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EASTERN CARIBBEAN CURRENCY UNION

Selected Issues

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Contents Page

Executive Summary 4

I. ECCU Business Cycles: Impact of the United States 6

Table 1. Growth Elasticities in the Caribbean 8

Figure 1. ECCU: Responses to One Percent U.S. Growth Shock 8
Figure 2. Antigua and Barbuda: Responses to One Percent U.S. Growth Shock 8

II. Optimal Reserves in the ECCU 9

Figure 1. ECCU: Optimal Level of Reserves Given Different Shocks to the Current Account 11
Figure 2. ECCU: Optimal Level of Reserves: Different Intensities of Bank Run 11
Figure 3. ECCU: Optimal Level of Reserves: Different Intensities of Projected Bank Run 11

III. Ponzi Schemes in the Caribbean 12

Table 1. Some Speculative Data on Selected Investment Schemes 14

IV. Assessing Exchange Rate Competitiveness in the ECCU 15

Figure 1. ECCU: Actual and Equilibrium REER, 1979–2008 17
Figure 2. ECCU: Contributions to Changes in Equilibrium Exchange Rates, 1982–2008 17

Figure 3. ECCU: Current Account Deficit, Actual and Estimated Norms 17
Figure 4. ECCU: Contributions to Current Account/GDP Norm, 1979–2008 17

V. A Risk Analysis of Public Debt in the ECCU: A Fan Chart Approach 18
A. Introduction 18
B. Literature Review 19
C. Methodology 20
D. Data Analysis 22
E. Concluding Remarks 27

References 28

Table 1. ECCU: Fiscal Reaction Function, 1984–2007 31
Table 2. Antigua and Barbuda: Fiscal Reaction Function, 1986–2007 32
Table 2a. Dominica: Fiscal Reaction Function, 1984–2007 32
Table 2b. Grenada: Fiscal Reaction Function, 1989–2007 33
Table 2c. St. Kitts and Nevis: Fiscal Reaction Function, 1984–2007 33
Table 2d. St. Lucia: Fiscal Reaction Function, 1984–2007 34
Table 2e. St. Vincent and the Grenadines: Fiscal Reaction Function, 1990–2007 34
Table 3. Caribbean Countries: Fiscal Reaction Function 35
Table 4. Selected Emerging Markets: Estimates of the Fiscal Reaction Function, 1990–2004 35
Table 5. Antigua and Barbuda: VAR Model 36
Table 5a. Dominica: VAR Model 36
Table 5b. Grenada: VAR Model 37
Table 5c. St. Kitts and Nevis: VAR Model 37
Table 5d. St. Lucia: VAR Model 38
Table 5e. St. Vincent and the Grenadines: VAR Model 38
Table 6. Antigua and Barbuda: Public Debt Risk Assessment 2008–12 39
Table 6a. Dominica: Public Debt Risk Assessment 2008–12 39
Table 6b. Grenada: Public Debt Risk Assessment 2008–12 40
Table 6c. St. Kitts and Nevis: Public Debt Risk Assessment 2008–12 40
Table 6d. St. Lucia: Public Debt Risk Assessment 2008–12 41
Table 6e. St. Vincent and the Grenadines: Public Debt Risk Assessment 2008–12 41

Figure 1. Change in Public Debt and Primary Surplus 42
Figure 2. Primary Surplus and Lagged Public Debt 43
Figure 3. Public Debt Under the First-Case Scenario, 2008–12 44
Figure 4. Public Debt Under the Best-Case Scenario, 2008–12 45

VI. Insurance Against Natural Disasters in the Caribbean 46
A. Introduction 46
B. Debt Dynamics and Natural Disasters in the ECCU 46
C. Improving Debt Sustainability with Disaster Insurance 47

D. What Impact from Climate Change? 50
E. Conclusions....50

References....52

Box 1. The Caribbean Catastrophe Risk Insurance Facility (CCRIF)....53

Table 1. ECCU: Exogeneous Shocks and Economic Policy Outcomes, 1988–2007....54
Table 2. Transfer Inflows in the Aftermath of Natural Disasters, 1970–2008 55
Table 3. Probability Distribution and Cost of Hurricanes 56
Table 4. Central Government Debt in 2020....56
Table 5. Probability Distribution and Cost of Hurricanes: Simulation for Dominica and Grenada 56
Table 6. Estimated Optimum Insurance Coverage and the CCRIF 57

Figure 1. ECCU: Estimated Cost of Hurricanes....58
Figure 2. Debt Sustainability Analysis: Central Government Debt to GDP....59
Figure 2a. Debt Sustainability Analysis: Central Government Debt to GDP....60
Figure 3. Debt Sustainability Analysis: Central Government Debt to GDP— Impact of Climate Change on Dominica and Grenada 61

EXECUTIVE SUMMARY

The analytical work associated with the Eastern Caribbean Currency Union (ECCU) 2009 Discussion on Common Policies supports the staff's advice on policies to strengthen macroeconomic stability, foster growth, enhance the resilience of the financial system, and reduce vulnerability.

The ECCU countries have not been immune to the global recession, particularly in view of their close relationship with advanced economies, and in particular, the United States, via tourism, foreign direct investment, remittances, and a common exchange rate linked to the U.S. dollar. The economic impact of these linkages are explored in **Chapter I: ECCU Business Cycles: Impact of the United States.** The analysis indicates that both the trend and cycle of output in ECCU economies are highly sensitive to movements in U.S. output and that the impact of U.S. business cycles on these economies has strengthened in recent years. Thus, the current downturn in the U.S. would be expected to have a substantial adverse impact on ECCU economies.

Under the present quasi-currency board arrangement, the Eastern Caribbean Central Bank (ECCB) is required to maintain international reserves sufficient to cover 60 percent of its demand liabilities. In practice, however, the ECCB maintains a reserve cover at about 100 percent. However, with open capital accounts and member countries highly susceptible to exogenous shocks (such as natural disasters and the current global financial crisis), **Chapter II: Optimal Reserves in the ECCU** poses the question of whether even this level of international reserves is adequate. Using a self-insurance model, the analysis finds that international reserves held by the ECCB are broadly adequate to cover current account shocks (including those associated with a typical natural disaster observed in the region) and some capital account shocks. However, in view of the financial deepening over the last decade, the ECCB would be challenged in the event of a moderate-to-severe deposit run.

The global financial crisis has brought to the fore the wide array of problematic financial schemes that can arise in an atmosphere of "irrational exuberance" combined with inadequate regulatory frameworks. Against this background, **Chapter III: Ponzi Schemes in the Caribbean** examines the emergence of unregulated investment schemes in the region and their potential economic and institutional damage. Among the key policy lessons drawn are the importance of independent financial regulators with broad authority to be proactive in investigating and prosecuting such schemes; local and international coordination and cooperation among regulators; adequate resources for enforcement; and a public that is well informed of the risks of investing with unregulated schemes.

With the common currency of the ECCU—the EC dollar—pegged to the U.S. dollar at an unchanged rate for more than three decades, a key question is the peg's impact on the region's external competitiveness. **Chapter IV: Assessing Exchange Rate Competitiveness**

in the ECCU sheds light on this question by estimating the equilibrium real exchange rate in these tourism-dependent economies. Using three different approaches, the analysis finds that the ECCU real exchange rate is close to its equilibrium level (and, in fact, is currently close to its most depreciated level in almost 20 years), and that movements in tourism-driven terms of trade and productivity are important determinants of the equilibrium exchange rate. Moreover, notwithstanding their high levels, medium-term current account deficits—largely financed by private capital flows—appear sustainable.

With public debt-to-GDP ratios among the highest in the world, a crucial determinant of macroeconomic stability for ECCU countries is whether their debt is on a sustainable trajectory. Given the risks surrounding public debt dynamics, the last two chapters explore two different approaches to securing debt sustainability within dynamic, stochastic frameworks:

- **Chapter V: A Risk Analysis of Public Debt in the ECCU: A Fan Chart Approach** uses a probabilistic approach to debt sustainability analysis and finds that for all but two countries in the region, fiscal policy does not react adequately to past debt accumulation to satisfy a condition for debt sustainability. Public debt risk profiles are derived using fiscal reaction functions which do respond to past debt, combined with estimated ECCU country-specific macroeconomic shocks. For half of the countries, there is only a low probability in the next five years of being on the right path to achieve the region's 60 percent debt-to-GDP target for 2020. The clear policy implication is that primary fiscal balances, particularly given the volatile macroeconomic region, need to be more responsive to past public debt developments to ensure that debt is placed on a solid downward path.

- **Chapter VI: Insuring Against Natural Disasters in the Caribbean** uses a stochastic simulation algorithm to examine the vulnerability of public finances to the risk of natural disasters (with a focus on hurricanes). It then illustrates how catastrophic risk insurance (such as that provided by the Caribbean Catastrophe Risk Insurance Facility) could significantly improve public debt sustainability through optimal insurance coverage—calculated, using historical hurricane data, based on cost-benefit analysis in terms of long-term debt sustainability. Comparing the optimal levels against the ECCU countries' actual insurance coverage indicates that, with one exception, all of the countries are likely significantly underinsured. Moreover, to the extent that climate change raises the frequency and intensity of hurricanes in the region, the degree of underinsurance would increase commensurately.

I. ECCU Business Cycles: Impact of the United States[1]

1. **The paper attempts to quantify the effects of U.S. business cycles on the Eastern Caribbean Currency Union (ECCU) economies, and identify the channels through which such spillovers occur**. Proximity to the United States and a fixed exchange rate between the two currencies facilitate close economic relationships and strong linkages among these economies. Given these strong linkages, ECCU economies are likely to be severely affected by the current downturn in the United States. Previous studies of business cycles in the Caribbean have shown close synchronization between developed countries and Caribbean business cycles and asymmetric real output responses over the cycle.

2. **The literature has proposed several channels through which spillovers can be transmitted from the U.S. to the ECCU**. By far the most important influence of the U.S. on the tourism-dependent ECCU countries is through tourism receipts, with trade in goods playing a much smaller role. About one third of the stayover tourists to the ECCU countries are from the U.S., the top tourist-source country. These economies are also heavily dependent on the U.S. for foreign direct investment, mainly in the tourism sector. The flow of remittances is also an important channel of influence reflecting the significant proportion of Caribbean migrants living in the U.S. Other channels of influence include financial market spillovers and official development assistance.

