THE FISCAL IMPLICATIONS OF HURRICANE STRIKES IN THE CARIBBEAN

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INTRODUCTION

- Losses due to tropical storms are estimated to be about $US 26 billion annually
- Caribbean: extreme weather may cost up to 9% of GDP annually by 2050 (CCRIF, 2014)
- Fiscal sector of Caribbean economies particularly vulnerable because:

    (1) limited budget capacity → limited financial reserves,

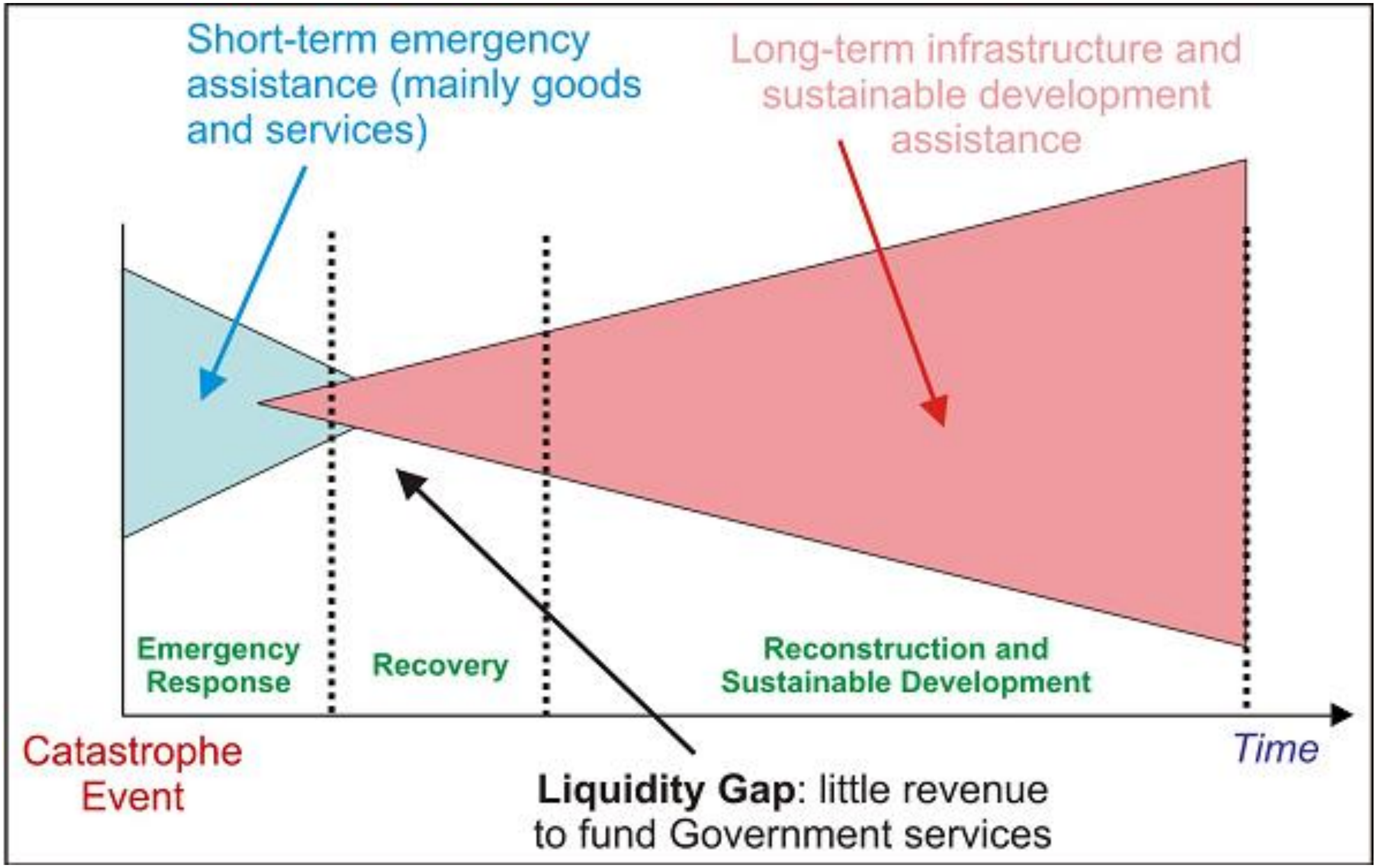
    (2) high level of debt →limited access to credit

    (3) high transaction costs of the small market → restricted access to private catastrophe insurance

    (4) International aid is too slow to arrive

INTRODUCTION

→ Potentially large Liquidity Gap immediately after a natural disaster



INTRODUCTION

- Grenada: Hurricane Ivan (2004)
- Fiscal vulnerability → Creation of the Caribbean Catastrophe Insurance Facility (CCRIF)
- CCRIF: multi-country risk pooling, parametric insurance scheme that provides members with ‘immediate’ fiscal relief when tropical storm occurs
- Since 2007 CCRIF has made payouts for 4 tropical storm events of nearly $US 24 million

INTRODUCTION

- Payouts are made according to storm characteristics, country's risk profile, and chosen coverage
- But chosen coverage should be based, amongst other things, on a country's expected fiscal impact, but little empirical evidence of the size of this
- Literature: Lis and Nickel (2009), Melecky and Raddatz (2013), Noy and Nualsri (2011), and Ouattara and Strobl (2013) → evidence mixed
- But all use annual data, whereas concerns about liquidity gaps are really with regard to much shorter periods (0-4 months?)

