

IMPACT APPRAISAL FOR SOVEREIGN DISASTER RISK FINANCING AND  
INSURANCE PROJECT: PHASE 1

OVERALL METHODOLOGY, PAPER 1

# Overview of Operational Framework

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## **Abstract**

The frequency and severity of humanitarian disasters will continue to grow in the coming years and at an accelerated pace. Low-income countries and donors are becoming increasingly interested in sovereign disaster risk financing and insurance (DRFI) as a way to increase financial resilience to disaster events. However, there is a need for better evidence to guide support in sovereign DRFI programs, to maximise their impact and reduce the human and economic cost of disasters. This paper presents a stylised overview of 15 technical background papers contributed to the first phase of a joint UK Department for International Development, World Bank, and Global Facility for Disaster Reduction and Recovery project to improve the evidence base for sovereign DRFI.

## **About the Project**

The UK Department for International Development (DFID), the World Bank Group and the Global Facility for Disaster Reduction and Recovery (GFDRR) have partnered to improve evaluation and evidence for sovereign disaster risk financing and insurance (DRFI). The \$3.2 million, 3-year (2013-2016) project was launched in 2013, and will develop and test a quantitative impact appraisal framework for sovereign DRFI. The project aims to meet this need by developing a methodology to evaluate a range of DRFI programs and provide quantitative results based on five country-specific case studies, and seeks to understand whether forward-looking impact appraisals can help effectively target support for disaster risk activities. The results will help better target and prioritize future investments from national governments and international donors in sovereign DRFI programs. This paper forms part of the background research underpinning the draft operational framework, to be pilot tested in the case studies in Phase 2 of the project.

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# OVERVIEW OF OPERATIONAL FRAMEWORK

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SOVEREIGN DRFI IMPACT APPRAISAL PROJECT  
OVERALL METHODOLOGY, PAPER 1

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## ABSTRACT

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The frequency and severity of humanitarian disasters will continue to grow in the coming years and at an accelerated pace. Low-income countries and donors are becoming increasingly interested in sovereign disaster risk financing and insurance (DRFI) as a way to increase financial resilience to disaster events. However, there is a need for better evidence to guide support in sovereign DRFI programs, to maximise their impact and reduce the human and economic cost of disasters. This paper presents a stylised overview of 15 technical background papers contributed to the first phase of a joint UK Department for International Development, World Bank, and Global Facility for Disaster Reduction and Recovery project to improve the evidence base for sovereign DRFI.

# 1 INTRODUCTION

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**Disasters losses have increased threefold since the 1980s and their impact – both economic and humanitarian - will continue to rise as more and more people and assets concentrate in risky areas in search of jobs and opportunities.** Over the past 30 years, the number of people living in flood-prone river basins has more than doubled, and the number of people exposed to tropical cyclones more than tripled. Direct financial losses have seen a rising trends over the years, reaching an average of US\$165 billion per year during the last decade<sup>1</sup>.

**Disasters can have long term and pervasive effects on the budget of vulnerable countries, when scarce resources are reallocated away from development programs to recovery and reconstruction.** Sovereign disaster risk financing and insurance (DRFI) instruments can protect the national budget and provide governments with the resources needed for immediate response as well as long term recovery and reconstruction.

**Many developing countries and donors are taking steps to prepare against disasters, and are increasingly interested in sovereign DRFI as a way to minimise the impacts.** Mexico's natural disaster fund FONDEN, for example, was first created in 1999 as a budgetary tool through which federal funds were allocated for rapid expenditure on the rehabilitation of federal and state infrastructure affected by disasters. FONDEN has since evolved to leverage private sector financing as part of a sophisticated sovereign DRFI strategy which combines risk retention and risk transfer. Regional mechanisms such as the Caribbean Catastrophic Risk Insurance Facility (CCRIF) are also popular solutions. CCRIF was the world's first regional catastrophe insurance facility and uses parametric insurance to give participating governments quick, short-term liquidity to finance response and early recovery in the event of major earthquakes or hurricanes. CCRIF currently pools risk across sixteen countries, and there are proposals to expand the facility to include additional beneficiaries. The Pacific Catastrophe Risk Assessment and Financing Initiative and African Risk Capacity are other, more recent examples of donor-supported regional mechanisms offering quick-disbursing index-based coverage for tropical cyclone and earthquake, and drought respectively.