Two analytical approaches

3. **Following the "common trends and common cycles" approach, the paper decomposes real GDP into trend and cycle for selected Caribbean economies, treating the ECCU as a single economy**. It then estimates the growth elasticities of the cycle and trend to U.S. growth. The analysis reveals that both the trend and cycle of the ECCU economies are highly sensitive to movements in U.S. output. In particular, the growth trend and cycle in the ECCU are found to synchronize closely with those of the U.S., with estimated cyclical and trend growth elasticities close to one. Indeed, the simple growth correlation between the U.S. and ECCU (0.4) is statistically significant and the highest among all Caribbean economies in the sample. This analysis also finds that reactions to U.S. economic movements, both trend and cycle, vary significantly across Caribbean economies, with different directions and magnitudes (Table 1), suggesting that Caribbean economies may not be as homogenous a group as commonly thought.

4. **The paper also uses VAR analysis to estimate the magnitude of spillovers from the U.S. to the ECCU, and to identify different channels through which spillovers occur**. The basic VAR analysis reveals the strong impact of U.S. economic movements on the

[1] Summary of IMF Working Paper, WP/09/71, "ECCU Business Cycles: Impact of the United States," by Yan Sun and Wendell Samuel.

ECCU. However, evidence on the channels for spillover is less clear-cut and requires further investigation. U.S. monetary policy does not appear to be an important channel of influence, and tourism is statistically important for only one ECCU country.

5. **The sample was split into three sub-periods to determine whether the strength of linkages between the ECCU economies and the U.S. had changed over time** (Figure 1). The standard VAR analysis shows that over the entire sample period of 1963–2007, the ECCU economies as a whole respond to a 1 percent U.S. growth shock by rising 0.4 percentage points in the first year (1Y). The estimated response increased to 0.7 and 0.8 percentage points for the sub-samples of 1976–2007 and 1989–2007, respectively. Similar results were obtained for individual countries, confirming that the impact of U.S. business cycles on the ECCU economies has increased in recent years.

6. **To identify spillover channels, the standard VAR equation was augmented with trade and financial indicators, as exogenous variables.** The individual channel's contribution to spillovers is equal to the difference between the response in the augmented VARs and the response from the basic VARs. Consistent with the low level of financial market integration between the ECCU and the U.S., the inclusion of financial variables did not add significantly to the estimated results from the basic VAR. Similarly, world commodity prices appear not to be a significant spillover channel. There is some evidence that tourism is the main channel for spillovers. In the case of Antigua and Barbuda, the largest ECCU economy, annual growth of tourist arrivals from the U.S. helped explain about half of the response of Antigua and Barbuda to a 1 percent growth shock in the U.S. in the first year (Figure 2).

7. **Overall, the results suggest that the current downturn in the U.S. will have significant negative impacts on ECCU economies.** This would require offsetting policies to moderate the adverse impact on ECCU economic activity. However, the fixed exchange rate regime with the U.S. precludes an independent monetary policy, and fiscal policy options are limited by the already tight fiscal positions and high public debt levels. Structural reforms, including safeguarding financial stability, improving the business climate, and reducing labor market rigidities, are critical to increasing the flexibility of ECCU economies. Securing concessional external financing to ease the adjustment, which some ECCU countries have been pursuing, would also be beneficial.

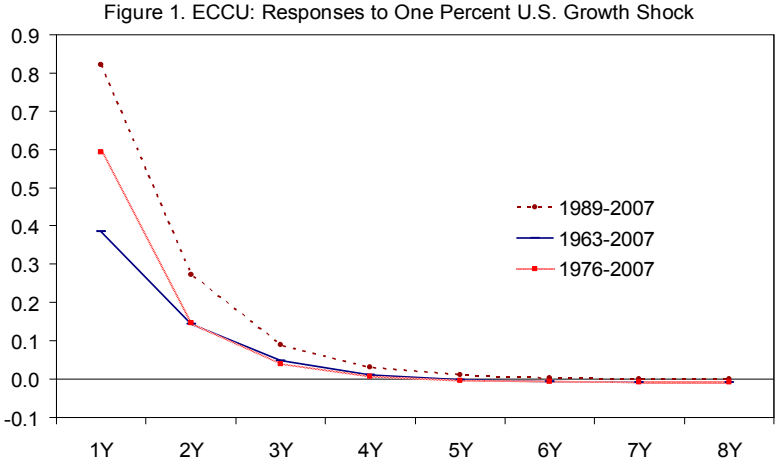
Table 1. Growth Elasticities in the Caribbean 1/

	Simple Growth Correlation with the U.S.	Elasticity of the Cycle to		Elasticity of the Trend to	
		U.S. Cycle	U.S. Trend	U.S. Cycle	U.S. Trend
Belize	0.15				1.09***
Barbados	0.21	1.64***	1.03**		-1.35***
ECCU	**0.40*** **	**0.92*** **			**0.94*** **
Guyana	0.06	1.25***			
Jamaica	0.10	0.36***			
Trinidad and Tobago	-0.18	-2.00**	1.10*		-1.46**

Source: Authors' calculations.

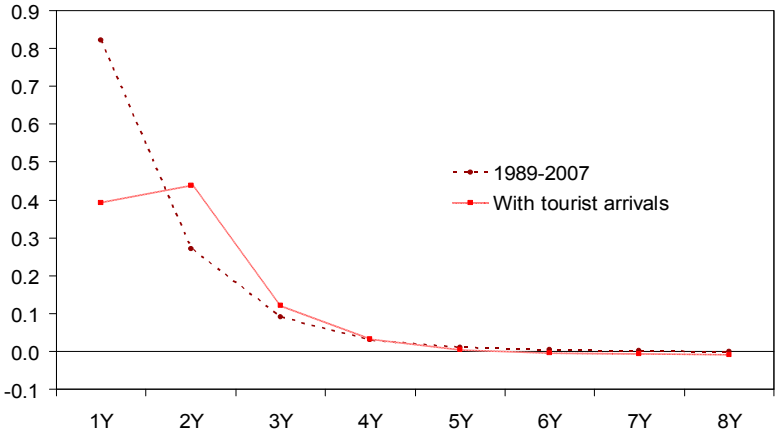
1/ Elasticity of the cyclical and trend component of growth in each Caribbean economy to the cycle and trend in the U.S., with ***, **, and * indicating significance at the 1, 5, and 10 percent levels, respectively.

Figure 1. ECCU: Responses to One Percent U.S. Growth Shock



Source: Authors' calculations.

Figure 2. Antigua and Barbuda: Responses to One Percent U.S. Growth Shock



Source: Authors' calculations.

II. Optimal Reserves in the ECCU[1]

1. **This paper analyzes the adequacy of international reserves in the ECCU, using an optimization framework.** Recent turbulence in global and Caribbean regional financial markets underscores the importance of reassessing the adequacy of international reserves held by the ECCB. With an open capital account and member countries highly susceptible to external shocks and natural disasters, the ECCB needs to maintain reserves to insure against current and capital account shocks. The ECCB is required by law to maintain international reserves to cover a minimum of 60 percent of its demand liabilities, and is often regarded as a quasi-currency board. In practice the ECCB maintains a reserve cover close to 100 percent of demand liabilities.

2. **Gauged by traditional measures of reserve adequacy, the ECCB's holdings of international reserves appear to be in line with comparator countries.** When compared with small, tourism-dependent economies, other currency unions and Caribbean countries, the ECCU indicators of reserve adequacy are found to be at the lower end of the range but close to the indicators for the comparators. In particular, the number of months of imports of goods and services held by the ECCB in international reserves averages around three, while most other comparator countries have reserves in excess of three months. Similarly, the ECCU countries have the lowest ratios of reserves to broad money and reserve money.

3. **Using a self-insurance model, this paper finds that international reserves held by the ECCB are broadly adequate.** The model is calibrated with parameters that have been used in a number of recent IMF studies of reserve adequacy. The results show that, historically, the ECCB's international reserves have been generally adequate for a variety of external current account and capital account shocks. However, the cushion of actual reserves over the optimal levels derived from the model has decreased over time. Moreover, the ECCB would be challenged in the event of moderate-to-severe deposit outflows.

4. **International reserves are broadly adequate to cover current account shocks and natural disasters.** Figure 1 shows that ECCU international reserves have been consistently above the optimal level needed to insure the region against potential current account shocks. Actual international reserves are larger than the amount required to withstand a shock equivalent to: (i) three months of imports; or (ii) a natural disaster of the average magnitude observed in the ECCU. In the event of a natural disaster with an impact on the current account of 10.8 percent of GDP and a probability of occurring of 10 percent, the optimal level of reserves is around 8.5 percent of GDP.

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[1] Summary of Working Paper, WP/09/77, "Optimal Reserves in the Eastern Caribbean Currency Union," by Mario Dehesa, Emilio Pineda, and Wendell Samuel.

5. **International reserves are also broadly adequate to cover some capital account shocks**. The level of dollarization in the ECCU is moderate, with foreign currency deposits (mainly denominated in U.S. dollars) accounting for about 15 percent of total private sector deposits. The analysis shows that ECCB reserves are currently around the optimal size to insure the region against capital flight equivalent to the outflow of all short-term external debt plus foreign currency deposits. Actual reserves would also cover a shock equivalent to all demand liabilities, as expected with a quasi-currency board arrangement in place.

6. **The ECCB would face challenges in responding to a scenario of a moderate to large deposit run.** As shown in Figure 2, the ECCB holds reserves to withstand a shock equivalent to about 20 percent of total private sector deposits. However, the current level of reserves could prove to be an inadequate buffer against a heavy deposit outflow, although the presence of strong foreign banks may reduce the level of reserves required to insure against deposit outflows.

7. **Financial deepening over the last decade has reduced the cushion of actual international reserves over the optimal level required to withstand deposit outflows**. The ECCB's operational rule of holding international reserves in excess of 80 percent of demand liabilities, while appealingly prudent, could systematically underinsure for deposit runs, because the deposit base has been growing at a much faster rate than demand liabilities. In fact, the income elasticity of broad money is estimated at 1.5 compared with an income elasticity of demand liabilities of about 1. Should this rule continue to be maintained, over time the level of international reserves would fall short of the optimal level. The projections in Figure 3 illustrate that even with full coverage of demand liabilities, in the next few years international reserves could fall below the level needed to cushion against a shock equivalent to 20 percent of total deposits.

