compared with US$26 per person under a reactive response (OCHA 2021).

The preferred specification incorporates these financing frictions, and the main results presented in this report reflect the estimated additional costs governments incur when financing emergency expenditure under crisis conditions. The direct-cost specification ($\lambda = 0$) produces lower estimates of fiscal returns because it excludes these procurement and financing costs. AA is one instrument in a family of prearranged financing tools that reduce the fiscal cost of the post-shock scramble for resources. Prearranged financing is consistently less expensive than reactive financing because it avoids the crisis-condition premium on procurement, borrowing, and program reallocation.

9.3 Data Gaps Should Inspire Better Learning, but Not Justify Delay

Six of the 11 cases generate positive gross fiscal savings under all fiscal effectiveness assumptions but lack the program cost data needed to calculate benefit-cost ratios. For these cases—floods and storms in Guatemala, storms in Honduras, floods in Bolivia and Ecuador, and droughts in Brazil—the estimated gross fiscal savings are positive under every parameter combination tested. Whether these savings exceed program costs cannot be determined because program costs are recorded in donor systems rather than government budgets and are not systematically reported at the framework level.

Closing these data gaps is an important actionable priority. However, where the available evidence consistently indicates potential benefits, incomplete data should encourage carefully designed action rather than delay. Event-level fiscal tracking of government emergency expenditure, systematic trigger back-tests for flood and drought forecasts, and framework-level program cost records would allow benefit-cost ratios to be calculated for the six cases that currently have only estimates of gross fiscal savings. The priority for future work is not solely to refine disaster probability (p) or hit rates (α), which are already relatively well estimated from historical data where back-tests exist. Rather, it is to narrow the credible range for fiscal effectiveness (δ) by tracking fiscal outcomes in countries where AA has been activated and to address gaps in fiscal exposure (G_0) and program cost (E_{cost}) data for cases with limited information.

Four specific data gaps, if addressed, could improve the precision of these estimates. Each identifies an area where investment in data infrastructure would most strengthen the credibility of fiscal calculations for AA.

The hit rate (α)—the probability that a forecast trigger is correctly activated when a disaster occurs—can be estimated through back-testing: a retrospective comparison of what the trigger would have predicted with what actually occurred. A back-test requires both a defined trigger rule and a historical record of disaster events against which to evaluate it. Such back-tests exist for Central American droughts, where the Central American Dry Corridor (CADC) forecasting system provides country-specific hit rates for Honduras, Guatemala, and El Salvador, and for Caribbean storms, where Cuba and Haiti have national trigger back-tests. No flood-specific trigger back-test is available for the LAC cases examined, and no back-test is available for the Southern Cone drought case. For 6 of our 11 cases, the hit rate is either assumed to be 0.50 or pooled across countries with back-tests for the same hazard type. Developing country-specific flood and drought trigger back-tests is the most direct way to reduce uncertainty in these cases.

Government fiscal exposure (G_0)—the amount the government spends on emergency response per disaster event—is available from PostShock for 7 of the 11 cases. PostShock records actual government expenditure, planned budgets, or post-disaster needs assessment figures for individual disaster events, applying a transparent priority rule that favors actual expenditure over planned budgets and planned budgets over Post-Disaster Needs Assessment (PDNA) estimates (Section 5.2). The Caribbean storm cases (Cuba and Haiti) and two Central American drought cases (Guatemala and El Salvador) lack fiscal exposure data of comparable quality to those in PostShock and rely on hazard-pooled medians—the median fiscal exposure across all countries with data for the relevant hazard type. Systematically recording post-disaster government expenditure at the event level—identifying how much was spent, on which activities, and in response to which specific disaster—would help close this gap.

Program cost (E_{cost})—the annual cost of maintaining and operating an AA framework, including trigger monitoring, supply pre-positioning, and disbursements in activation years—is observed for only 5 of the 11 cases: droughts in Honduras, Guatemala, and El Salvador, and storms in Cuba and Haiti. Program costs are recorded in donor accounting systems rather than government budgets because the existing LAC frameworks are donor-funded. Without program cost data, benefit-cost ratios (BCRs) cannot be calculated, and gross fiscal savings cannot be translated into net fiscal returns. For the six cases without cost data, we can establish that estimated gross savings are positive but cannot determine whether they exceed the costs of generating them. Framework activation registries containing disbursement-level data—recording expenditure each time a trigger is activated, along with the fixed costs of maintaining the system—would enable BCR calculations for all cases.