**The number and type of financial instruments to assist governments in managing their fiscal liability to disaster risk has grown exponentially in recent years.** The World Bank and others are supporting countries to develop risk financing strategies that combine complementary instruments in a risk-layering approach. Risk retention instruments such as budget allocations, reserves, and contingent lines of credit are used to finance recurrent events, and risk transfer instruments such as reinsurance and catastrophe bonds are used to provide additional financing for more extreme events.

**Yet, despite growing interest, the evidence on the impact, effectiveness and efficiency of sovereign DRFI programs remains limited.** There are very few evaluations of sovereign DRFI programs, and those that do exist typically do not directly address development impact or the impact of programs on the poor.<sup>2</sup> For example, whilst CCRIF is widely considered to be a success, a recent independent evaluation made it clear that evaluators lack the tools to assess performance beyond simple indicators such as the number of policies sold or the number of claims paid. In general, there is limited evidence on the relative development impact of alternative DRFI solutions and there is very little evidence from any program on the potential (expected) development impact of DRFI investments

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<sup>1</sup> Authors, with data from Swiss Re.

<sup>2</sup> Hinds, R. (2013) *Sovereign Insurance and Risk Finance Schemes for Disaster Management* (GSDRC Helpdesk Research Report No. 903), Birmingham, UK: GSDRC, University of Birmingham.

as compared to other interventions, such as investments in physical risk reduction. For governments and donors, such lack of evidence acts a clear barrier to scaled up investments in sovereign DRFI programs.

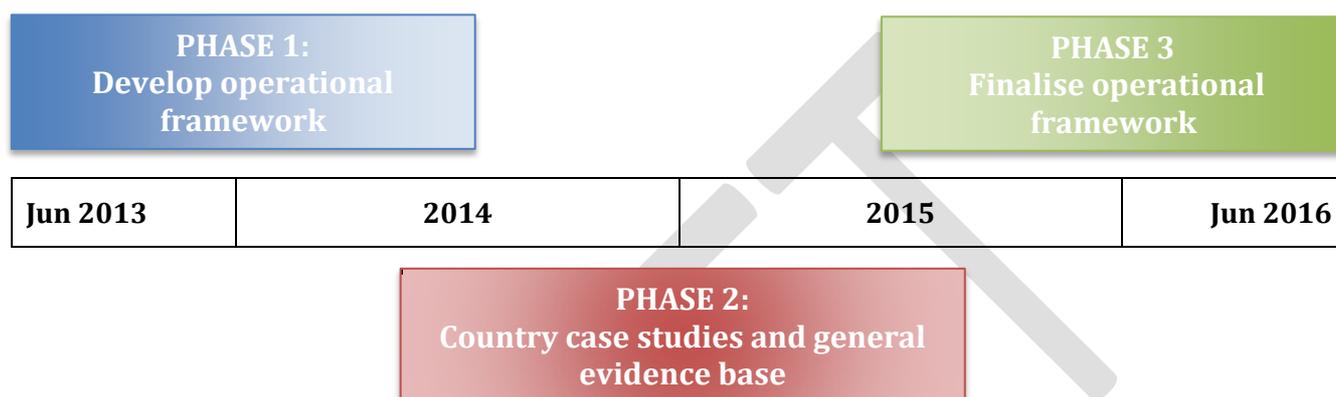
**There is currently no widely accepted framework for evaluating the development impact of sovereign DRFI solutions.** Leading development organisations rely more and more on scientifically sound evaluations of development impact to inform decision-making processes, but such methodologies cannot be directly applied to the evaluation of sovereign DRFI programs. A key challenge in evaluating sovereign DRFI instruments is that they are not an end in themselves, but rather tools that provide governments with the necessary liquidity in the aftermath of a disaster. Defining a counterfactual ('what would happen without this instrument?') is therefore challenging as it requires making assumptions about what governments might do (or not do) in the aftermath of a disaster both with and without the instrument. Other challenges include the sensitivity of sound decision-making to low frequency, but high impact events, and the lack of historical data for such events.