8. **The constraints to monetary policy arising from a fixed exchange rate regime limit the ability of the ECCB to accumulate reserves.** While the ECCB has a variety of monetary tools at its disposal, they are inherently limited because of the fixed exchange rate under the currency board arrangement. The most readily available tool is the rate of interest on fixed deposits that commercial banks hold with the ECCB, but raising this could imply quasi-fiscal losses for the ECCB since the rate that would be required to attract significant amounts of commercial bank fixed deposits might be higher than the central bank is earning on its foreign reserves. Retaining more of the central bank's profits could be another solution, but the accompanying build up in reserves is likely to be slow. Efforts by the central bank to strengthen the regulatory framework and to establish credit lines with international financial institutions (particularly other central banks) might also be useful to help insure against large adverse capital movements.

Figure 1. ECCU: Optimal Level of Reserves Given Different Shocks to the Current Account
(In percent of GDP)

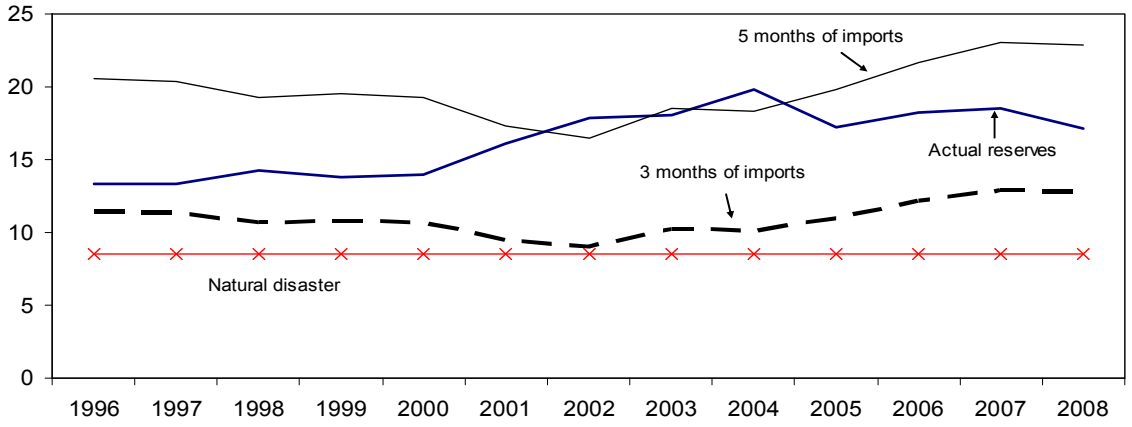


Figure 2. ECCU: Optimal Level of Reserves: Different Intensities of Bank Run
(In percent of GDP)

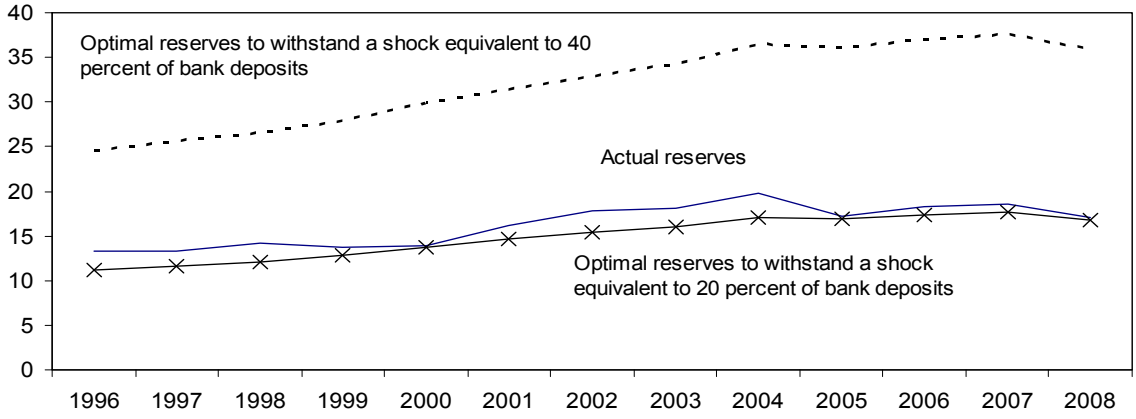
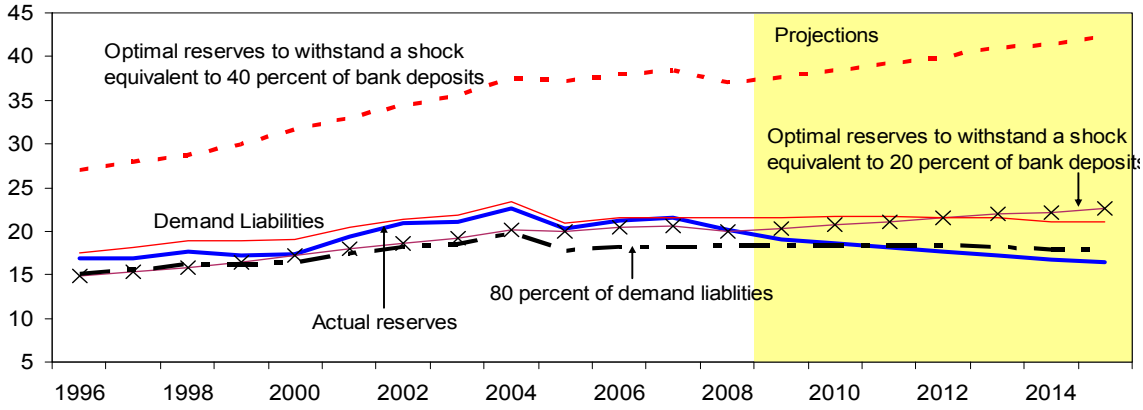


Figure 3. ECCU: Optimal Level of Reserves: Different Intensities of Projected Bank Run
(In percent of GDP)



Source: Authors' calculations.

III. PONZI SCHEMES IN THE CARIBBEAN[1]

1. **In several Caribbean states, unregulated investment schemes (UIS) grew quickly, particularly during 2006–08, by claiming unusually high monthly returns and through referrals by existing members.** Such high returns are usually associated with Ponzi schemes, in which returns may be paid to investors out of the money paid in by subsequent investors rather than from genuine profits. Such schemes emerge on a regular basis even in developed countries with strong regulatory frameworks, as highlighted by the recent experience in the United States with a US$50 billion alleged Ponzi scheme run by Bernard Madoff. However, their impact has been greater in countries with weaker regulatory frameworks. This is illustrated by the well-known case of Albania, and by more recent and ongoing cases in the Caribbean, Colombia, and Lesotho (Table 1).

2. **The experiences of different countries show that such schemes can lead to large-scale economic and institutional damage.** The negative consequences include: undermining confidence in financial markets; diverting savings from productive to unproductive uses; incurring fiscal costs; diverting deposits from banks and increasing nonperforming loans; causing swings in consumption; inducing socio-economic strife; and undermining the reputation of political authorities, regulators, and law enforcers. However, controlling and closing down schemes is often difficult for a variety of reasons. In many countries, regulatory frameworks are not sufficiently developed to detect and shut down UIS at an early stage. Once schemes become large, the authorities can become increasingly reluctant to trigger their collapse.

3. **Jamaica experienced rapid growth in the number and size of UIS, especially during the period 2006–08.** A study conducted by the Caribbean Policy Research Institute (CaPRI), an independent think tank, identified 21 UIS which were operating in Jamaica by January 2008. The business opportunity behind the schemes varied, although a majority of them claimed to be engaged in foreign exchange trading. Some of the schemes were conduits to invest in other better-known schemes. A few claimed to be investing in a variety of assets, including real estate. The schemes share a number of common features. They all offered returns significantly higher than those offered by regulated entities; for example, many offered a 10 percent monthly return, a level usually seen only in Ponzi schemes. Neither the operators nor the schemes were licensed or registered by either the Jamaican Financial Services Commission (FSC) or the Bank of Jamaica (BoJ). They provided limited or no information on their business model that would explain such high returns: investors were not provided with a prospectus or with audited (or even unaudited) financial statements. A number of these features are "red flags" for investment fraud.

[1] Summary of IMF Working Paper WP/09/95, "Ponzi Schemes in the Caribbean," by Ana Carvajal, Hunter Monroe, Catherine Pattillo, and Brian Wynter.

4. **Two of the main schemes were OLINT, which claimed to be a club to invest in foreign currency trading, and Cash Plus Limited, which claimed to be part of a conglomerate with subsidiaries engaged in many sectors.** As has been the case in many other jurisdictions, the UIS engaged in highly visible public relations campaigns. These campaigns involved donations to charitable causes and sponsorship of high profile events. The UIS succeeded in obtaining support from prominent individuals in Jamaica as well as the media to the point that in January 2007, a business newspaper named OLINT's founder business personality of the year. There was considerable debate in Jamaica concerning whether the activities of the UIS constituted issuing securities or deposit-taking, and thus required action by the regulatory authorities, or whether they were simply private clubs.

5. **Initially all actions taken against OLINT and Cash Plus came from the FSC, beginning March 2006.** They encompassed: (i) issuing cease and desist orders against schemes for alleged breaches of the registration/licensing requirements; (ii) providing warnings informing the public of schemes that were not registered with or licensed by the FSC; and (iii) undertaking a public education campaign "think and check before you invest". In late 2007, the BoJ issued warning letters to schemes that purported to be carrying on foreign currency trading, stating the need for a license. The schemes were able to defer regulatory action as well as closure of their bank accounts through court appeals. In 2008, the criminal authorities filed charges against the founder of Cash Plus. OLINT began failing to make payments to investors in 2008, and closed its offices in Jamaica.