Fiscal effectiveness (δ)—the proportional reduction in government emergency expenditure attributable to AA—is the least well-identified parameter in the model and the most consequential for the main finding. Estimating it directly would require comparing government expenditure in

disaster years when the AA trigger was activated with expenditure in disaster years when it was not, for the same country-hazard pair. This would involve tracking government expenditure by budget line across triggered and non-triggered disaster events and attributing the differences to the anticipatory intervention. Such an analysis would require fiscal administrative data linked to specific disaster events and AA activation records—data that are not currently available in standardized form across LAC. Until fiscal effectiveness can be estimated directly, the model relies on the triangular distribution assumption Tri(0.10, 0.20, 0.30), informed by the welfare evaluation literature and adjusted downward to reflect the partial translation of welfare gains into fiscal savings.

10 Conclusion on the AA Modeling

Anticipatory action is likely to generate fiscal benefits across a range of scenarios, regions, and disaster types. The Honduras drought framework—the case with the strongest data—generates US$1.69 in fiscal savings for every US$1 of program costs under the preferred specification, which includes financing frictions, at our central estimate of fiscal effectiveness. The conservative direct-cost specification ($\lambda = 0$) produces a benefit-cost ratio (BCR) of 1.21. The Guatemala drought framework (BCR = 0.78) and the El Salvador drought framework (BCR = 0.93) approach break-even under the preferred specification. The six cases without program cost data generate positive gross fiscal savings under all assumptions tested, although net returns cannot be calculated. These estimates could be higher if broader, long-term disaster-related fiscal costs—including revenue losses, deferred public investment, and debt service on emergency borrowing—were taken into account.

Data quality and availability limit the precision of the estimates, but these constraints do not necessarily justify delaying action. The fiscal effectiveness parameter (δ)—the proportional reduction in government emergency expenditure attributable to AA—has not yet been measured directly. It is informed by the welfare evaluation literature, although coverage gaps, differences in expenditure composition, and measurement limitations prevent a direct translation of welfare gains into fiscal savings. Investing in the empirical infrastructure needed to measure fiscal effectiveness directly—including event-level fiscal tracking that links government expenditure to specific disaster events and AA activation records, as well as systematic trigger back-tests for flood and drought forecasts—is essential to strengthening the fiscal case. However, compiling these data also depends on experience gained through AA activations. Data limitations should therefore not, by themselves, prevent action.

Implementation and data collection should proceed in parallel. Countries that activate AA frameworks can generate the fiscal data needed to validate the model—but only if fiscal outcomes are tracked alongside welfare outcomes from the outset. Waiting for complete data before acting would forgo opportunities to learn: the fiscal evidence base can improve as AA frameworks become operational and generate expenditure records that enable direct estimation of fiscal effectiveness. Countries that incorporate fiscal tracking into their AA frameworks from the outset will generate evidence that can either confirm or lead to revisions of the estimates presented in this report.

The model, data, and code are published in an open-access repository. The framework is designed to evolve as the evidence base strengthens: better trigger back-tests improve estimates of the hit rate (α), more comprehensive PostShock coverage narrows uncertainty surrounding fiscal exposure (G_0), and event-level fiscal tracking, once available, will allow the assumed fiscal effectiveness parameter (δ) to be replaced with an empirically estimated value.

The central argument extends beyond any single set of estimates: governments do not need perfect evidence to act. By integrating anticipatory action into fiscal policy, building institutional capacity, and securing access to contingent financing that disburses funds before disasters strike, countries can move from reactive response toward sustained readiness—while continuously improving the evidence base to refine and strengthen their interventions.

References

Allaire, M. 2018. "Socio-Economic Impacts of Flooding: A Review of the Empirical Literature." *Water Security* 3: 18–26.

Allan, S., and E. Bayley. 2023. *Opportunity Cost of COVID-19 Budget Reallocations: Cross-Country Synthesis*. London: Centre for Disaster Protection.

Anand, V. 2023. "Prediction Technologies and Decision-Making: A Model for Forecast-Based Financing for Risk Mitigation." Available at SSRN: https://ssrn.com/abstract=5211250.