INTRODUCTION

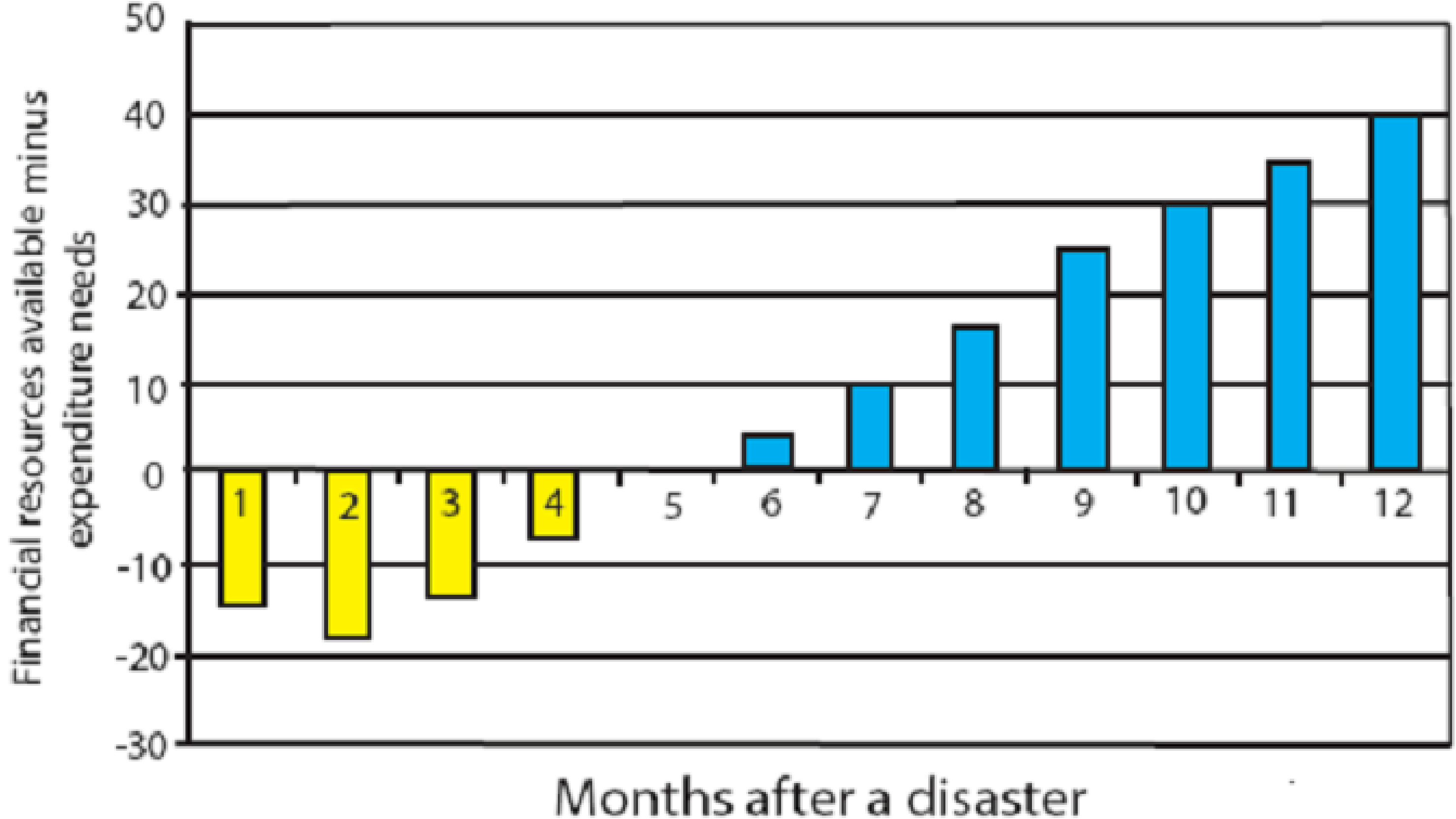


Figure 1: Liquidity Gap

INTRODUCTION

THIS PAPER:

a. Assembles panel of monthly data on fiscal expenditure and revenue for 12 Caribbean countries over the period 2000-2012