6. **OLINT and its offshoots also operated elsewhere in the Caribbean.** In April 2006, OLINT claimed that it had been authorized to conduct investment business in St. Kitts, and the St. Kitts Financial Services Commission issued an advisory that this was not the case. However, the founder of OLINT subsequently established a company called OLINT TCI in the Turks and Caicos Islands. Schemes were established in Grenada, Dominica, and St. Lucia to channel funds into OLINT TCI. The Grenada regulatory authorities invited the Eastern Caribbean Securities and Regulatory Commission (ECSRC) to determine whether the latter had jurisdiction, and the ECSRC issued cease and desist orders against schemes in Grenada and Dominica in May 2008. In July 2008, the Financial Crimes Unit of the Royal Turks and Caicos Islands Police Force raided the offices of OLINT TCI and froze its assets. In February 2009, the founder of OLINT was arrested in Turks and Caicos and charged with forgery, false accounting, and theft.

7. **Key policy lessons for addressing UIS include:** being proactive in investigating unregulated schemes; seeking emergency relief such as an asset freeze; bringing charges, both civil/administrative and criminal, if necessary; coordinating and cooperating locally and internationally; and keeping the public informed. Preconditions for an effective response include: independence of financial regulators; broad authority to investigate and prosecute unregulated schemes; authority to cooperate and exchange information with other financial regulators, both locally and internationally; adequate resources for enforcement; and specialization and speedy disposition by the courts.

Table 1. Some Speculative Data on Selected Investment Schemes

Country	Name(s)	Years in Operation	Promised Rate of Return	Amounts Invested/Lost		Number of Investors/Accounts	
				In U.S. dollars	In percent of GDP	Number 1/	In percent of population
Jamaica	OLINT, Cash Plus, World Wise, LewFam, etc.	2004-08	6-20 percent/month	1-2 billion	12 ½-25	50,000	2
Grenada	SGL Holdings	2006-08	7-10 percent/month	30 million	5	…	…
United States	Madoff Investment Securities	-2008	10-17 percent/year	50 billion	0.3	13,000	<0.01
Colombia	DRFE, DMG, etc.	2005-08	300 percent/six months	1 billion	0.4	up to 4 million	<8
Lesotho	MKM Burial Society	-2007	60 percent/year	42 million	3	100,000	4
Albania	VEFA, Gjallica, Kamberi, etc.	1991-97	4-19 percent/month	1.7 billion	79	2 million	57
Macedonia	TAT Savings House	-1997	4-5 percent/month	80 million	3	25,000	1
Romania	Caritas	1992-94	800 percent/six months	450 milion	1.5	2-3 million	9-13
Russia	MMM	1993-94	7,000 percent/six months	1-1.5 billion	0.5-0.8	1-2 million	0.6-1.3
Peru	CLAE	1978?-93	5 percent/month	200 million	0.3	300,000	1.2
Serbia	Dafiment Bank	1990-93	15 percent/month	600 million	…	14 million	133

Source: IMF Working Paper 09/95.

1/ Number of accounts for Dafiment Bank.

IV. Assessing Exchange Rate Competitiveness in the ECCU[1]

1. **The paper estimates the equilibrium real exchange rate in the tourism-driven ECCU economies, using three different approaches.** First, the purchasing power parity (PPP) hypothesis is used to provide a benchmark to assess real exchange rates in the region. Second, a fundamentals-based equilibrium real exchange rate approach is used to explore sources of real exchange rate fluctuations in ECCU countries. Third, the macroeconomic balance approach is employed to examine whether the medium-term current account balance of the ECCU deviates from an estimated equilibrium current account position.

2. **The PPP hypothesis is a common starting point when calculating the equilibrium real exchange rate.** Panel unit root tests indicate that real exchange rates in the ECCU economies revert to a long-run constant, thereby lending support to the PPP hypothesis. The paper finds little evidence of overvaluation of the EC dollar, and the speed of adjustment toward equilibrium is faster than that typically found in the literature for fixed-exchange rate regimes. The PPP analysis provides a first benchmark for the analysis of the real exchange rate, but it explains only a limited portion of real exchange rate volatility and fails to explain turning points in the real exchange rate. Thus it is necessary to introduce a model that emphasizes the time-varying nature of the real exchange rate, whereby real factors (fundamentals) have a role in its determination.

3. **There is a large empirical literature on the real determinants of the long-run real exchange rate.** In the case of the tourism-dominated economies of the ECCU, the real exchange rate is expected to be driven by: *tourism-based productivity differentials* (which raise nontradable prices); *higher terms of trade* (appreciates the real exchange rate through wealth effects); *higher government consumption* (likely to appreciate the real exchange rate to the extent that it falls mostly on nontradables rather than tradables); and *increased net foreign assets* (which can in principle sustain a stronger real exchange rate). Figure 1 confirms the findings made by the PPP analysis: real exchange rates in the ECCU in general have experienced two periods of overvaluation, one in the early 1980s, and a second in the early 2000s. Based on data through end-2008, the ECCU real exchange rate is close to its most depreciated level in almost 20 years (reflecting the depreciation of the U.S. dollar against major currencies since 2002). Figure 2 demonstrates that the ECCU equilibrium real exchange rate has depreciated since 2000 as a result of a continuing accumulation of net foreign liabilities, increased government consumption spending, and the worsening terms of trade. A key finding is that the ECCU real exchange rate appears to be competitive: (i) there is little evidence of overvaluation of the EC dollar, as the ECCU real exchange rate is close to its equilibrium level; and (ii) movements in tourism-driven terms of trade and productivity are important determinants of the equilibrium real exchange rate.

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[1] Summary of IMF Working Paper WP/09/78, "Assessing Exchange Rate Competitiveness in the Eastern Caribbean Currency Union," by Emilio Pineda, Paul Cashin, and Yan Sun.

4. **Common arguments to claim an overvaluation of the EC dollar are the large current account imbalances in the region.** The paper also makes use of the macroeconomic balance approach of the IMF's Consultative Group on Exchange Rate Issues (CGER) to assess real exchange rates in the ECCU. The macroeconomic balance approach calculates the difference between the current account (CA) balance projected over the medium term (2014) at the prevailing exchange rate, and an estimated equilibrium current account balance or norm. If the CA projected for the medium term exceeds (is close to) the estimated equilibrium CA or norm, there is evidence of exchange rate overvaluation (little evidence of overvaluation). Following the substantial CGER-based literature, key determinants of equilibrium current account balances in the Caribbean were found to be: *fiscal balances* (a fiscal surplus raises national saving and thereby increases the current account balance); *oil balance* (higher oil prices decrease the current account balance of oil-importing countries); *relative income* (at relatively low stages of development, increases in relative income would tend to improve a country's access to foreign capital and be negatively correlated with the current account balance); *relative economic growth* (stronger economic growth relative to trading partners is likely to be associated with a lower current account balance); *foreign direct investment (FDI) and grants* (higher FDI tends to affect the current account balance through increased imports).

5. **The equilibrium current account deficit (the current account 'norm') is estimated at between 16–20 percent of GDP for the ECCU, for sample sets consisting of CARICOM-based and tourism-based economies** (Figure 3). The staff's projected medium-term (2014) current account balance for the ECCU (20 percent of GDP) is close to the estimated level of the equilibrium current account. This implies that despite their high levels, the medium-term current account deficit—largely financed by private capital flows—appears sustainable. This also indicates that there is little evidence of overvaluation of the real exchange rate, as the medium-term current account balance is close to the current account norm. In addition, as shown in Figure 4, increased FDI and the growing oil trade imbalance have been the major contributors to the large ECCU current account imbalance.

6. **While the ECCU current account imbalance is projected to remain above its estimated equilibrium level for an extended period, it is expected to decline over the medium term to a sustainable level.** As tourist arrivals pick up and tourism-based investment opportunities in the ECCU decline over the medium term, private capital inflows and current account imbalances will narrow. Nonetheless, the region's high external imbalance, large public and external debt, and associated financing needs do pose risks that warrant careful monitoring and continued efforts at fiscal consolidation, to enhance debt sustainability, maintain competitiveness, and support the region's currency board arrangement.

Figure 1. ECCU: Actual and Equilibrium REER, 1979–2008 1/
(Index 2000=100)

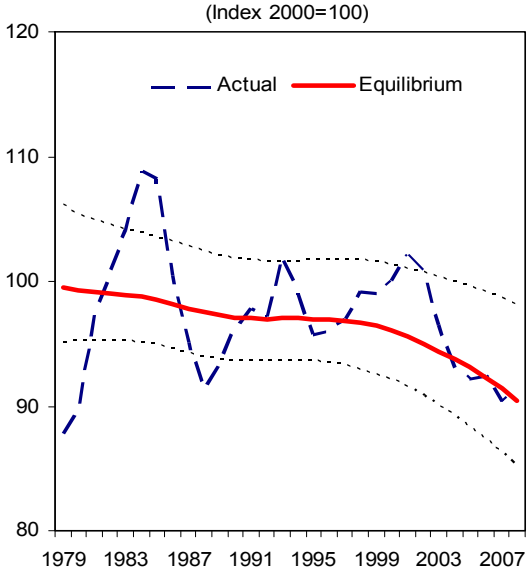


Figure 2. ECCU: Contributions to Changes in Equilibrium Exchange Rates, 1982–2008
(In percent)

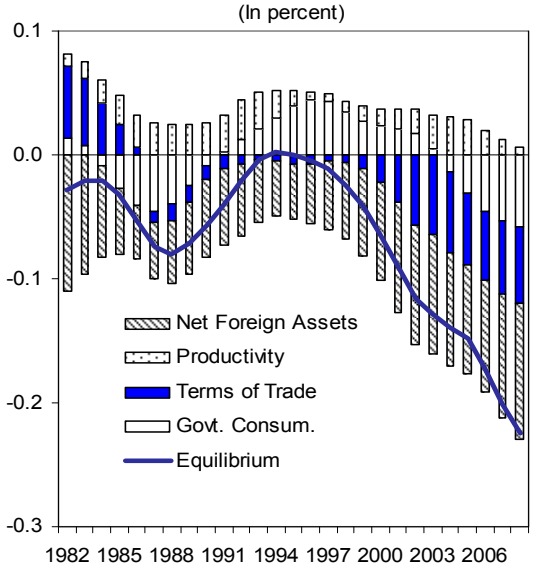


Figure 3. ECCU: Current Account Deficit, Actual and Estimated Norms 2/
(In percent of GDP)