**Developing a robust and widely agreed evaluation methodology to assess existing DRFI schemes and new products is critical - both for donors supporting these schemes, and for the countries themselves as the principal investors.** In an effort to better understand the impact and effectiveness of financial protection strategies, the World Bank and the Global Facility for Disaster Reduction and Recovery (GFDRR) have partnered with the UK Department for International Development (DFID) for the Sovereign DRFI Impact Appraisal project. The project uses probabilistic disaster risk models to evaluate selected sovereign DRFI programs based on simulated scenarios. It aims to take the financial resilience agenda to the next level: not only helping countries be financially prepared for disasters, but through improved evidence and forward-looking appraisal to ensure that this is done in the most cost-effective way.

**This paper summarises the findings from the first phase of the project, which defines principles for the development of an operational framework to evaluate alternative sovereign DRFI programs through country case studies to be performed over 2014 - 2015.** In Section 2, the paper provides an overview of the context, rationale and aim of the Sovereign DRFI project. Section 3 outlines the background research conducted for the project and presents the principles for the development of the operational framework.

## 2 THE IMPACT APPRAISAL PROJECT

To address these issues, the UK Department for International Development (DFID), the World Bank and the Global Facility for Disaster Reduction and Recovery (GFDRR), have partnered in an effort to improve evaluation and evidence for sovereign DRFI. Over the next three years, the **Sovereign DRFI Impact Appraisal project** (the “Impact Appraisal project”) will develop and test a quantitative impact appraisal framework for sovereign DRFI. The project will be rolled out in three phases:



- PHASE 1 focuses on the background research necessary to fill evidence and data gaps and to develop a **draft operational framework**
- PHASE 2 will develop the general evidence base for sovereign DRFI and will test the operational framework through five **country-specific case studies**
- Finally, PHASE 3 will produce a final **framework**, designed so that it can be implementable for all potential DRFI investments by DFID, GFDRR the World Bank, and other institutions committed to evidence based development investments.

The project seeks to understand whether forward-looking impact appraisals can help effectively target support for disaster risk activities. It aims to understand whether it is possible to develop a conceptually sound, quantitative impact appraisal tool that:

- Takes into account the probabilistic nature of the impact of sovereign DRFI programs rather than being too heavily influenced by historical data;
- Quantifies trade-offs between many of the key dimensions of a sovereign DRFI program;
- Generates results that are sufficiently robust to model and parameter uncertainty but are still able to guide evidence-based decision making;
- Can complement more qualitative measures of impact; and
- Results in headline figures on the impact of sovereign DRFI programs on development and poverty that are meaningful for decision makers.

This paper summarises the findings of the first phase of the Impact Appraisal project, and proposes principles for an operational framework for the evaluation of sovereign DRFI programs. There are many aspects of sovereign DRFI which are challenging to evaluate. This paper proposes principles for a framework for quantifying the expected impacts from some of the key channels through which sovereign DRFI might be expected to benefit development. The approach in this paper does not

attempt to present a complete evaluation framework for sovereign DRFI, but rather a structure for the quantitative part of an evaluation framework. From a technical perspective its approach is similar to that of cost benefit analysis, but where the benefit is expressed in terms of the development impact and the cost in terms of currency.

The principles presented in this paper draw on 15 background papers prepared during phase 1 of the project. These papers cover various topics relevant to evidence and evaluation for sovereign DRFI, such as the macroeconomic and public finance implications of disasters and sovereign DRFI programs, the combination of microeconomic data and catastrophe risk models, and actuarial approaches to assessing the cost of DRFI instruments.

These background papers are being used to develop a draft operational framework to be piloted in 2014-2015, and to develop a workplan for further investments in the generic evidence base, which will be used to support the case studies and further refine the framework. These findings will be used to develop a robust and coherent operational framework that will be applied to future evaluation of sovereign DRFI programs. The goal is for the framework to enable decision-makers to understand when sovereign DRFI programs are (and when they are not) effective components of a comprehensive approach to managing the financial risk associated with disasters.