b. Estimates the impact of tropical storm damages on the fiscal sector

c. Makes predictions with regard to expected fiscal impact

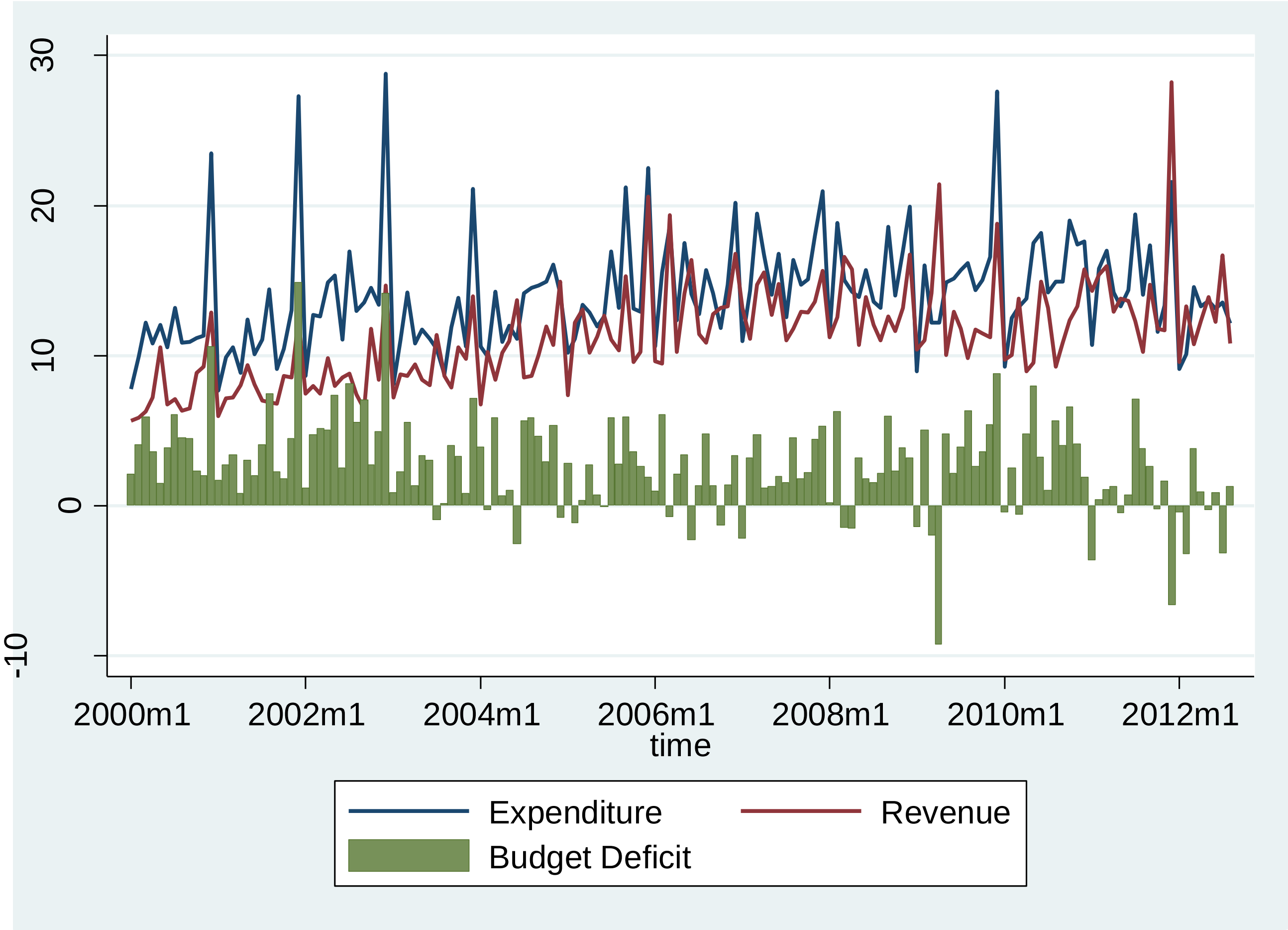
DATA

Government Revenue & Government Expenditure:

- Compiled from a number of sources (Central Banks, Statistical Offices etc.)
- Countries covered (12): Anguilla, Antigua & Barbuda, Bahamas, Barbados, Dominica, Grenada, Haiti, Jamaica, St. Kitts & Nevis, St. Lucia, Montserrat, St. Vincent & Grenadines
- Sample period: 2000-2012
- (nearly) balanced panel
- Note: all countries in our sample run a mean monthly budget deficit!

DATA

Ex: St. Kitts & Nevis – Fiscal Sector



DATA

Tropical Storm Losses:

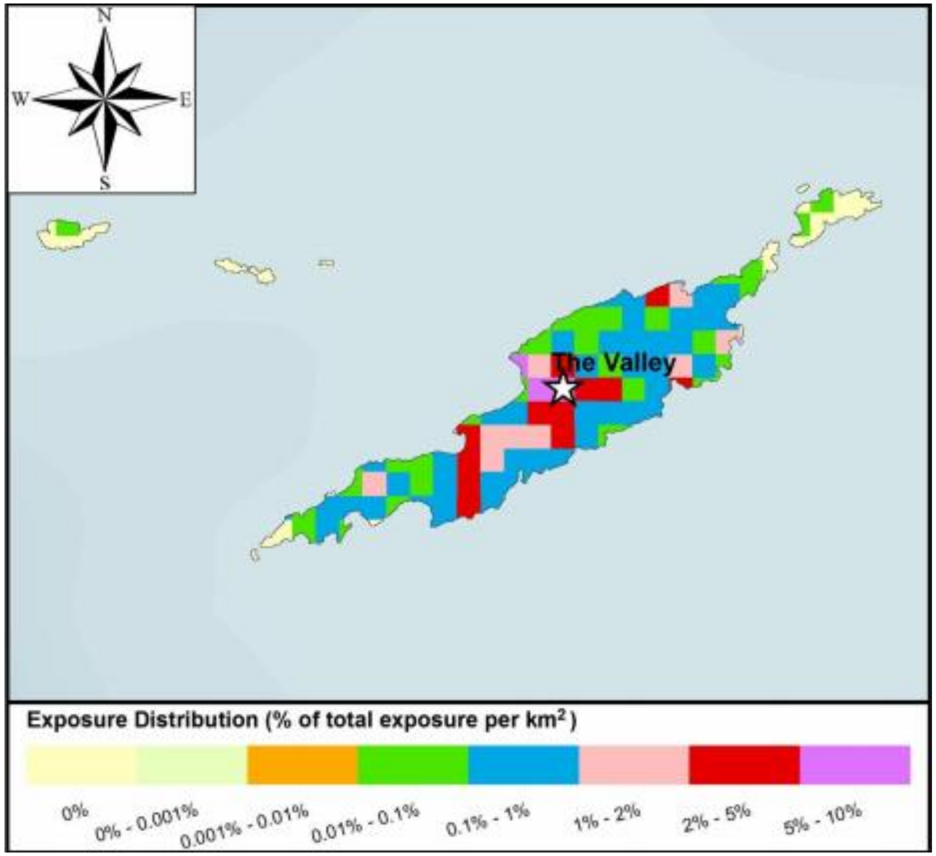
- Ex-post Damage data: (1) prone with measurement error; (b) likely to introduce endogeneity bias
- We here use “ex-ante” losses from CCRIF’s 2G Hazard & Loss Model:

  a. Divides countries into 30 arc-second pixels & estimates their asset values

  b. Uses damage functions & storm characteristics to calculate asset loss for each pixel due to wind and storm surge