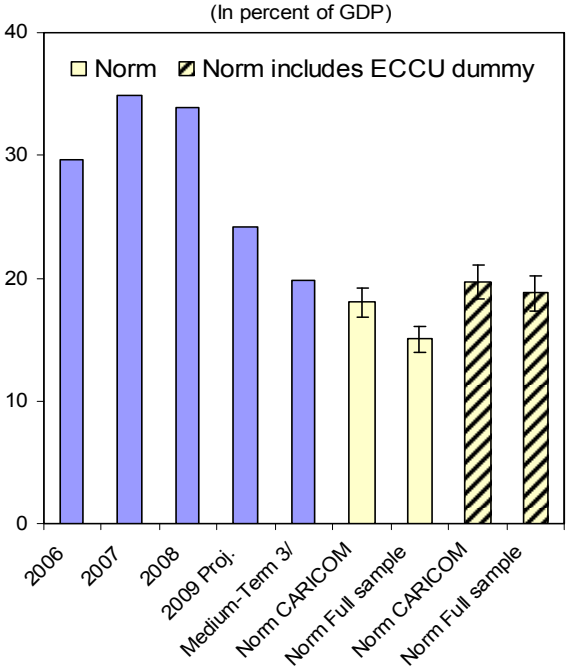
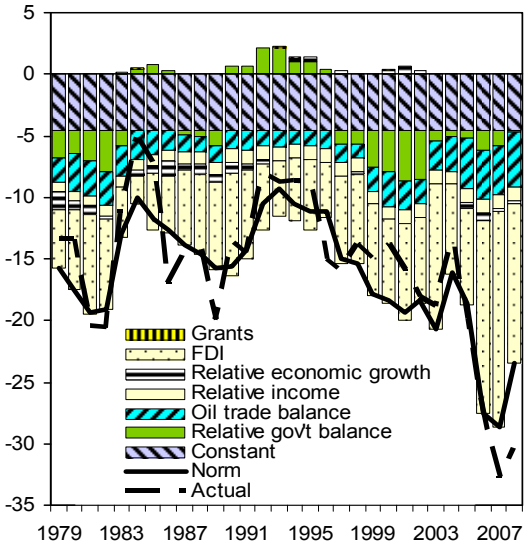


Figure 4. ECCU: Contributions to Current Account/GDP Norm, 1979–2008
(In percent)



Sources: IMF, Information Notice System; and authors' calculations, estimates and projections.

1/ The dotted lines around the equilibrium exchange rate represent 90 percent confidence intervals of the prediction.

2/ In computing the norms, medium-term values of the fiscal balance, oil-balance, output growth, and relative income are drawn from staff projections. Band is ±1 standard error of the prediction. CARICOM sample includes ECCU countries and The Bahamas, Barbados, Belize, and Jamaica. Full sample includes 24 tourism-dependent economies as defined by Bayoumi and others (2005).

3/ Based on Fund staff estimates. Medium-term is 2014.

V. A Risk Analysis of Public Debt in the ECCU: A Fan Chart Approach[1]

A. Introduction

1. **Public debt-to-GDP ratios in the ECCU countries are among the highest in the world.** Public debt in the ECCU has risen significantly since the mid-1990s, reflecting the region's proneness to natural disasters, other exogenous shocks, macroeconomic volatility, and large fiscal deficits. Public debt averaged about 100 percent of GDP at end-December 2008 and is set to increase during the current economic downturn.[2] While the Monetary Council of the ECCB has set an objective for all countries to achieve a debt-to-GDP ratio of 60 percent by 2020, national fiscal policies have not yet been linked to this medium-term benchmark. This paper is motivated by the rising indebtedness of countries in the region. The objective is to illustrate the risks surrounding public debt dynamics related to macroeconomic volatility, and the role of strong fiscal policy adjustment that is responsive to shocks.

2. **This paper applies a stochastic simulation algorithm to analyze debt sustainability in the ECCU.** The standard framework used by the IMF and the World Bank to conduct debt sustainability analysis assesses uncertainty surrounding future macroeconomic conditions and fiscal policy through the use of single shock "bound tests".[3] An important shortcoming of this approach is the deterministic approach to assessing risks. It ignores both the correlation among shocks and the joint response of macroeconomic variables relevant for debt dynamics. A number of recent studies have attempted to address these shortcomings by introducing uncertainty into the analysis. Given the ECCU countries' proneness to natural disasters and macroeconomic volatility, this paper uses the stochastic simulation algorithm proposed by Celasun et al. (2006). The virtue of this approach is that it exploits the historical dynamics observed in the data to generate more likely shock scenarios, and recognizes the probabilistic nature of assessing long-term debt sustainability.

3. **A necessary condition for debt to be sustainable is that primary fiscal balances react to the accumulation of public debt, with higher past debt leading governments to adjust by running larger primary balances.** We find that, with the exception of Dominica and Grenada, fiscal reaction functions for countries in the ECCU are not well behaved in this sense.[4] The estimated reaction functions also indicate strong fiscal policy inertia. Two

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[1] Prepared by Koffie Ben Nassar and Catherine Pattillo.

[2] See *Eastern Caribbean Currency Union—Staff Report for the 2009 Discussion on Common Policies of Member Countries* (www.imf.org). This study uses data for the six Fund-member ECCU countries: Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines.

[3] See IMF (2002) and World Bank (2004a and 2004b) for the framework applied to debt sustainability in low-income countries.

[4] Dominica and Grenada undertook comprehensive debt restructurings in the early 2000s. For Dominica, debt restructuring, coupled with prudent fiscal management, has placed public debt firmly on a declining path.

alternative well-behaved fiscal reaction functions (estimated from different country samples) are used to generate scenarios for public debt risk profiles, illustrating how the responsiveness of fiscal policy to past debt affects prospects for debt sustainability in the ECCU. The first scenario utilizes an estimated fiscal reaction function for 14 countries in the Caribbean, and the second uses coefficients estimated by Celasun et al. (2006) for 5 middle-income countries (Argentina, Brazil, Mexico, South Africa, and Turkey). The results, together with the strong presence of policy persistence, underscore the need to improve the sensitivity of fiscal policy to public debt, in order to put medium-term debt dynamics on a path to achieve the debt-to-GDP ratio of 60 percent by 2020.

4. **The paper is organized as follows.** Section B surveys the literature and Section C describes the basic structure of the model. Section D illustrates the model's key simulation properties, including the fan charts. Section E provides concluding remarks.

B. Literature Review

5. **The literature contains several operational definitions of debt sustainability.** In the classical literature, if the real interest rate is less than the economy's growth rate, government deficits could continue *ad infinitum* without an increase in the debt-to-GDP ratio.[5] By contrast, if the government borrows at an interest rate that exceeds the growth rate, the debt will rise unless compensated for by the primary surplus.[6]

- The concept of government *solvency* is closely related to debt sustainability. For a government to be solvent, it must be able to service its debt obligations in perpetuity without explicit default. This, in turn, requires that the current debt not exceed the present discounted value of future primary surpluses.[7]

- The solvency concept is not very demanding, however, in that a government could satisfy the condition by running large primary deficits for some time, but promising a sharp adjustment and series of primary surpluses in the future, which may not be feasible.

[5] Theoretical models that seem to allow this possibility have been explored by Buiter (1979), Eaton (1981), and Carmichael (1982).

[6] McCallum (1984) shows that it has been difficult to develop equilibrium models in which investors would continue to buy government debt when the government borrows at an interest rate that exceeds the growth rate.

[7] Using postwar U.S. data, Hamilton and Flavin (2001) find support for the proposition that all that is needed for the government to issue interest-bearing debt is to promise its creditors that it will balance its budget in expected present-value terms.

- Thus, the concept of *debt sustainability* typically requires more; i.e., that the government's intertemporal budget constraint is satisfied without an unrealistically large future correction in the primary balance, given the cost of financing (IMF, 2002). Operationally, sustainability assessments determine whether a projected plausible path of future primary balances implies a stabilizing or declining debt-to-GDP ratio over time.[8]

- A third operational concept relates to debt *thresholds,* which could be of two types: (i) a debt-to-GDP ratio beyond which debt distress, default or crises are likely; and (ii) national or regional targets for debt-to-GDP ratios deemed to be sustainable, such as the ECCB's target of 60 percent debt-to-GDP ratios for ECCU countries by 2020.

6. **In recent years, several studies have generated multivariate stochastic simulations of future debt trajectories, based on econometric models.**[9] Garcia and Rigobon (2004), Hostland and Karam (2005), Celasun et al. (2006), Penalver and Thwaites (2006), and Tanner and Samake (2006) generate explicit probability distributions for projected debt paths that take into account the interaction among key variables that influence debt. One of the most prominent papers on debt thresholds is Reinhart, Rogoff, and Savastano (2003), who identify thresholds beyond which countries are susceptible to debt crises, which vary from country to country and depend importantly on history. To our knowledge, Di Bella (2008) is the only previous study to have used this type of approach in the Caribbean. He extends Reinhart, Rogoff, and Savastano's (2003) model to estimate a country specific debt threshold for the Dominican Republic.[10]

C. Methodology

7. **This paper uses a stochastic simulation algorithm developed by Celasun et al. (2006).** The methodology randomly generates a large sample of bound tests covering a range of likely shock combinations from which frequency distributions of the debt-to-GDP ratio are derived for each year of a projection, permitting an explicitly probabilistic assessment of debt sustainability. Projected paths and shocks to the economic variables are combined with a model-based projection for the primary balance, where the primary balance responds to economic shocks and to past debt levels. The virtues of the probabilistic approach are twofold. First, it depicts debt paths under realistic shock configurations (to growth, interest

[8] Buiter (1985) and Blanchard et al. (1991) model the primary fiscal balance required to stabilize the public debt. The objective is to stabilize the debt-to-GDP ratio at its current level or at any other level deemed more desirable.

[9] See for example Barnhill (2003), Xu and Ghezzi (2003) and Mendoza and Oviedo (2004).