### 3 TOWARDS A FRAMEWORK FOR IMPACT APPRAISALS

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#### 3.1 KEY EVIDENCE GAPS

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**In order to develop the principles for an operational framework for the evaluation of sovereign DRFI programs, the Impact Appraisal Project has identified several evidence gaps.** Of the evaluations of sovereign DRFI programs that do exist, methodologies tend to be multi-method, using document review, empirical interviews, field missions, and project sampling (Hinds, 2013). A number of evaluations highlight the lack of monitoring and evaluation frameworks as an impediment to in-depth evaluation (IEG, 2012), while The Grantham Research Institute on Climate Change and Environment (GRICCE) asserts that assessing the effectiveness and sustainability of risk transfer schemes remains a challenge (GRICCE, 2011).

Mahul and Boudreau (2010) analysed 21 GFDRR-funded projects that have DRFI as one of their primary components. Hinds (2013) highlights this review did not adopt evaluative methodologies, but presents some key impacts and lessons learned from DFRI activities. These include:

- The development of DFRI strategies is highly technical, requiring extensive risk assessment and loss modelling. Developing countries often lack the technical capacity to develop DFRI schemes, so extensive capacity building must accompany technical assistance.
- DRFI is a new, complex, and evolving field which many in the development risk management community may not fully understand. Disaster risk financing and insurance requires extensive knowledge management through outreach materials, workshops and other events.
- An assessment of the fiscal impact of natural disasters and identifying potential budget gaps in post-disaster needs are crucial steps in engaging in dialogue with Finance Ministries.

An evaluation of the World Bank's Catastrophe Drawdown Option (CAT-DDO) for Guatemala highlighted that a better definition of outcomes and indicators would have made it easier to measure

progress and evaluate accomplishments (Hinds, 2011), while a GFDRR / World Bank evaluation of Mexico's Natural Disaster Fund (2012) suggested additional analysis is required to strengthen understanding of disaster risk.

To address the lack of evidence in these areas, the Impact Appraisal Project has commissioned 16 research papers to address the shortcomings in the current literature. The key findings of these papers are set out in the following sections.

### 3.2 PATHWAYS TO IMPACT

**Dana and von Dahlen (2014) introduce seven potential pathways to impact for sovereign DRFI:**



- a) **Access to capital:** Disasters provide opportunities for high impact public expenditure, but limited resource availability, especially in low income economies, can constrain such expenditures. As a central pathway to impact, the three papers in this collection of background papers on public finance and macroeconomics provide insights into how one could appraise the impact of access to capital.<sup>3</sup>
- b) **Speed:** Early response following a natural disaster saves lives, and a growing body of research provides evidence to support that claim. For example, in Clarke and Hill's (2013) cost benefit

<sup>3</sup> Bevan and Cook (2014, in this collection of background papers), Hallegatte (2014, in this collection of background papers), and Fattal Jaef (2014, in this collection of background papers).

analysis of the Africa Risk Capacity, a perfectly targeted food security response of USD 400 to an affected household within two months of harvest could lead to impact worth USD 1294.

- c) **Autonomy:** Sovereign DRFI programs can provide governments with an important degree of autonomy, which can provide important political economy incentives for public investments and local sourcing of goods and services to support response and recovery. De Janvry (2014, in this collection of background papers) posits that the political economy aspects of this could perhaps be quantified in countries like Mexico which have a long track record of financial protection against disasters;
- d) **Market signals:** DRFI programs provide sovereigns with incentives and opportunities to send clear signals to the market about what risks the government will cover and what the government will do to respond to a disaster event. De Janvry (2014) presents examples and proposal for how such impacts could be quantified.
- e) **Knowledge:** Whilst quantifying the benefits of additional knowledge can be extremely challenging, it is possible if that knowledge leads to action. For example, according to the World Development Report (2014) early warning systems have a benefit-cost ratio of over 4;
- f) **Discipline:** Sovereign DRFI strategies have the potential to help governments overcome some of the more challenging issues related to discipline by promoting policies which are credible, predictable, transparent, and sustainable. De Janvry (2014) presents examples and proposal for how such impacts could be quantified.
- g) **Financial management capacity:** Implementation of a sovereign DRFI program can support the building of financial, legal and regulatory capacity within a country, which can in due course be applied to other types of high value public financial transactions.

See Dana and von Dahlen (2014) for further discussion of these pathways.

