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Disaster Risk Financing and Insurance Program

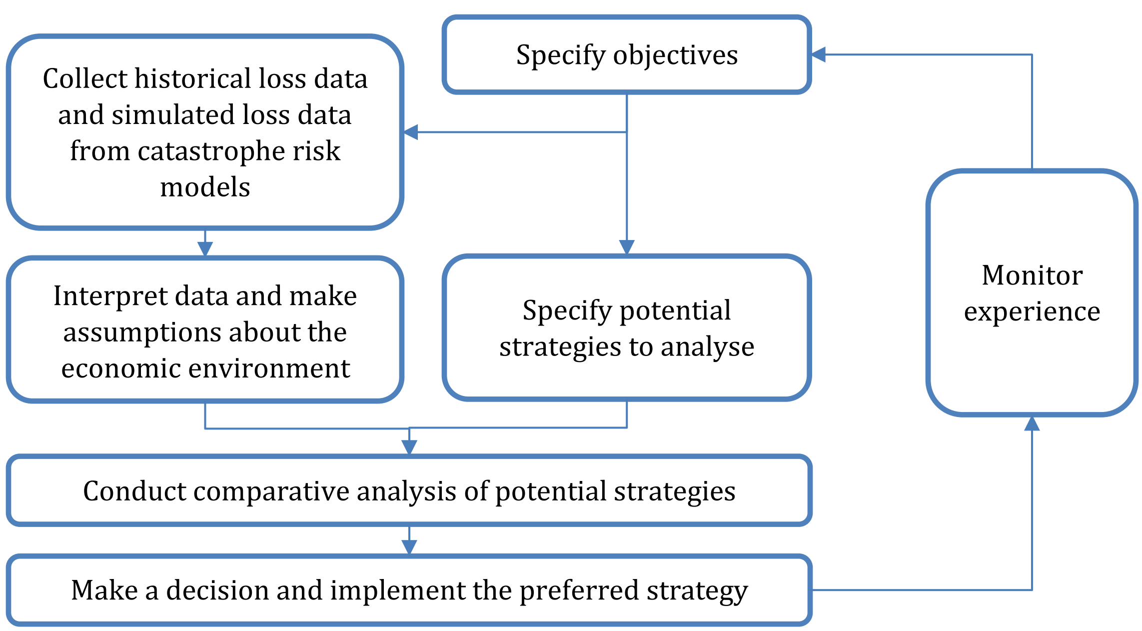
FINANCIAL RISK ANALYTICS FOR INFORMED SOVEREIGN DISASTER RISK FINANCING DECISION MAKING

Evaluating the level of financial protection and associated costs of sovereign disaster risk financing and insurance (DRFI) decisions is challenging. DRFI strategies are often presented as a combination of financial instruments, such as domestic reserves, contingent credit and catastrophe risk transfer instruments. However, governments usually lack tools to help them evaluate and quantify the costs and benefits of such strategies and answer questions like: what should be the annual budget allocation for post-disaster response? What should be the size of domestic reserves? What should be the amount of contingent credit? Shall government purchase catastrophe risk transfer instruments?

Financial risk analytics helps the decision makers evaluate the financial costs and benefits of sovereign DRFI strategies. Understanding the financial implications of alternative sovereign DRFI strategies requires detailed financial analysis. For example, understanding the tradeoff between the quality of financial coverage and its price requires some quantitative financial analysis. The results of financial analysis can also be used to document and justify the process of sovereign DRFI decision making.

Disaster risk analytics builds a financial interface between technical information generated by catastrophe risk models and financial decision making processes (Figure 1). Catastrophe risk models provide technical risk information (such as simulated losses, average annual losses, probable maximum losses, etc.) that cannot be directly used for the purposes of financial decision making. By comparison, the objective of disaster risk analytics is to provide comparative analysis of different potential disaster risk financing and insurance strategies. Disaster risk analytics process the outputs of catastrophe risk models to help decision makers understand, assess and ultimately make decisions about financial strategies against natural disasters.