[10] Kraay and Nehru's (2006) paper on determinants of debt distress, which depend on the quality of policies and institutions, was an important contribution to the development of policy-dependent thresholds for external debt sustainability, used in the IMF-World Bank debt sustainability analyses.

rates, exchange rates), derived from country-specific estimation of the correlation across shocks and the joint responses. Unlike standard DSAs, it recognizes the persistence of shocks through time, reflecting historical dynamic relationships. Second, the primary balance is endogenous, based on estimated fiscal reaction functions. For this application to the ECCU, the fiscal reaction functions play a different role than in Celasun et al. (2006), illustrating how the assumption of alternative fiscal policies would affect the probabilistic projection of debt paths.

8. **The methodology encompasses three building blocks.**[11]

- First, a fiscal policy reaction function is estimated. In line with the literature, it is specified as:

$$b_{i.t} = a_0 + \alpha s_{i,t-1} + \gamma\, ygap_{i,t} + C_{i,t}\lambda + \eta_i + \varepsilon_{i,t}, \qquad t=1,...T,\ i=1,...N \tag{1}$$

  where $b_{i,t}$ is the primary fiscal balance-to-GDP ratio in country i and year t, $s_{i,t-1}$ is the stock of public debt-to-GDP ratio at the end of period $t-1$, $ygap_{i,t}$ is the output gap, $C_{i,t}$ is a vector of control variables, η_i is an unobserved, country fixed-effect, and $\varepsilon_{i,t}$ is an error term.[12]

- Second, the joint distribution of shocks and forecasts of the nonfiscal determinants of public debt are calibrated based on historical country-specific data. For each country, the following unrestricted VAR model is estimated:

$$Y_t = \gamma_0 + \sum \gamma_k Y_{t-k} + \xi_t \tag{2}$$

  where $Y_t = \left(r_t^f, r_t, g_t, z_t\right)$, γ_k is a vector of coefficients, and r^f, r, g, z, and ξ denote the real foreign interest rate, the real interest rate, the real GDP growth rate, the log of the real effective exchange rate, and a vector of well-behaved error terms: $\xi \sim N(0,\Omega)$. Thus, as shocks occur each period, the VAR produces joint dynamic responses of all elements in Y.

[11] See Celasun et al. (2006) and Debrun (2005).

[12] Specified this way, the reaction function helps disentangle whether a high debt level is the result of adverse shocks (bad luck) or of undisciplined (bad) past policies. If the reaction function indicates that the authorities have systematically reacted in a stabilizing way to debt buildups, one can conclude that a high debt-to-GDP ratio is primarily due to bad luck. In this case, a debt ratio can be very high and yet sustainable as long as bad luck does not strike repeatedly.

- Third, for each simulated constellation of shocks, quarterly VAR projections are annualized. The corresponding debt path is then calculated recursively using equation (1) and the conventional stock-flow identity:

$$s_t \equiv \left(\frac{\left(1+r_t^f\right)}{1+g_t}\right)\left(1+\Delta z_t\right)s_{t-1}^* + \left(\frac{1+r_t}{1+g_t}\right)\left(1+r_t\right)\widetilde{s}_{t-1} - b_t + h_{t,} \qquad (3)$$

where the total debt-to-GDP ratio, s_t, is the sum of foreign-currency, s_t^*, and domestic currency, $\widetilde{s}_t$, denominated debt and depends on the real cost of borrowing in foreign (r_t^f) and domestic (r_t) currency, real GDP growth, g_t, the real rate of currency depreciation, Δz_t, primary fiscal surplus-to-GDP ratio, b_t, and below-the-line expenditures (stock-flow adjustments) in percent of GDP, h_t.[13]

D. Data Analysis

Debt dynamics in the Caribbean

9. **Governments concerned with solvency would be expected to run higher primary surpluses if debt in previous years has been increasing, in order to ensure that public debt does not explode.** Bohn (1998) shows that a positive and significant coefficient on lagged debt in a regression explaining the primary surplus implies the consistency of fiscal policy with long-run solvency, and ensures that the debt ratio will revert to some long-run steady state value. This condition is necessary but not sufficient for ensuring debt sustainability, since as noted above, solvency in present value terms could rest on a promise of a future large adjustment.

10. **How does fiscal policy in the Caribbean respond to past accumulation of public debt?** This section first examines unconditional correlations between primary balances and public debt. These relationships may be misleading, however, as they do not control for key determinants of the primary balance such as output cycles and institutions. Estimated fiscal policy reaction functions can be used to explore how the endogenous response of fiscal policy—controlling for a range of determinants and country-specific effects—affects projected debt dynamics, and the risks to debt sustainability.

11. **A casual examination indicates that the primary balance has been related to changes in the public debt-to-GDP ratio in the six ECCU countries.** The scatter plot in Figure 1 shows that periods of high primary surpluses (deficits) are associated with decreases

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[13] Notice that in each simulation, the primary surplus, b_t, incorporates a fiscal policy shock $\varphi_{i,t} \sim N\left(0, \sigma_{\varphi i}^2\right)$, where $\sigma_{\varphi i}^2$ is the country-specific variance of the reaction function's residuals.

(increases) in public debt ratios. The association between the two variables is stronger for St. Kitts and Nevis and weaker for St. Vincent and the Grenadines, perhaps reflecting significant stock flow adjustments in the latter country. Figure 2 plots the path of lagged debt-to-GDP ratios against primary fiscal surplus-to-GDP ratios for each country, showing that in several of the countries (Dominica, Grenada, St. Kitts and Nevis) fiscal policy appears to have been responsive to developments in the debt-to-GDP ratio in recent years. The high variability in the data, especially for Antigua and Barbuda, indicates that both variables are subject to various shocks (e.g., fluctuations in GDP growth, and below-the-line movements). Next, econometric methods will determine whether the relationship holds conditioning on other determinants of the primary balance.

12. **Fiscal reaction functions are estimated using panel data techniques, given the relatively short data period.** The function relates the primary fiscal balance to lagged public debt, the output gap, real oil prices, and a measure of institutional quality, and in some specifications controls for inertia in fiscal policy by including the lagged primary balance.[14] The equations are estimated using generalized least squares (GLS) random effects, and system generalized method of moments (GMM). The latter controls for endogeneity of the output gap and lagged debt, and corrects for the bias introduced by the lagged primary balance variable in the presence of country fixed effects.[15]

13. **The estimation results indicate that fiscal policy in the ECCU as a whole does not respond systematically to the public debt-to-GDP ratio**. The results are not consistent with the requirement for long-term debt sustainability—lagged debt is negatively and significantly correlated with the primary fiscal balance, suggesting that debt would not converge to a steady-state value (Table 1). However, Ordinary Least Squares (OLS) estimates show that Dominica and Grenada have behaved differently from the rest of the ECCU, perhaps reflecting the fact that they undertook debt restructuring in the early 2000s (Table 2).[16] Information from the ECCU fiscal reaction functions cannot be used as an input to the stochastic fan-chart algorithm, since the necessary response of the primary balance to lagged debt is absent. As discussed below, this result and the evidence of strong fiscal policy inertia supports the case for institutional mechanisms to link national fiscal policies to the 60 percent of GDP regional target for public debt.

14. **Results are mixed for a fiscal reaction function using a wider sample of 14 Caribbean countries.** In the GLS model the primary surplus exhibits a positive and

[14] Abiad and Ostry (2005), among others, also include the lagged dependent variable in a fiscal reaction function.

[15] While panel estimation controls for country-specific effects, one caveat is that the linear estimators assume similar fiscal behavior across countries.

[16] The estimated results for Dominica and Grenada are not used in the stochastic simulations, because they are conditional on a different set of regressors.

statistically significant response to the lagged debt ratio, suggesting that fiscal policy conforms to this condition for long-term debt sustainability (Table 3). The coefficient on lagged debt remains positive in the system-GMM model, but loses significance, and the lagged primary surplus effect indicates strong policy inertia.

15. **There is some support for the hypothesis that the fiscal response to past debt is stronger when the debt is below a particular threshold.** An alternative specification considered in the literature includes a nonlinear reaction term to determine whether the primary balance reacts positively to lagged debt at low debt levels, but the relationship weakens or disappears at higher debt levels. The results of the nonlinear function including a debt spline indicate that in the GLS random effects estimation, the primary balance responds positively and significantly to lagged debt when debt is below 60 percent of GDP, but this relationship is not present for debt above this threshold[17].

16. **While there is no evidence for counter-cyclical fiscal policy, other potential determinants of the primary balance have the expected effects in the wider Caribbean sample.** The estimated coefficient on the output gap depicts an acyclical behavior—the primary fiscal balance does not seem to react in any significant way to GDP shocks.[18] Real oil prices have a significant negative effect, suggesting that higher oil prices translate into lower primary surpluses, possibly through higher government spending on fuel price sensitive goods and services. Estimated results suggest that, everything else being equal, countries with strong political institutions (low corruption, high bureaucratic quality, efficient law enforcement, government stability and high democratic accountability) generate higher primary surpluses.

17. **In contrast to the ECCU results, fiscal reaction functions estimated in the literature find that emerging market countries tend to improve the primary balance when debt has increased.** Celasun et al. (2006) estimate fiscal reaction functions for a set of five emerging market countries and find a positive response of primary surpluses to public debt in all specifications (Table 4).[19] The magnitude of the coefficients is much higher than in the Caribbean country sample, indicating that fiscal policy responds more aggressively, tending to make corrections to moderate debt.

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[17] Results are shown in the forthcoming IMF Working Paper.

[18] Araujo (2009) finds that fiscal policy in the ECCU has been procyclical, with higher public expenditure during good years.

[19] See also Abiad and Ostry (2005) and IMF (2003).

Stochastic Debt Fan Charts

18. **The next step in the methodology estimates VAR models for the ECCU countries, to produce a joint distribution of shocks for the fan charts.** Four-variable VAR models (domestic and foreign interest rates, real GDP growth, and real effective exchange rate) are estimated using quarterly data over the period 1986:Q1 to 2007:Q4. Table 5 provides the estimated VAR coefficients and correlation matrices of shocks for each country. The joint distribution of all nonfiscal shocks for the fan charts is calibrated using the estimated covariance matrix of the VAR residuals.[20] The fiscal shock is assumed to be orthogonal to the other variables and is consistent with the standard error of the OLS regressions reported in Table 2. New macroeconomic disturbances occur every quarter and feed into VAR forecasts of the nonfiscal variables. After annualizing the results, the public debt and primary balance projections are determined recursively using equation (3). Annual frequency distributions for public debt are calculated on a sample of 1,000 repeated simulations.