**Depending on the context and recent history, it may be possible to accurately identify some of these types of impact through careful ex-post assessments, such as randomized controlled trials.**

For example, de Janvry (2014), Bevan and Cook (2014), and Hallegatte (2014) suggest that questions such as how the establishment of sovereign DRFI programs can change ex-ante behaviour, what the impact of cuts and spending was, and how large macroeconomic multiplier effects are could all be identified through carefully designed studies.

**However, in general it will be necessary to build appraisals on the foundations of catastrophe risk models.** Whilst historical or hypothetical scenarios can be useful for understanding costs and benefits, scenarios alone cannot provide a solid foundation for appraisal.

**Evaluating sovereign DRFI programs will clearly require both further investments in the generic evidence base and carefully calibrated structural models build on catastrophe risk models.**

### 3.3 IMPACT APPRAISAL METHODOLOGY

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**It is not possible to evaluate the development impact of a sovereign DRFI strategy without taking into account what expenditure it is financing.** In general, it is not possible to evaluate the *development* impact of any financial instrument (loan, savings, insurance, etc.) without understanding what it is being used for. In general, a sovereign DRFI program with poor budget targeting and execution, or high leakage will have low development impact regardless of how cost effective the financing strategy. For example, holding a reinsurance policy that provides a government with quick funds in the aftermath of a disaster will have low development impact if the government's execution of

these funds is slow and poorly targeted. By contrast, acquiring and using additional financing to quickly scale up an efficient social safety net may have very high development impact.

**Evaluating a sovereign DRFI program will therefore require evaluation of both the development impacts of expenditure, and the cost efficiency of risk financing.** For example, one can evaluate a social safety net that automatically scales up in response to disasters and its associated DRFI strategy, or a program for reconstruction of public assets and its associated DRFI strategy, but one cannot in general directly assess the development impact of either of these DRFI strategies in isolation without regard to what they are financing.

**Whilst there are a number of potential questions that could be asked of sovereign DRFI programs, one useful question for decision makers is “what is the ‘average annual’ impact of the program?”**<sup>4</sup> The benefits from a sovereign DRFI program are probabilistic and typically arise only if a disaster occurs. Even after 10 years of experience from a sovereign DRFI program, the actual experience is unlikely to accurately reflect the prospective disaster risk faced in a probabilistic sense. For example, if no disasters occur at all during this period then the reinsurance policy may appear to have been poor value, whereas if a 1-in-100 year disaster occurred then the same reinsurance policy may appear to have been excellent value. Of course, experience from a sovereign DRFI program can still act as a useful *input* into an evaluation framework, for example to understand the effectiveness of post-disaster targeting and budget execution. However, it can only ever be one input into an evaluation framework and would need to be adjusted to reflect an objective view on the prospective disaster risk faced.

**Teh (2014a) motivates and defines an impact appraisal approach to sovereign DRFI, which acknowledges the annual average impact as a recognized intermediate output on the way to a full cost benefit analysis.** This paper outlines an ‘impact appraisal’ approach as a method for analyzing the impacts of DRFI strategies and provides some suggestions for the interpretation of the appraisal results. The approach is similar to that of cost benefit analysis, such as adapted by Clarke and Hill (2012) in the analysis of the African Risk Capacity Facility, but where the probabilistic distribution of opportunity costs and household-level impacts are recognized intermediate outputs as steps on the way to a full cost benefit analysis.

**The first step in the framework is to specify a credible joint strategy for contingent public expenditure and for financing this expenditure.** For example, this might involve credibly specifying how a social safety net would scale up in a disaster year and how this scaling up would be financed using a combination of budget allocation and risk transfer instruments. Specifying a credible joint strategy will require expert understanding of both the post-disaster fund execution capacity of the country, and the budgetary and risk financing instruments employed.

**Evaluating a sovereign DRFI program requires a clear counterfactual: ‘What would have been done and how would this have been financed in the absence of the DRFI program?’ (Teh 2014b).** Defining a clear counterfactual can be challenging due to the fungibility and ad hoc nature of post-disaster public expenditure.<sup>5</sup> For example, suppose that a government purchases a reinsurance policy to finance the scaling up of a social safety net in the aftermath of a potential large disaster. If the

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<sup>4</sup> For detailed discussion about this point with regards to disaster risk management interventions in general see Kull, D., Mechler, R. and Hochrainer-Stigler, S. (2013), *Probabilistic cost-benefit analysis of disaster risk management in a development context*. Disasters.