FIGURE 1. FLOWCHART FOR FINANCIAL DECISION MAKING



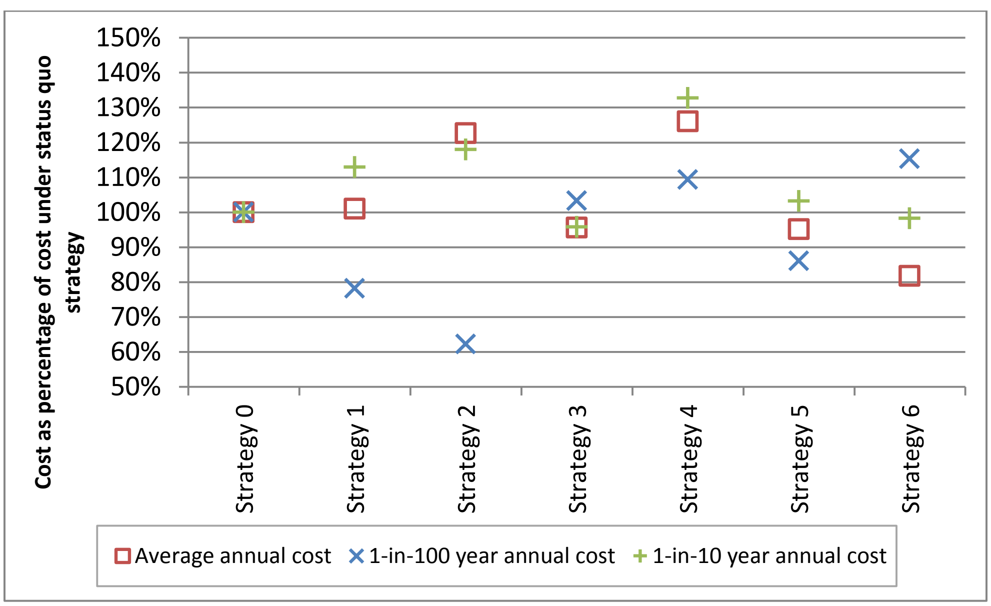
Robust, flexible DRFI analytic decision tools allow decision makers to compare alternative financial strategies in real-time and support sound, cost-effective financial decision making. Such financial tools can be developed as Excel spreadsheets with a mixture of user inputs, financial calculations, and results. Appropriate presentation of results can help decision makers to answer specific questions and to support their decision making process. The following are three illustrative examples developed by the World Bank/GFDRR DRFI Program.

ILLUSTRATIVE DECISION TOOL 1: HELPING A MINISTRY OF FINANCE DESIGN A DRFI STRATEGY

In this illustrative example (based on a real case), the government has already implemented a sophisticated sovereign DRFI strategy, but requests support in understanding how a range of alternative strategies might compare in terms of the level of protection offered and the associated cost. The differing strategies include a range of risk transfer (e.g. excess of loss reinsurance, indexed insurance, cat swap, etc.), risk retention (e.g. domestic reserves or contingent credit) and budgetary (e.g. annual or multi-year budget allocation) mechanisms and could not be meaningfully compared without detailed quantitative analysis.

Figure 2 presents a comparative summary of the differing levels of protection (in terms of the 1-in-10 and 1-in-100 year cost retained by the government) and average costs (in terms of the average annual cost) as calculated by the disaster risk analytics decision tool. If the objective of the government is to minimize its annual average cost, strategy 6 (retention only) is optimal; however it exposes the government to higher costs when a 1-in-100 event strikes. On the contrary, strategy 2 (high level of reinsurance coverage) allows the government to minimize its cost in the event of a 1-in-100 year disaster, but the average annual cost is higher.

FIGURE 2. COMPARING COST AND PROTECTION FOR A RANGE OF SOVEREIGN DRFI STRATEGIES



ILLUSTRATIVE DECISION TOOL 2: HELPING A MINISTRY OF FINANCE TO DESIGN A PARAMETRIC CATASTROPHE SWAP FOR EARTHQUAKE RISK.

In this illustrative example (based on a real case), the government has been approached by reinsurance companies presenting different proposals for catastrophe swaps to protect their debt against earthquake risk, and requested support from the World Bank to better specify its preferred schedule of coverage and evaluate those proposals. A disaster risk analytics decision tool is developed, building on the probabilistic earthquake hazard module developed by the government's earthquake authority. The decision tool allows the user to input a range of alternative parametric triggers and coverage levels for different at-risk geographical areas, and presents metrics such as the estimated technical premium and the expected frequency of claim payments for the selected user inputs. This allows the Ministry to better understand the cost of changing the triggers and coverage levels for different risk units.