19. **Fan charts summarize risks to the debt dynamics—the frequency distribution of the 1,000 debt paths generated.** Shocks to interest rates, growth and the exchange rate affect the economy over the projection period (2008–12).[21] Because the panel estimates of the fiscal reaction function for the ECCU are not well behaved, Scenario 1, or "no policy change" uses the estimated fiscal reaction function for the Caribbean as a whole (Table 3), and in Scenario 2, or "best-case," fiscal policy is allowed to adjust to relevant macroeconomic shocks according to the pattern observed in the five middle-income countries (Table 4). The responsiveness of the primary surplus to public debt is stronger in the latter case.

20. **The fan charts illustrate the significant uncertainty surrounding public debt projections, giving a better idea of the overall risks (upside and downside) to public debt projections in the ECCU.** Three conclusions can be drawn:

- **For all six ECCU countries, both scenarios generally show the median debt path to be either stable or falling.** Fiscal policy that makes adjustments in response to past public debt accumulation, as assumed in the scenarios, would contribute to putting debt on a downward path in the ECCU.

[20] These error terms are contemporaneously correlated and identification depends on the assumed ordering of the equations in the VAR.

[21] Different colors delineate deciles in the distributions of debt ratios, with the zone in dark grey representing a 20 percent confidence interval around the median projection and the overall cone, a confidence interval of 80 percent.

- **The overall risk profile obtained for the six countries reflects the idiosyncrasies of their respective economies.** Given that the sensitivity of fiscal policy is the same for each country under a given scenario, the widths of the confidence intervals reflect each country's past volatility as identified by the VAR. Comparing the ninth to the first decile indicates that less volatile economies—such as Dominica and St. Lucia—exhibit narrower confidence intervals (Table 6). Grenada and especially St. Kitts and Nevis exhibit the widest confidence intervals for the public debt risk profiles, reflecting greater past volatility. Compared to estimates for South Africa in Debrun (2006), the uncertainty associated with public debt profiles in the ECCU, measured by the gap between the ninth and the first percentile, is two to ten times wider, reflecting the region's extreme past macroeconomic volatility, particularly for growth.

- **Except for Dominica, the policy response to shocks under both scenarios proves too weak to prevent growing debt ratios in the two upper deciles of the charts.** For St. Kitts and Nevis, for example, the distribution of the debt ratio is skewed towards the upside, indicating that there is at least a 20 percent chance that combinations of adverse shocks may lead debt to exceed 220 percent of GDP by 2012. Unsurprisingly, skewness seems to be associated with high volatility. Given the probabilities of an increasing debt ratio, a more aggressive response of fiscal policy to the public debt-to-GDP ratio than in the two scenarios is warranted to contain upside risks to debt dynamics.

21. **The public debt risk profiles can also provide debt sustainability indicators**. As discussed in Section B, there are a number of operational methods for assessing the sustainability of public debt. For the ECCU, the ECCB Monetary Council has set a target of 60 percent debt-to-GDP by 2020, a threshold that the region has determined would be sustainable. For each country, the probability that public debt will decline towards the 60 percent target during the projection period, and the probability of upside risks to the debt ratio (debt exceeding 90 percent of GDP) are summarized in Table 6. If the probability of debt below 60 percent is very low by the end of the projection period (2012), then reaching the region's sustainability target by 2020 would also seem unlikely without assuming a future radical improvement in fiscal policies.

22. **Even with the assumption of strong primary surplus responsiveness, the probability of public debt declining toward 60 percent of GDP in the medium term is low.** St. Lucia, Dominica, and St. Vincent and the Grenadines are the only countries where there is greater than a 50 percent probability that debt declines to 60 percent of GDP in the best-case scenario. These probabilities are below 20 percent for Antigua and Barbuda and St. Kitts and Nevis. There are also significant differences across the countries in the extent to which a stronger responsiveness of the primary surplus to public debt (best-case scenario) substantially increases the probability that debt will decline to the 60 percent sustainability target by 2012. This reflects the significant distance a number of the countries are from the

threshold in either scenario. The scenario assumptions do matter for Dominica, where the probability is 0.3 percent in the no-policy change scenario and 0.88 percent in the best-case scenario.

E. Concluding Remarks

23. **This paper applies a probabilistic approach to debt sustainability analysis for countries in the ECCU.** For all but two countries in the region, fiscal policy does not react adequately to past debt accumulation to provide a foundation for debt sustainability. Public debt risk profiles are derived using fiscal reaction functions which do respond to past debt, combined with estimated ECCU country-specific macroeconomic shocks. For half of the countries, there is only a low probability in the next five years of being on the right path to achieve the region's 60 percent debt-to-GDP target by 2020.

24. **Stronger responsiveness of primary fiscal balances to past public debt, particularly in volatile macroeconomic environments such as in the ECCU, would increase the likelihood of placing debt on a downward path and limiting the upside risks.** These results, coupled with the findings of strong fiscal policy inertia, underscore the need for formal mechanisms to operationalize the ECCB's debt sustainability benchmark, by linking national fiscal policies to the benchmark.[22] This would involve setting primary balance targets consistent with achieving the 60 percent debt-to-GDP ratio, and adjusting those targets in response to macroeconomic and debt developments.

[22] See *Eastern Caribbean Currency Union—Staff Report for the 2009 Discussion on Common Policies of Member Countries* (www.imf.org).

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Table 1. ECCU: Fiscal Reaction Function, 1984–2007
Dependent Variable: Primary Fiscal Surplus in Percent of GDP

	GLS Random Effects	GLS Random Effects	System GMM
Constant	0.03	-2.14*	-1.20
	[0.03]	[-1.9]	[-1.54]
Lagged debt	-0.02*	-0.03**	0.00
	[-1.68]	[-2.26]	[-0.42]
Output gap		-0.15**	-0.06
		[-2.1]	[-0.65]
Real oil prices		0.03	0.01
		[0.69]	[0.36]
Institutions		3.41***	0.97
		[3.03]	[1.15]
Lagged dependent variable			0.52***
			[9.11]
R-squared within	0.00	0.05	
R-squared between	0.83	0.92	
R-squared overall	0.02	0.14	
Number of observations	125	125	119
Hansen test (p-value)			1.00
Arellano-Bond test for AR(1) (p-value)			0.17
Arellano-Bond test for AR(2) (p-value)			0.97

Source: Authors' calculations.
Note: Brackets denote t-statistics; * , **, *** denote significance at 10, 5, and 1 percent respectively.

Table 2. Antigua and Barbuda: Fiscal Reaction Function, 1986–2007
Dependent Variable: Primary Fiscal Surplus in Percent of GDP

	OLS	OLS	OLS	OLS
Constant	2.11*	2.58*	1.65	-2.14
	[1.81]	[2.03)	[1.22]	[-0.22]
Lagged debt	-0.04**	-0.05**	-0.07***	-0.07***
	[-3.28]	[-3.34]	[-3.58]	[-3.43]
Output gap		-0.07	-0.18*	-0.19*
		[-0.93]	[-1.77]	[-1.77]
Real oil prices			0.10	0.08
			[1.59]	[1.00]
Institutions				6.19
				[0.4]
R-squared	0.36	0.39	0.47	0.47
Adj. R-squared	0.33	0.32	0.38	0.34
Number of observations	21	21	21	21
Root Mean Squared Error (RMSE)	2.28	2.29	2.2	2.26

Source: Authors' calculations.

Note: Brackets denote t-statistics; * , **, *** denote significance at 10, 5, and 1 percent respectively.

Table 2a. Dominica: Fiscal Reaction Function, 1984–2007
Dependent Variable: Primary Fiscal Surplus in Percent of GDP

	OLS	OLS	OLS	OLS
Constant	-8.72**	-10.76***	-9.51**	-9.52**
	[-2.83]	[-3.0]	[-2.51]	[-2.45]
Lagged debt	0.11***	0.14***	0.09	0.09
	[2.66]	[2.85]	[1.21]	[1.20]
Output gap		0.21	0.07	0.05
		[1.1]	[0.29]	[0.22]
Real oil prices			0.09	0.08
			[1.01]	[0.72]
Institutions				0.37
				[0.25]
R-squared	0.25	0.29	0.33	0.33
Adj. R-squared	0.22	0.22	0.23	0.18
Number of observations	23	23	23	23
Root Mean Squared Error (RMSE)	3.38	3.36	3.36	3.45

Source: Authors' calculations.

Note: Brackets denote t-statistics; * , **, *** denote significance at 10, 5, and 1 percent respectively.

Table 2b. Grenada: Fiscal Reaction Function, 1989–2007
Dependent Variable: Primary Fiscal Surplus in Percent of GDP

	OLS	OLS	OLS	OLS
Constant	-3.73	-3.68	-6.80*	35.91
	[-1.07]	[-1.02]	[-1.93]	[1.39]
Lagged debt	0.02	0.22	0.23**	0.22**
	[0.47]	[0.43]	[2.18]	[2.22]
Output gap		-0.05	0.02	-0.01
		[-0.33]	[0.14]	[-0.08]
Real oil prices			-0.38	-0.68**
			[-2.19]	[-2.79]
Institutions				-60.08
				[-1.66]
R-squared	0.01	0.02	0.27	0.40
Adj. R-squared	-0.05	-0.11	0.12	0.21
Number of observations	18	18	18	18
Root Mean Squared Error (RMSE)	4.32	4.44	3.97	3.74

Source: Authors' calculations.

Note: Brackets denote t-statistics; * , **, *** denote significance at 10, 5, and 1 percent respectively.

Table 2c. St. Kitts and Nevis: Fiscal Reaction Function, 1984–2007
Dependent Variable: Primary Fiscal Surplus in Percent of GDP

	OLS	OLS	OLS	OLS
Constant	10.7***	-5.78	-7.68*	7.92
	[7.00]	[-1.58]	[-1.79]	[1.59]
Lagged debt	0.00	0.02	-0.01	-0.18***
	[0.00]	[0.56]	[-0.23]	[-3.36]
Output gap		-0.49	-0.51	-0.57**
		[-1.56]	[-1.59]	[-2.43]
Real oil prices			0.17	-0.22
			[0.87]	[-1.23]
Institutions				44.50***
				[4.07]
R-squared	0.00	0.12	0.15	0.56
Adj. R-squared	-0.05	0.03	0.02	0.46
Number of observations	23	23	23	23
Root Mean Squared Error (RMSE)	3.77	7.62	7.67	5.68

Source: Authors' calculations.