Anyfantaki, S., M. Blix Grimaldi, C. Madeira, S. Malovaná, and G. Papadopoulos. 2025. "Decoding Climate-Related Risks in Sovereign Bond Pricing: A Global Perspective." Working Paper Series 3135. Frankfurt am Main: European Central Bank.

Balana, B., D. Adeyanju, C. Clingain, K. S. Andam, A. de Brauw, I. Yohanna, O. Olarewaju, and M. Schneider. 2023. *Anticipatory Cash Transfers for Climate Resilience: Findings from a Randomized Experiment in Northeast Nigeria*. Washington, DC: International Food Policy Research Institute.

Bello, O. D. 2017. "Disasters, Economic Growth and Fiscal Response in the Countries of Latin America and the Caribbean, 1972–2010." *CEPAL Review* 121: 7–30.

Bevan, D., and S. J. Cook. 2015. "Public Expenditure Following Disasters." Policy Research Working Paper 7355. Washington, DC: World Bank.

Christian, P. J., F. A. Dunsch, J. Heirman, E. M. Kelley, F. Kondylis, G. Lane, J. Waidler, N. Adusumalli, O. Batmunkh, and K. Malhotra. 2025. "Fast Action for Floods: RCT Evidence on Forecast-Based Cash Transfers from Bangladesh and Nepal." NBER Working Paper 34414. Cambridge, MA: National Bureau of Economic Research.

Clarke, D. J., and S. Dercon. 2016. *Dull Disasters? How Planning Ahead Will Make a Difference*. Oxford: Oxford University Press.

CRED (Centre for Research on the Epidemiology of Disasters). 2025. Emergency Events Database (EM-DAT). Brussels: UCLouvain. Accessed June 26, 2025.

de Brauw, A. 2025. "Cost Effectiveness of Anticipatory Action: Lesotho, Madagascar, and Mozambique."

Delgado, R., H. Eguino, and A. Lopes Pereira. 2021. *Fiscal Policy and Climate Change: Recent Experiences of Finance Ministries in Latin America and the Caribbean*. Monograph IDB-MG-941. Washington, DC: Inter-American Development Bank.

Devereux, S. 2007. "The Impact of Droughts and Floods on Food Security and Policy Options to Alleviate Negative Effects." *Agricultural Economics* 37: 47–58.

Draganić, L., L. Srdelić, and M. J. Dávila-Fernández. 2025. "Extreme Events and Public Debt Dynamics: Lessons from Croatia's Experience."

Duenwald, C., Y. Abdih, K. Gerling, V. Stepanyan, A. Al-Hassan, G. Anderson, A. Baum, S. Saksonovs, L. Agoumi, C. Chen, et al. 2022. *Feeling the Heat: Adapting to Climate Change in the Middle East and Central Asia*. Washington, DC: International Monetary Fund.

Fan, R. Y., D. Lederman, H. Nguyen, and C. J. Rojas. 2023. "Calamities, Debt, and Growth in Developing Countries." *IMF Economic Review*.

Fuje, H., J. Yao, S. M. Choi, and H. Mighri. 2023. "Fiscal Impacts of Climate Disasters in Emerging Markets and Developing Economies." Washington, DC: International Monetary Fund.

Gros, C., M. Bailey, S. Schwager, A. Hassan, R. Zingg, M. M. Uddin, M. Shahjahan, H. Islam, S. Lux, C. Jaime, and E. Coughlan de Perez. 2019. "Household-Level Effects of Providing Forecast-Based Cash in Anticipation of Extreme Weather Events: Quasi-Experimental Evidence from Humanitarian Interventions in the 2017 Floods in Bangladesh." *International Journal of Disaster Risk Reduction* 41: 101275.

HDX (Humanitarian Data Exchange). 2020. "Multi-Hazard Average Annual Loss." https://data.humdata.org/dataset/multi-hazard-average-annual-loss.

IMF (International Monetary Fund). 2026a. "Fiscal Monitor Database, April 2026: General Government Expenditure (% of GDP)." IMF DataMapper. Accessed July 26, 2026.