→ total asset loss for each island for each tropical storm

DATA


N
W
E
S
The Valley
Exposure Distribution (% of total exposure per km^2)
0%
0% - 0.001%
0.001% - 0.01%
0.01% - 0.1%
0.1% - 1%
1% - 2%
2% - 5%
5% - 10%

DATA

	Nr. of Storms	Mean Loss (% pts of exposure)	Max. Loss (% of pts of exposure)
ANGUILLA	9	0.19	1.23
ANTIGUA & BARBUDA	6	0.02	0.11
BAHAMAS	23	0.04	0.33
BARBADOS	7	0.05	0.11
DOMINICA	2	0.08	0.15
GRENADA	7	0.69	4.23
HAITI	19	0.03	0.13
JAMAICA	12	0.14	0.47
ST. KITTS & NEVIS	7	0.03	0.11
ST. LUCIA	7	0.06	0.14
MONTSERRAT	6	0.05	0.11
ST. VINCENT & GRE.	10	0.05	0.12

ECONOMETRIC METHODOLOGY

Panel VARX specification:

$$y_{i,t} = \sum_{j=1}^{p} \varpi_{ij} y_{i,t-j} + \sum_{k=0}^{s} \xi_k x_{i,t-k} + \sum_{i}^{N} \gamma_i + \sigma_{i,t}$$

y: endogenous variables (revenue & expenditure); x: exogenous variable (hurricane loss); γ: country specific fixed effects;

σ: error term

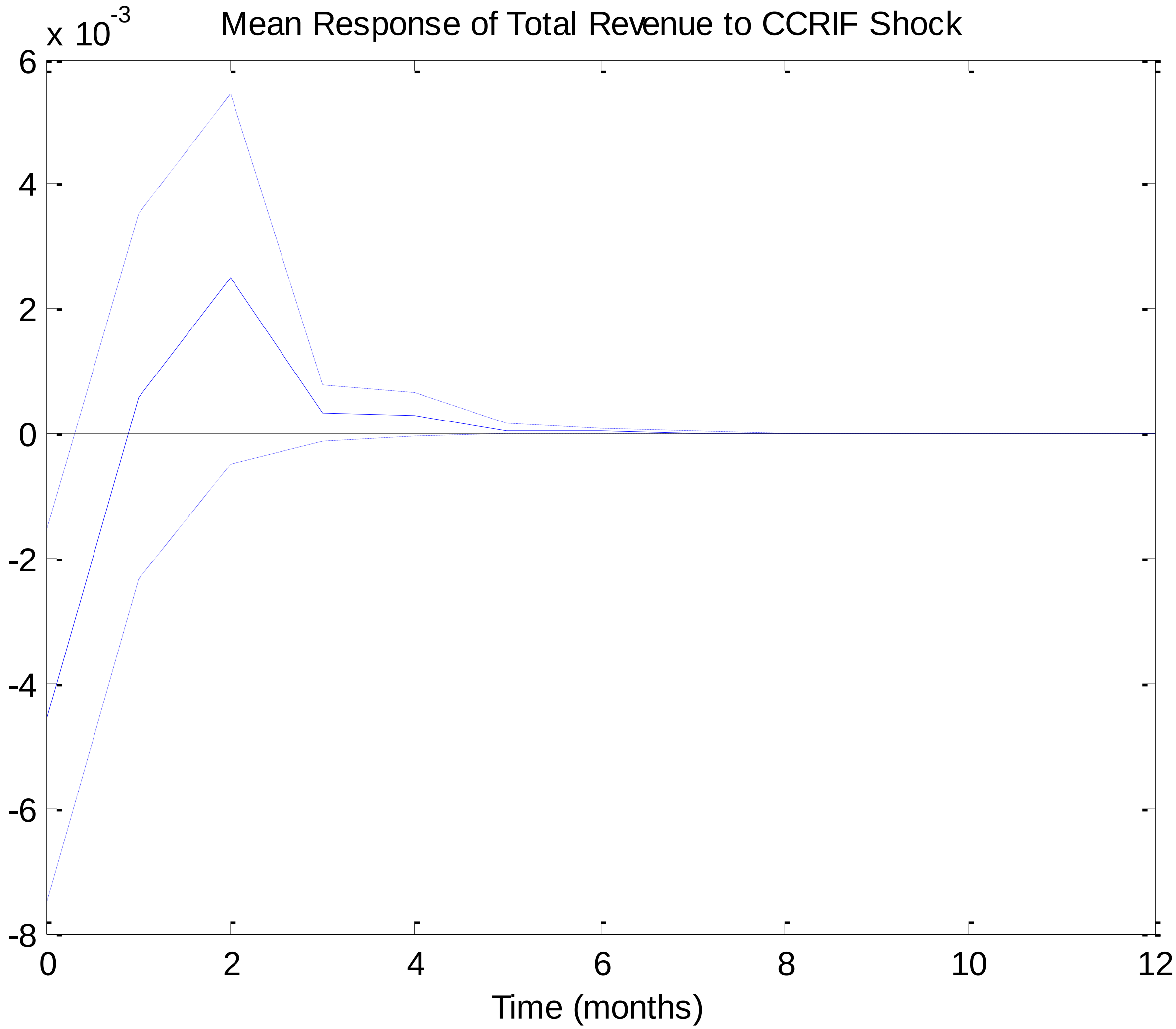
Estimation Method: bias-corrected LSDV (Fomby et al, 2013)