<sup>5</sup> As famously explained by Paul Rosenstein-Rodin, then Deputy Director of the World Bank’s Economics Department, in 1947, fungibility is ‘when the World Bank thinks it is financing an electric power station, but it is really financing a brothel.’

government would have partially scaled up the social safety net anyway by reallocating budget from other sectors, then the DRFI strategy is partially acting to release post-disaster resources for the government to spend on budget items other than the social safety net. If the reinsurance premium is being financed by resources being reallocated from other programs then opportunity costs of funding must be reflected in the calculation. If, instead, the premium is being financed from additional revenue then the public cost of funds must be accounted for. Timing is also important. In the current example, the DRFI strategy may allow the safety net to be scaled up more quickly than if the scaling up was financed by ex-post budget reallocation.

**If donors are financing or co-financing the DRFI program then the counterfactual must account for what this donor financing would have been used for in the absence of the DRFI program.** For example, if a donor pays a reinsurance premium on behalf of a country then the counterfactual must account for what the donor would have done with the money otherwise, and should reflect any reduction (or increase) in likely post-disaster donor assistance.

**If a sovereign DRFI strategy finances additional post-disaster expenditures, it may be reasonable to consider a simple counterfactual under which the combined financing/expenditure program is not implemented.** This contrasts with the case in which a sovereign DRFI strategy finances general budget support.

**Another key issue in developing a model-based approach to evaluation, discussed in Grenham (2014), is that of how assumptions are set.** This paper recognises that an important part of the SDRFI impact assessments will be setting appropriate assumptions, and presents an actuarial approach to setting assumptions. The paper also suggests that a principles-based approach, rather than a more prescriptive rules-based approach, would be most appropriate for the draft operational framework for impact appraisal.

**The final paper on overall methodology, Ley-Borrás and Fox (2014), presents an overview of probabilistic catastrophe risk models, and how they could be used for appraising sovereign DRFI instruments and strategies.** It also presents a decision model (an influence diagram) as a rigorous representation of the relationships between the decisions, uncertain events and consequences relevant to sovereign DRFI decision making.

### 3.4 PUBLIC FINANCE AND MACROECONOMICS

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**Disasters provide opportunities for high impact public expenditure, if funds can be mobilised and executed quickly enough.** In the aftermath of a disaster there are typically a number of opportunities for public expenditure which have high development impact. Depending on the nature of the disaster, these can include activities such as supporting livelihoods, rebuilding critical public infrastructure (e.g., water, electricity and key transportation lines) to ensure continuity of public service provision, supporting the rebuilding of low income housing, and rebuilding/repairing all affected public infrastructure.

**However, if budget mobilisation is not timely enough, or if expenditure is poorly targeted or executed the development impact of post-disaster public expenditure could be much lower.** In contrast, for a poorly targeted or poorly executed expenditure plan the marginal impact of additional post-disaster public expenditure may not be much higher than the marginal impact in normal years.

**However, quantifying the impact of public expenditure is challenging, in particular when in the form of general budget support.** For example, a major joint evaluation of Partnership General Budget

Support in 2006 concluded that ‘study teams could not confidently track distinct (separately identifiable) Partnership General Budget Support effects to the poverty impact level in most countries.’<sup>6</sup> Tracking the use of additional post-disaster financial resources may be even more challenging.

**Bevan and Cook (2014) tackle the extremely challenging questions of how disasters affect the composition and level of public expenditures, and how such impacts might be valued.** They argue that disasters may induce changes in the level, timing and composition of spending, and that there is much still to learn both about what expenditure reallocations and other adjustments are likely to take place, and about how these might be valued. Consistent with the literature on general budget support they suggest that heroic assumptions will be necessary evaluating the impact of sovereign DRFI strategies.