IMF (International Monetary Fund). 2026b. "General Government Gross Debt (% of GDP) (GG_DEBT_GDP)." IMF DataMapper, Fiscal Monitor Database. https://www.imf.org/external/datamapper/GG_DEBT_GDP@GDD/CAN/FRA/DEU/ITA/JPN/GBR/USA/VEN/COL/PER/HND. Accessed July 26, 2026.

Jagnani, M., and R. Pande. 2024. "Forecasting Fate: Experimental Evaluation of a Flood Early Warning System."

Lingle, B., C. Kousky, and L. Shabman. 2018. *Federal Disaster Rebuilding Spending: A Look at the Numbers*. Philadelphia, PA: Risk Management and Decision Processes Center.

Loayza, N. V., E. Olaberría, J. Rigolini, and L. Christiaensen. 2012. "Natural Disasters and Growth: Going Beyond the Averages." *World Development* 40(7): 1317–36.

Milivojević, L. 2023. "Natural Disasters and Fiscal Drought." Policy Research Working Paper 10298. Washington, DC: World Bank.

Mogge, L., J. Röckert, and K. Krähnert. 2025. "Anticipatory Cash Transfers in the Context of Weather Disasters." *Journal of the Association of Environmental and Resource Economists*.

Nguyen, H., A. Feng, and M. García-Escribano. 2025. "Understanding the Macroeconomic Effects of Natural Disasters." IMF Working Paper 2025/046. Washington, DC: International Monetary Fund.

Nishizawa, H., S. Roger, and H. Zhang. 2019. "Fiscal Buffers for Natural Disasters in Pacific Island Countries." IMF Working Paper 19/57. Washington, DC: International Monetary Fund.

Noy, I. 2009. "The Macroeconomic Consequences of Disasters." *Journal of Development Economics* 88(2): 221–31.

OCHA (United Nations Office for the Coordination of Humanitarian Affairs). 2021. "Bangladesh Monsoon Flooding 2020: Anticipatory Action Pilot." Accessed June 2, 2026.

OECD (Organisation for Economic Co-operation and Development). 2019. *Fiscal Resilience to Natural Disasters: Lessons from Country Experiences*. Paris: OECD Publishing.

Pople, A., R. Hill, S. Dercon, and B. Brunckhorst. 2024. "The Importance of Being Early: Anticipatory Cash Transfers for Flood-Affected Households."

Pople, A., P. Premand, S. Dercon, M. Vinez, and S. Brunelin. 2025. "The Earlier the Better? Cash Transfers for Drought Response in Niger." Technical Report. Washington, DC: World Bank.

Raddatz, C. E. 2009. "The Wrath of God: Macroeconomic Costs of Natural Disasters." Policy Research Working Paper 5039. Washington, DC: World Bank.

Ramey, V. A., and M. D. Shapiro. 1998. "Costly Capital Reallocation and the Effects of Government Spending." *Carnegie-Rochester Conference Series on Public Policy* 48: 145–94.

Rentschler, J., M. Salhab, and B. A. Jafino. 2022. "Flood Exposure and Poverty in 188 Countries." *Nature Communications* 13(1): 3527.

Weingärtner, L. 2021. "Mapping Financial Flows for Disasters."

Weingärtner, L., and E. Wilkinson. 2019. *Anticipatory Crisis Financing and Action: Concepts, Initiatives and Evidence*. London: Centre for Disaster Protection.

WFP (World Food Programme). 2020. "Forecast-Based Financing in Nepal: A Return on Investment Study." Rome: World Food Programme.

Wiyanti, A., and A. Halimatussadiah. 2021. "Are Disasters a Risk to Regional Fiscal Balance? Evidence from Indonesia." *International Journal of Disaster Risk Science* 12(6): 839–53.

Appendix

Appendix A. The Full Model and Its Reduction

Section 4.1 presents the identity actually calibrated. That identity is a special case of a fuller decision model.

A.1 The Decision Problem

Consider three periods $t \in \{0,1,2\}$. At $t = 0$ the decision-maker chooses an early-action investment level $c_\tau \geq 0$ and a forecast threshold $\tau \in [0,1]$. At $t = 1$ a probabilistic forecast Φ is observed and early action is taken if and only if $\Phi \geq \tau$. At $t = 2$ the disaster state $D \in \{0,1\}$ is revealed.