Panel root tests → all variables were stationary

AIC and SBC criteria → maximum of 12 month lags

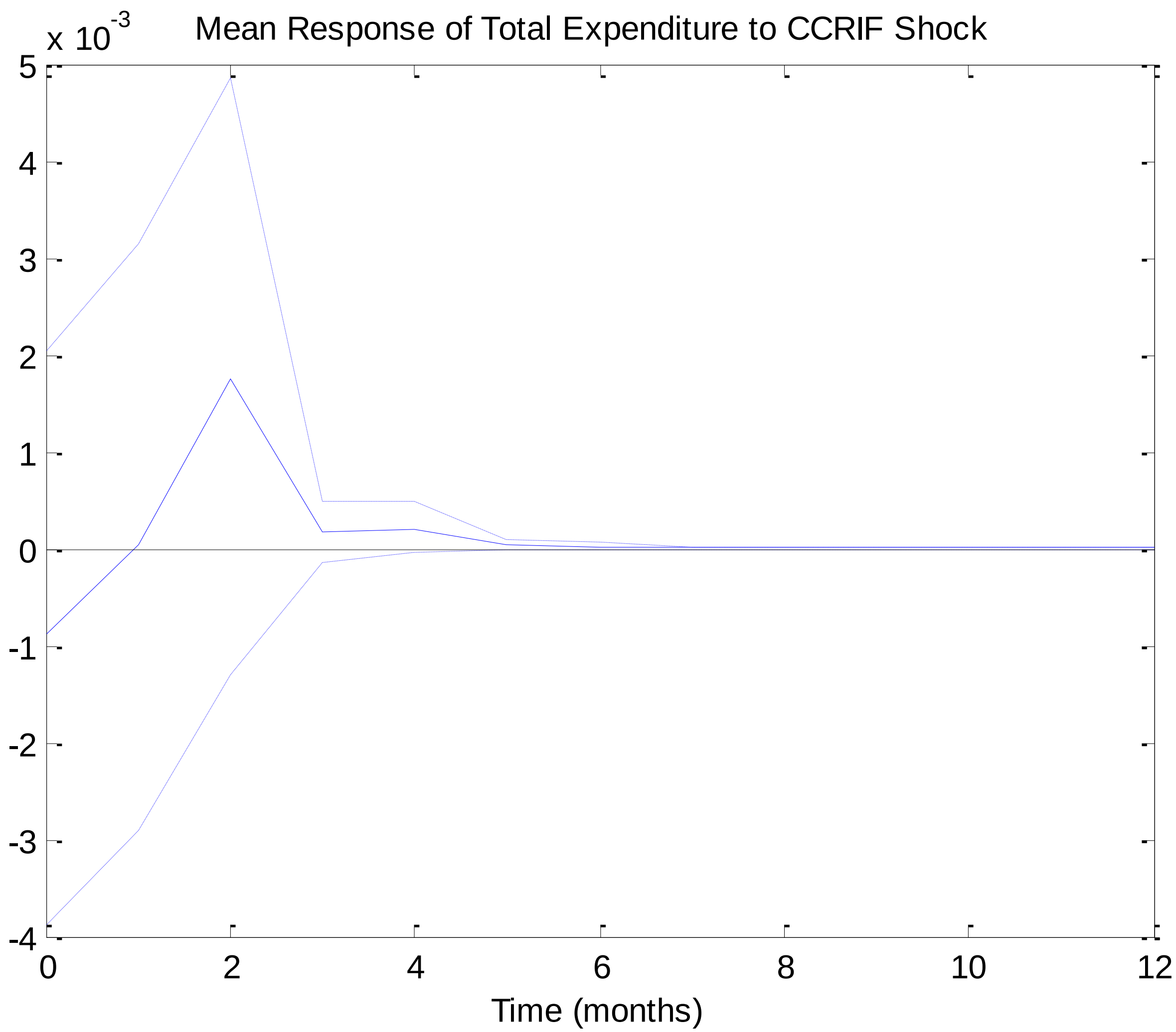
ECONOMETRIC RESULTS

Government Revenue



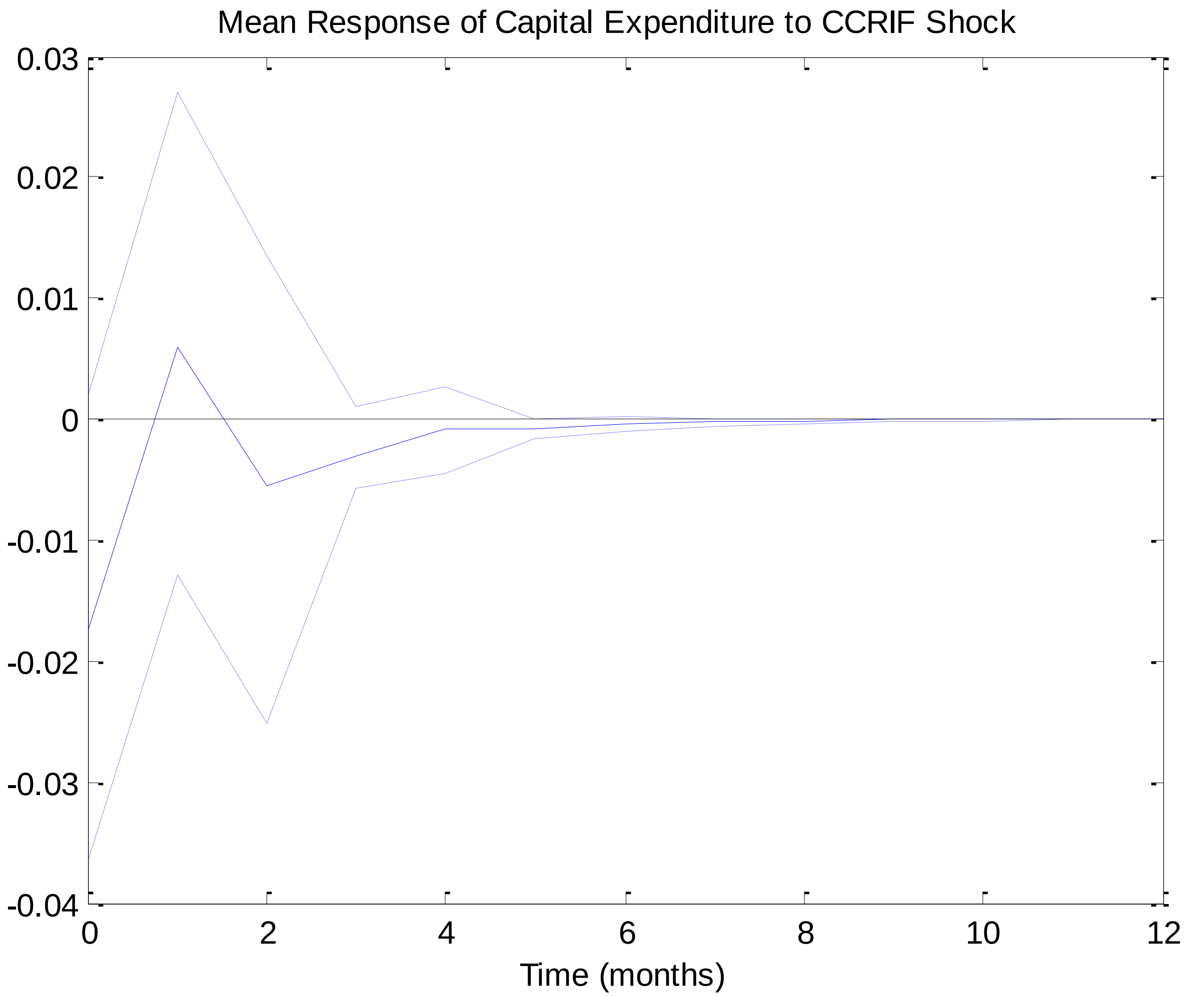
ECONOMETRIC RESULTS

Government Expenditure



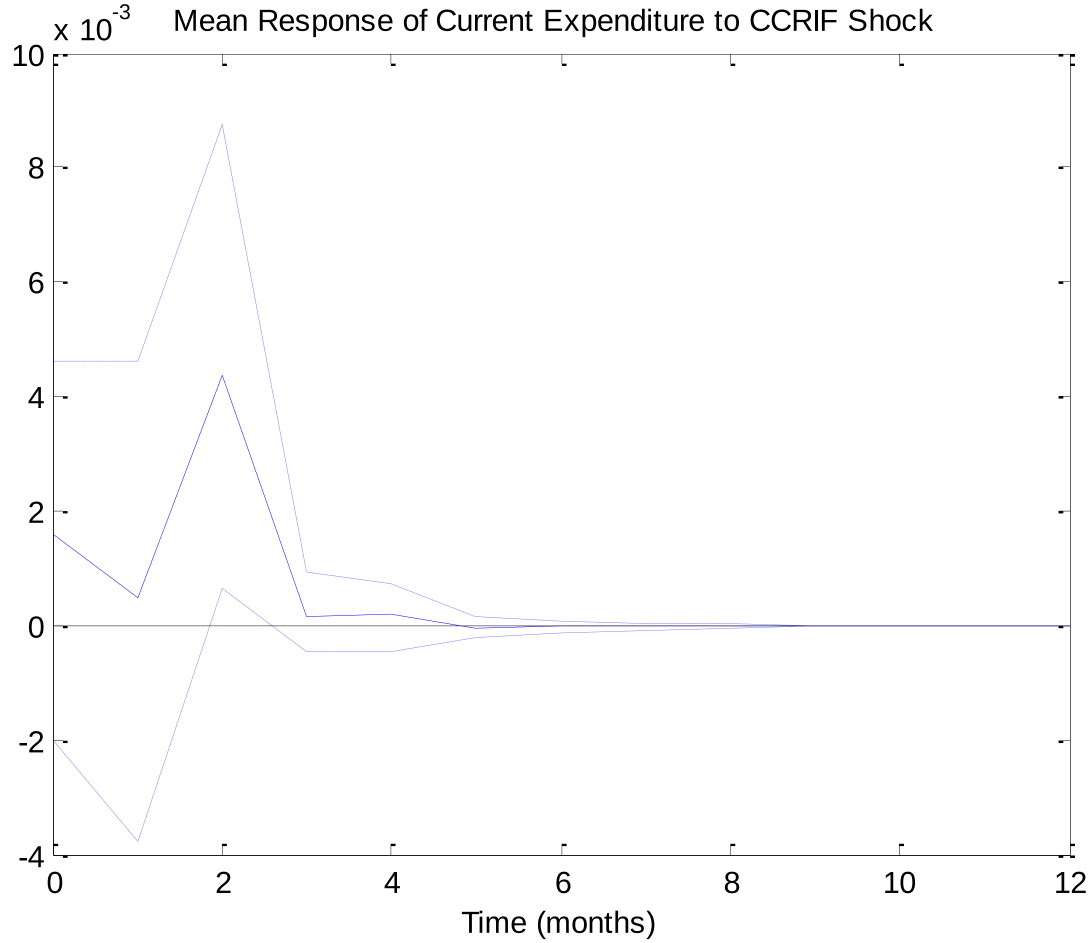
ECONOMETRIC RESULTS

Government Capital Expenditure



ECONOMETRIC RESULTS

Government Current Expenditure



ECONOMETRIC RESULTS

Economic Significance

Revenue:

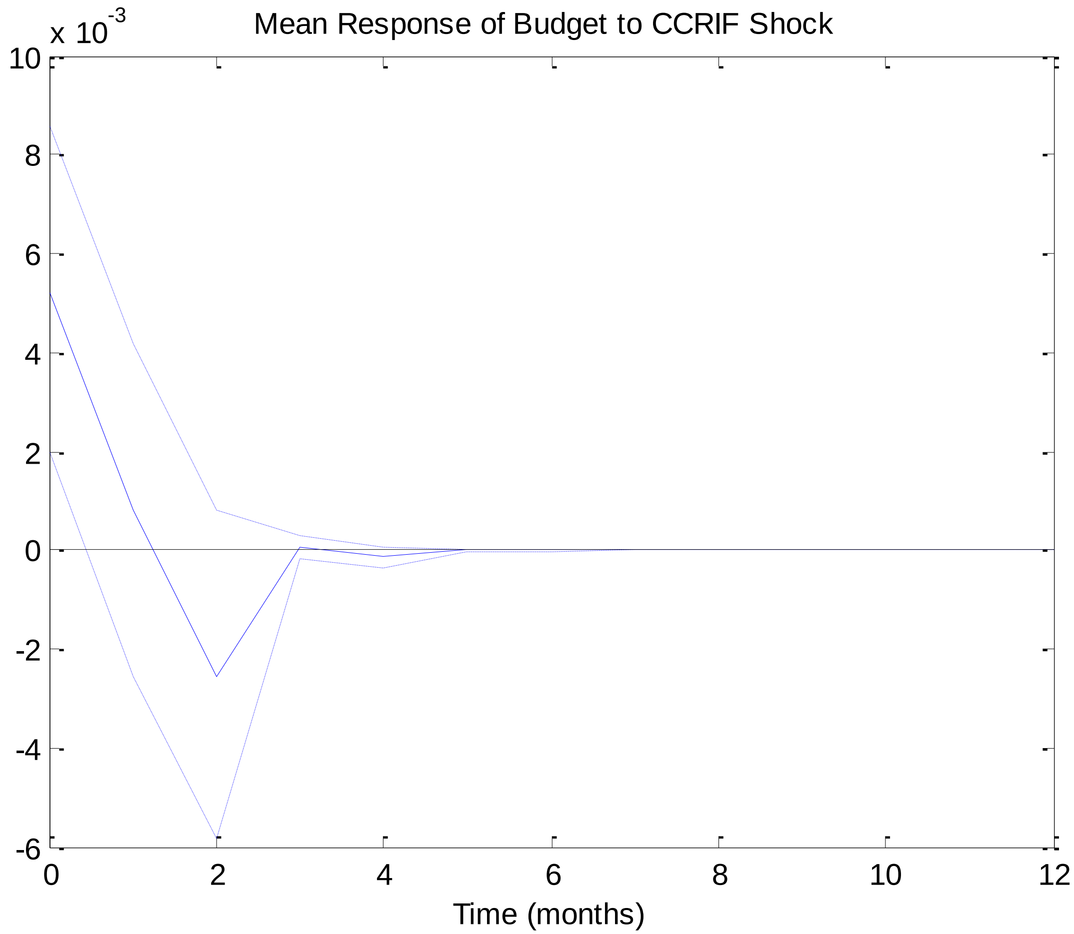
- Average impact of a damaging storm → 17.6 per cent of monthly revenue
- Largest observed event over 2000-2012 → 300 per cent of monthly revenue (Hurricane Ivan for Grenada)

Current Expenditure:

- Average impact of a damaging storm → 16.8 per cent of monthly current expenditure
- Largest observed event over 2000-2012 → 255 per cent of monthly current expenditure

ECONOMETRIC RESULTS

Government Budget Deficit



ECONOMETRIC RESULTS

Economic Significance

Budget Deficit Increase:

- Average impact of a damaging storm → 20.3 per cent of monthly revenue
- Largest observed event over 2000-2012 → 347 per cent of monthly revenue

ECONOMETRIC RESULTS

Comparison to CCRIF Payouts

		Budged Deficit	CCRIF Payout
Tropical Cyclone Earl (2010)	**Anguilla**	**3,991,048**	**4,282,733**
Tropical Cyclone Thomas (2010)	**Barbados**	**11,936,235**	**8,560,247**
Tropical Cyclone Thomas (2010)	**St. Lucia**	**2,617,366**	**3,241,613**
Tropical Cyclone Thomas (2010)	**St. Vincent & Gr.**	**1,782,300**	**1,090,388**