**Hallegatte (2014) shows that the welfare impact of a disaster depends significantly on the macroeconomic resilience of the economy to natural disasters.** Here, resilience is broken down into two components: *instantaneous resilience*, i.e. the ability to limit the magnitude of the immediate loss of income for a given amount of capital losses; and *dynamic resilience*, i.e. the ability to reconstruct and recover quickly. The paper proposes a promising rule of thumb to estimate the macroeconomic resilience. Also on a macroeconomic theme, Fattal Jaef (2014) presents a macroeconomic model with sovereign default to provide a framework for quantifying the benefits from sovereign DRFI of improved credit ratings.

### 3.5 MICROECONOMICS AND CATASTROPHE RISK MODELLING

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**A single set of household-level indicators could provide a basis for estimates of the annual average development impact of a potential or current sovereign DRFI program.** Although the accuracy of such indicators may vary depending on how much information has been collected and analysed and whether the program has been implemented, a single set of indicators may be appropriate throughout the policy cycle.

**Scott and Shepherd (2014) present such indicators, along with further metrics which could be used to measure annual average development impact.** This paper introduces a range of microeconomic indicators commonly used to measure development outcomes, such as household consumption, household assets, measures of human capital (health, education and nutrition), food security and measures of coping (insurance and social capital), and describes the survey typically used to calculate them. Examples of such impact and outcome-based indicators include:

- Average annual reduction in number of people in poverty
- Average annual reduction in number of people falling into poverty as a result of a disaster
- Average annual per capita increase in household consumption of poorest 40% of population
- Average annual per capita increase in net present value of income of poorest 40% of population
- Average annual reduction in mortality
- Average annual reduction in number of days of sickness since previous time period
- Average annual increase in child enrollment in primary / secondary school
- Average annual increase in value of agricultural assets / livestock / non-agricultural business assets
- Average annual per capita increase in household food consumption or average increase in number of meals eaten per day

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<sup>6</sup> Lister, S and Carter R (2006) ‘*Evaluation of General Budget Support, synthesis report*’, IDD & associates, International Development Department (IDD), School of Public Policy, Birmingham, UK

- Nutritional indicators such as annual average reduction in stunting or annual average increase in BMI.

The paper finishes by giving an overview of the data sources available in ten countries to be considered as the basis of the case studies in the second phase of the Impact Appraisal project.

**At the centre of the Impact Appraisal methodology is a catastrophe risk model, with outputs based on household-level impacts. 'Annual average development impact' indicators may be supplemented by '1-in-5/10/50 year development impact' indicators to reflect the modelled development impact in extreme years.** Indicators that capture the development impact of sovereign DRFI programs in catastrophic years may be of interest to decision makers. For example, even short time periods spent in extreme poverty can have long-run consequences, both for health outcomes (particularly if there are young children in the household) and for livelihoods (particularly if households have to engage in forced selling of assets to meet basic consumption needs). The paper by Anttila-Hughes and Sharma (2014) provides a brief outline of cat risk models as they currently exist, and outlines the major econometric issues involved in incorporating research from the growing literature on the microeconomic impacts of disasters into a cat model framework.

**A disaster risk model to be used for the evaluation of sovereign DRFI programs must be able to jointly model post-disaster public expenditure opportunities and disbursements from risk financing instruments.** In the above framework the same probabilistic disaster risk model is used to move from isolated scenarios to 'annual average' or '1 in X year' figures both on the expenditure and the financing side. If indexed financial instruments (e.g. parametric reinsurance or parametric cat swaps) are to be considered as financing instruments the risk model must therefore capture the correlation between public expenditure opportunities and the income from these instruments. This allows proper modeling of the extent to which expenditures match liabilities.

**As with all information feeding into the evaluation process, risk models should be able to be subject to sensitivity analysis.** For example, when modelling government's contingent liability for post-disaster reconstruction of public assets, incomplete exposure databases can lead to large model uncertainty, regardless of how accurate the hazard or vulnerability components of a model are. Similarly, when modelling food security response cost need, incomplete information about the geographical location and baseline vulnerability of people can lead to large model uncertainty that needs to be reflected in the calculation process. This model uncertainty should be conveyed through the evaluation through sensitivity analysis.