Without early action a disaster causes loss $l_0 > 0$. Investment c reduces this to $l(c)$, with $l(0) = l_0$, $l'(c) < 0$ (early action reduces loss), and $l''(c) > 0$ (diminishing returns). The functional form is exponential:

$$l(c) = l_0 e^{-\beta c}, \quad \beta > 0$$

where β is the effectiveness of early action. Writing $\theta(\tau) = P(\Phi \geq \tau)$ for the unconditional probability the trigger fires and $r(\tau) = P(D = 1 \cap \Phi < \tau)$ for the probability of a missed disaster, the four states are:

STATE	PROBABILITY	FISCAL COST	INTERPRETATION
s_{00}	$1 - \theta - r$	0	No disaster, trigger silent
s_{01}	$\theta + r - p$	c_τ	False alarm
s_{10}	r	l_0	Disaster missed
s_{11}	$p - r$	$c_\tau + l(c_\tau)$	Disaster anticipated

The expected fiscal saving relative to no framework is

$$\Delta F = (p - r)[l_0 - l(c_\tau)] - \theta c_\tau$$

and the jointly optimal design solves $l'(c^*) = -\theta/(p - r)$ together with $\tau^* = c_\tau/[l_0 - l(c_\tau)]$.

A.2 Reduction to the Calibrated Identity

Define the hit rate $\alpha \equiv (p - r)/p$, the proportional loss reduction $\delta \equiv 1 - l(c_\tau)/l_0$, and write $G_0 \equiv l_0$. The first term becomes

$$(p - r)[l_0 - l(c_\tau)] = \alpha p \cdot \delta l_0 = \alpha \delta p G_0$$

If frameworks are donor-funded, the government's own activation outlay is zero (which is what we assume, so $c_{\tau,govt} = 0$), which removes the $-\theta c_\tau$ term from the government's accounts and leaves $\Delta F = \alpha \delta p G_0$, the identity used throughout this report.

A.3 What the Reduction Sets Aside

The reduction is exact given its assumptions, but it discards the model's optimal-design content.

1. *δ is assumed, not derived.* In the full model, loss reduction is a choice determined by c_τ and β. Here δ is a literature-anchored constant, uniform across hazards. No β is estimated, and no observed c_τ is mapped to a δ. The model's central question is therefore not answered by the calibration.
2. *τ never appears empirically.* Thresholds are taken as given by each framework's existing trigger design rather than solved for, and the forecast-calibration condition $E[\Phi] = p$ is not tested.
3. *The $-\theta c\tau$ term is dropped by assumption, not shown to be zero.* It is zero for the government only while frameworks remain donor-funded. Under a government-funded scenario it returns, and false alarms become a direct fiscal cost.

A note on notation. Two distinct trigger probabilities appear in this report, and they are given separate symbols. In the main text, q is the false-alarm rate: the probability the trigger fires conditional on no disaster occurring, which is what multiplies (1 – p) in the state table of Section 4.1. In this appendix, $\theta = P(\Phi \geq \tau)$ is the unconditional activation rate: the probability the trigger fires in any year, whatever the outcome. The two are related by $\theta = p\alpha + (1 - p)q$.

To explore more IDB publications, visit
https://publications.iadb.org/en

Copyright © **2026** Inter-American Development Bank (IDB). This work is subject to a Creative Commons Attribution 4.0 International Public License CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/legalcode). The terms and conditions indicated in the URL link must be met and the respective recognition must be granted to the IDB.

Any and all disputes arising under this license that cannot be settled amicably shall be resolved in accordance with the following procedure. Pursuant to a notice of mediation communicated by reasonable means by either you or the licensor to the other, the dispute shall be submitted to non-binding mediation conducted in accordance with the World Intellectual Property Organization (WIPO) Mediation Rules. Any dispute that cannot be settled amicably shall be submitted to arbitration pursuant to the United Nations Commission on International Trade Law (UNCITRAL) rules. The use of the IDB name for any purpose other than the respective recognition and the use of the IDB logo are not authorized by this license and require an additional license agreement.

Note that the URL link includes terms and conditions that are an integral part of this license.

The opinions expressed in the work are those of its authors and do not necessarily reflect the views of the IDB, its Board of Executive Directors, or the countries they represent.




OCHA
IDB