EXPECTED FISCAL GAP

- A country's choice of policy will depend on its expectations
- Example - Country A wants to know the *Return Period* of an event that causes a 10 per cent budget deficit (relative to monthly revenue):

$$\mathrm{Re}turnPeriod = \frac{1}{\Pr(damage \geq damage^*)} = ?$$

so that:

$$\frac{\beta_{BudgetDeficit}\, damage^*}{\overline{revenue}_{damage=0}} = 0.1$$

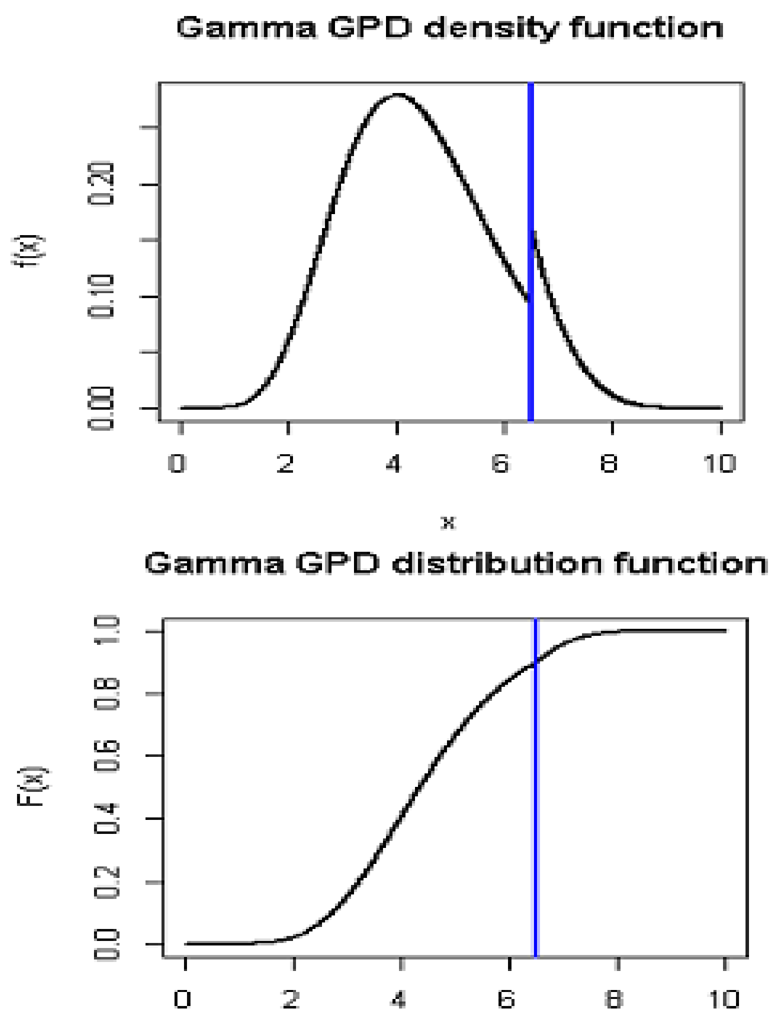
EXPECTED FISCAL GAP

- How to estimate Pr(damage ≥ damage*)?
- Hurricanes are relative rare events that take on extreme values → heavy tail distributions → extreme value distributions
- General approach in the literature: use of a peak over threshold model
- Problem: uncertainty associated with choice of threshold

EXPECTED FISCAL GAP

- Solution: extreme value mixture models
- Parametric Bulk Model (Behrens et al, 2004)
  - Gamma Distribution model below the threshold
  - Generalized Pareto Distribution model above threshold
  - Threshold endogenously determined
- But: asymptotic properties still not well understood

EXPECTED FISCAL GAP



EXPECTED FISCAL GAP

- Estimated the parametric bulk model for each country separately using data from CCRIF Loss model for storms from 1855-2012
- Calculated 1 / Pr(damage ≥ damage*), i.e., the return period of damage*

Return periods:

Country	10%	50%	100%	Country	10%	50%	100%
ANGUILLA	19	45	57	***HAITI***	11	35	83
	[16, 25]	[41, 54]	[55, 64]		[10, 13]	[33, 37]	[82, 86]
ANTIGUA	7	44	166	***JAMAICA***	13	58	68
& BARBUDA	[7, 9]	[41, 49]	[163, 176]		[12, 15)	[55, 66)	[55, 61]
BAHAMAS	12	29	165	***ST. KITTS***	8	59	165
	[11, 13)	[28, 30)	[163, 168)	***& NEVIS***	*[7, 9)*	*[55, 65)*	*[163, 178)*
BARBADOS	10	60	86	***ST. LUCIA***	11	171	186
	[9, 11)	[55, 74)	[82, 97]		*[10, 14)*	*[163, 221)*	*[163, 205)*
DOMINICA	31	58	85	***MONTSERRAT***	45	57	67
	[28, 48]	[55, 81]	[82, 110]		[42, 83]	[55, 98]	[55, 98]
GRENADA	15	85	168	***ST. VINCENT***	10	168	174
	[13, 16]	*[82, 107]*	*[163, 215]*	**& GRENADINES**	[8, 12]	[163, 193]	[163, 182]

CONCLUSION

- Estimated the impact of hurricane strikes on the fiscal gap of Caribbean countries
- Found this to be potentially sizeable

Future Research:

- Advantages of Risk Pooling? Should other countries join?
- Budget Reallocation?