FIGURE 3. COMPARING COST FOR A USER-DEFINED CATASTROPHE SWAP FOR EARTHQUAKE RISK

Insurance Model

Risk Unit	*Include Risk Unit?*	*Payout Type*	*Attachment point (Magnitude)*	*Smoothed attachment point - Return Period*	*Exhaustion point (Magnitude)*	*Smoothed exhaustion point - return period*	*Annual probability that a payment occurs from at least one element of cover*	*Annual average payout from layer (USD)*
Risk Unit 1	Yes	Linear	5.58	15	7.99	802	7%	11,600
Risk Unit 2	Yes	Linear	6.37	15	7.99	398	7%	13,400
Risk Unit 3	Yes	Linear	5.25	15	7.99	1,720	7%	10,100
Risk Unit 4	Yes	Linear	6.27	15	7.99	815	7%	16,200
Risk Unit 5	Yes	Linear	5.22	15	7.49	1,405	7%	13,600
Risk Unit 6	Yes	Linear	6.47	15	7.99	982	7%	17,000
Risk Unit 7	Yes	Linear	6.64	15	7.49	116	6%	30,600
Risk Unit 8	Yes	Linear	6.65	15	7.49	107	6%	31,500
Risk Unit 9	Yes	Linear	7.04	15	7.49	29	6%	46,700
Risk Unit 10	Yes	Linear	5.83	15	7.49	663	6%	16,900
Risk Unit 11	Yes	Linear	5.77	15	7.99	1,086	6%	12,600
Risk Unit 12	Yes	Linear	5.23	15	7.49	1,106	7%	12,700
Risk Unit 13	Yes	Linear	6.12	15	7.49	269	6%	14,500

Outputs

Total annual average payout (USD)	247,400
Probability a payout occurs from at least one risk unit	58%

1. Assuming the product has no aggregate coverage limit

Total Coverage	13,000,000
Payout rate	1.90%

2. Assuming the product has aggregate coverage limit equal to the Insurance Coverage entered

Total Coverage	1,000,000
Payout rate	24.74%

Note: Option 2 outputs overestimate the payout rate. This overestimation is only small if the probability that a payout occurs from at least one risk unit is low.

ILLUSTRATIVE DECISION TOOL 3: HELPING MINISTRIES OF FINANCE SELECT CATASTROPHE RISK INSURANCE COVERAGE FROM DIFFERENT COVERAGE OPTIONS.

Five Pacific Island Countries requested support in choosing from a range of different catastrophe index insurance contract options offered through the Pacific Catastrophe Risk Insurance Pilot. As part of the capacity building process, the World Bank developed a disaster risk analytics decision tool which allows Ministries of Finance to better understand the coverage options offered by presenting a range of comparative metrics (Figure 4) and ultimately to select their insurance preferred coverage.

FIGURE 4. COMPARING METRICS FOR THREE INDEX INSURANCE COVERAGE OPTIONS

Country-specific risk profile

Inputs

Modeled government emergency loss from event in USD	20,000,000
Modeled Peril	Tropical Cyclone
Display style: select 'Advanced Display' to show Strategy D, which allows the user to input a custom insurance purchase strategy.	Normal Display

Colour coding

Input - feel free to change
Formula - do not change

Calculations

A loss from a tropical cyclone at least this large is expected to occur with annual probability...	1.70%
A loss from a tropical cyclone at least this large is expected to occur on average approximately once every...	59 years

	Strategy A: 1-in-10 year per-peril attachment points	*Strategy B: 1-in-15 year per-peril attachment points*	*Strategy C: 1-in-20 year per-peril attachment points*
The insurance claim payment under each strategy would be:	2,630,000	2,740,000	2,800,000
The retained loss under each strategy would be:	17,370,000	17,260,000	17,200,000

Details of three different strategies

	Strategy A		*Strategy B*		*Strategy C*	
	Earthquake and Tsunami cover	*Tropical Cyclone cover*	*Earthquake and Tsunami cover*	*Tropical Cyclone cover*	*Earthquake and Tsunami cover*	*Tropical Cyclone cover*
Attachment point (years)	10	10	15	15	20	20
Attachment point (USD)	1,110,000	2,620,000	1,530,000	4,160,000	2,340,000	5,950,000
Exhaustion point (years)	150	150	150	150	150	150
Exhaustion point (USD)	24,640,000	40,400,000	24,640,000	40,400,000	24,640,000	40,400,000
Annual average loss in layer (USD)	480,000	840,000	440,000	720,000	390,000	610,000
Full loss limit (USD)	23,530,000	37,780,000	23,110,000	36,250,000	22,300,000	34,450,000
Ceding Percentage	15.1%	15.1%	17.3%	17.3%	19.9%	19.9%
Coverage Limit (USD)	3,560,000	5,720,000	4,000,000	6,270,000	4,450,000	6,870,000
Annual probability that a claim payment occurs from at least one element of cover	19%		13%		10%	

Note: Figures are highly indicative. Coverage limit may change depending on market conditions. Under all strategies the Ceding Percentage is set so that the total expected claim payment (over both policies) is US$200,000.

CONTACTS

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