**Anttila-Hughes and Sharma (2014), Sharma and Hohl (2014), and Muir-Wood (2014) present different aspects of disaster risk modelling.**

**Muir-Wood (2014) explores how the methodologies of probabilistic catastrophe loss modelling, could be employed to investigate the impact of disasters on poverty.** It is argued that impacts on poverty can be captured by employing four key model outputs: a) direct damages and loss, b) indirect economic impacts and disruption, c) deaths and injuries and d) losses to household 'agriculture'.

**Sharma and Hohl (2014) discusses how catastrophe crop risk models can inform assessments of food security needs at the sovereign level for developing countries.**

**Anttila-Hughes and Sharma (2014) outlines the major econometric issues involved in incorporating research from the growing literature on the microeconomic impacts of disasters into a cat model framework.** They draw attention to issues arising from disasters' generally low recurrence frequencies, the likely role of difficult-to-document indirect damages in influencing total

disaster costs, and issues related to generalizing disaster response functions across different domains. They end by noting the large discrepancy between the current state of the literature on disaster impacts on microeconomic indicators and the level needed for adequate cat risk model performance, and suggest both means of closing that gap as well as potential areas for future research.

**De Janvry (2014) discusses a range of microeconomic aspects of sovereign DRFI evaluation:** (1) use of game setups to analyze the private willingness-to-pay for disaster protection through risk transfer or risk retention instruments; (2) use of ex-post analysis of existing DRFI schemes (such as Mexico's FONDEN, PACC, and Fondos) to analyze the willingness to provide political support to such schemes; (3) use of ex-post analysis of existing schemes to analyze not only the ex-post shock coping but also the ex-ante risk management impact of DRFI schemes, with the expectation that the latter can have a large effects on growth; and (4) use of mainly global data to do ex-post impact analysis of natural disasters and the resilience-enhancing value of DRFI schemes (examples exist for the disaster-impact relationship that can be extended to the role of DRFI in risk reduction, shock coping, and risk management).

### 3.6 ACTUARIAL AND REINSURANCE

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**Clarke and Poulter (2014) address the issue that the annual average cost of a DRFI strategy should combine evidence on the cost of public (or donor) funds with evidence on the cost of DRFI instruments.** Understanding the annual average cost of a sovereign DRFI strategy is a highly technical area and typically requires specialist expertise. In general, evidence from public finance on the cost of public funds or opportunity cost of acquiring by reducing other expenditures can allow estimation for the cost of state-uncontingent financing, and indicative multiples of DRFI instruments can be used to generate the additional cost of state-contingent financing.<sup>7</sup> This paper attempts to tackle the 'cost' side of cost benefit analysis for a range of potential financing strategies, from simple to highly complex. Formulae and a theoretical rationale for calculating the opportunity cost of a range of financial and budgetary instruments are presented, and the paper concludes with a series of worked examples.

**Grenham and Frost (2014) consider the issues that arise due to the fact that decisions to implement a specific SDRFI strategy, or to decide between alternative options, will be made by ministers, senior policy makers or civil servants who may not be experts in all or any of the areas that have been used in calculating the projected cost and benefits of the various sovereign DRFI strategies.** The paper sets out what they need to do to be able to understand and where necessary challenge the recommendations made by the technical experts.

## 4 CONCLUSION

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**While challenging, evaluating sovereign DRFI programs from a humanitarian perspective is a necessary precondition to enable future investment in this area from governments and donors.** The Impact Appraisal project aims to enhance the capacity of policymakers to make critical decisions as to when DRFI programs are effective components of a comprehensive approach to managing the financial risk associated with disasters.

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<sup>7</sup> The 'multiple' of a financial instrument is the expected discounted cost of the instrument divided by the expected discounted income from the instrument.

**This paper summarises the initial findings of the first phase of the Impact Appraisal project, and proposes principles for an operational framework for the evaluation of sovereign DRFI programs.** It begins to provide answers on how insights, analysis and evidence from a diverse range of technical disciplines could be combined within a coherent quantitative ex-ante framework to evaluate the impact of sovereign DRFI programs on poverty reduction and development efforts.

**Evidence on the impact of DRFI strategies is lacking, and the first phase of the Impact Appraisal project has attempted to address some of these gaps in order to develop a draft operational framework.** This is just the first step, and the operational framework will be finalized during phase 3 of the project, after pilot testing in at least five countries and additional research to strengthen the generic evidence base.

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