Note: Brackets denote t-statistics; * , **, *** denote significance at 10, 5, and 1 percent respectively.

Table 2d. St. Lucia: Fiscal Reaction Function, 1984–2007
Dependent Variable: Primary Fiscal Surplus in Percent of GDP

	OLS	OLS	OLS	OLS
Constant	2.50	2.25	1.92	1.42
	[1.36]	[1.12]	[0.94]	[0.56]
Lagged debt	-0.04	-0.04	0.02	0.02
	[-1.02]	[-0.80]	[0.3]	[0.29]
Output gap		0.04	0.11	0.97
		[0.36]	[0.82]	[0.64]
Real oil prices			-0.08	-0.09
			[-0.9]	[-0.94]
Institutions				1.13
				[0.34]
R-squared	0.05	0.05	0.1	0.10
Adj. R-squared	0.00	-0.04	-0.05	-0.10
Number of observations	23	23	23	23
Root Mean Squared Error (RMSE)	2.66	2.70	2.73	2.79

Source: Authors' calculations.

Note: Brackets denote t-statistics.

Table 2e. St. Vincent and the Grenadines: Fiscal Reaction Function, 1990–2007
Dependent Variable: Primary Fiscal Surplus in Percent of GDP

	OLS	OLS	OLS	OLS
Constant	-0.24	0.00	-0.93	0.49
	[-0.10]	[-0.00]	[-0.30]	[0.12]
Lagged debt	-0.01	-0.01	0.02	0.00
	[-0.21]	[-0.30]	[0.25]	[-0.03]
Output gap		-0.10	-0.08	-0.10
		[-0.96]	[-0.64]	[-0.77]
Real oil prices			-0.03	0.01
			[-0.51]	[0.14]
Institutions				-2.53
				[-0.55]
R-squared	0.00	0.06	0.08	0.11
Adj. R-squared	-0.06	-0.07	-0.13	-0.19
Number of observations	17	17	17	17
Root Mean Squared Error (RMSE)	1.80	1.80	1.86	1.90

Source: Authors' calculations.

Note: Brackets denote t-statistics.

Table 3. Caribbean Countries: Fiscal Reaction Function 1/
Dependent Variable: Primary Fiscal Surplus in percent of GDP

	GLS Random effects	GLS Random effects	System GMM
Constant	-1.67**	-1.50	-0.43
	[-2.14]	[-1.64]	[-0.81]
Lagged debt	0.02**	0.02***	0.00
	[2.321]	[2.72]	[1.20]
Output gap		-0.03	0.00
		[-0.65]	[-0.01]
Real oil prices		-0.05**	-0.01
		[-2.11]	[-0.66]
Institutions		2.12***	0.57
		[2.86]	[1.29]
Lagged primary surplus			0.59***
			[17.24]
R-sq. within	0.03	0.15	
R-sq. between	0.06	0.23	
R-sq. overall	0.02	0.16	
Number of observations	203	203	193
Hansen test (p-value)			1.00
Arellano-Bond test for AR(1) (p-value)			0.09
Arellano-Bond test for AR(2) (p-value)			0.61

Source: Authors' calculations.

Note: Brackets denote t-statistics; * , **, *** denote significance at 10, 5, and 1 percent respectively.

1/ In addition to the ECCU, the sample includes The Bahamas, Barbados, Belize, Dominican Republic, Guyana, Jamaica, Suriname, and Trinidad and Tobago.

Table 4. Selected Emerging Markets: Estimates of the Fiscal Reaction Function, 1990–2004
Dependent Variable: Level or Change in Change in the Primary Fiscal Balance

	(1) LIML (Difference)	(2) System GMM	(3) GMM with DV	(4) LIML (Difference)	(5) GMM with DV
Lagged debt	0.04	0.03***	0.05***	0.12	0.10***
	[0.032]	[0.01]	[0.01]	[0.17]	[0.04]
Output gap	0.10	0.22***	0.33***		
	[0.11]	[0.07]	[0.11]		
Real oil prices	0.48***	0.08**	0.35***	0.49***	0.36***
	[0.07]	[0.03]	[0.08]	[0.11]	[0.09]
Institutions	0.37	-0.22	-0.68***	0.46	-0.38
	[0.484]	[0.322]	[0.258]	[0.45]	[0.26]
IMF program	0.77***	1.12	1.11***	0.78**	0.94**
	[0.35]	[0.69]	[0.33]	[0.34]	[0.33]
Default	0.87**	0.88	1.19***	0.75***	1.08***
	[0.35]	[0.81]	[0.40]	[0.30]	[0.37]
Debt spline				-0.11	-0.06*
(50 percent)				[0.19]	[0.04]
Positive output gap				-0.09	0.18
				[0.36]	[0.63]
Negative output gap				0.26	0.27
				[0.25]	[0.23]
Constant		-0.68	-0.96		-3.63
		[1.48]	[1.14]		[2.89]
Country dummies	No	No	Yes	No	Yes
Number of observations	349	399	418	368	418
Hansen test (p-value)	0.84	1.00	0.45	--	0.03
Arellano-Bond test for AR(1) (p-value)		0.05			
Arellano-Bond test for AR(2) (p-value)		0.09			
Cragg-Donald Stat.	7.23		19.63	1.96	

Source: Celasun, Debrun, and Ostry (2006).

Note: Brackets denote t-statistics; * , **, *** denote significance at 10, 5, and 1 percent respectively.

Table 5. Antigua and Barbuda: VAR Model

	Foreign Interest Rate	Domestic Interest Rate	Growth	Log of REER
Foreign interest rate (-1)	-0.062	0.000	-0.090	-0.002
	[-0.521]	[0.000]	[-1.12001]	[-0.589]
Domestic interest rate (-1)	-0.068	0.187	-0.376	0.009
	[0.248]	[5.473]	[-1.415]	[1.064]
Growth (-1)	0.078	0.110	1.800	0.001
	[1.129]	[2.000]	[38.303]	[0.424]
Log of REER (-1)	-5.238	-3.555	-3.607	1.086
	[-1.315]	[-1.1257]	[-1.337]	[8.613]
Constant	9.051	-1.615	22.677	0.319
	[0.962]	[-0.216]	[3.559]	[1.071]
R-squared	0.072	0.272	0.987	0.816
Adj. R-squared	-0.036	0.188	0.985	0.794

Residual Correlation Matrix

	Foreign Interest Rate	Domestic Interest Rate	Growth	Log of REER
Foreign interest rate	1.000	-0.041	-0.037	-0.039
Domestic interest rate	-0.041	1.000	-0.158	-0.317
Growth	-0.037	-0.158	1.000	-0.020
Log of REER	-0.039	-0.317	-0.020	1.000

Source: Authors' calculations.

Table 5a. Dominica: VAR Model

	Foreign Interest Rate	Domestic Interest Rate	Growth	Log of REER
Foreign interest rate (-1)	-0.024	0.006	0.017	-0.004
	[-0.216]	[0.182]	[0.255]	[-1.318]
Domestic interest rate (-1)	-0.092	1.083	0.157	0.005
	[-0.255]	[11.037]	[0.715]	[0.495]
Growth (-1)	-0.020	0.001	1.792	-0.002
	[-0.220]	[0.046]	[31.918]	[-0.713]
Log of REER (-1)	-3.040	-1.722	-2.086	0.903
	[-0.709]	[-1.485]	[-0.804]	[7.703]
Constant	11.206	2.765	-0.298	0.436
	[1.307]	[1.192]	[-0.057]	[1.857]
R-squared	0.038	0.801	0.980	0.830
Adj. R-squared	-0.062	0.780	0.978	0.812

Residual Correlation Matrix

	Foreign Interest Rate	Domestic Interest Rate	Growth	Log of REER
Foreign interest rate	1.000	0.012	-0.001	0.052
Domestic interest rate	0.012	1.000	0.004	0.061
Growth	-0.001	0.004	1.000	-0.100
Log of REER	0.052	0.061	-0.100	1.000

Source: Authors' calculations.

Table 5b. Grenada: VAR Model

	Foreign Interest Rate	Domestic Interest Rate	Growth	Log of REER
Foreign interest rate (-1)	-0.077	0.016	-0.009	-0.003
	[-0.678]	[0.695]	[-0.065]	[-1.003]
Domestic interest rate (-1)	0.204	0.775	0.537	0.020
	[0.358]	[6.788]	[0.800]	[1.140]
Growth (-1)	-0.064	0.007	1.721	-0.001
	[-1.571]	[0.868]	[35.691]	[-0.531]
Log of REER (-1)	-3.082	1.221	-3.763	0.796
	[-0.813]	[1.603]	[-0.841]	[6.938]
Constant	9.654	-2.539	-1.490	0.923
	[0.985]	[-1.289]	[-0.129]	[3.116]
R-squared	0.079	0.678	0.967	0.734
Adj. R-squared	-0.016	0.644	0.964	0.707

Residual Correlation Matrix

	Foreign Interest Rate	Domestic Interest Rate	Growth	Log of REER
Foreign interest rate	1.000	0.072	-0.110	-0.081
Domestic interest rate	0.072	1.000	0.080	0.104
Growth	-0.110	0.080	1.000	-0.009
Log of REER	-0.081	0.104	-0.009	1.000

Source: Authors' calculations.

Table 5c. St. Kitts and Nevis: VAR Model

	Foreign Interest Rate	Domestic Interest Rate	Growth	Log of REER
Foreign interest rate (-1)	-0.027	0.005	0.026	0.003
	[-0.235]	[0.206]	[0.240]	[0.878]
Domestic interest rate (-1)	-0.019	1.394	-0.135	-0.003
	[-0.053]	[16.166]	[-0.385]	[-0.330]
Growth (-1)	0.022	0.006	1.725	-0.001
	[0.426]	[0.500]	[34.470]	[-0.656]
Log of REER (-1)	-2.210	0.189	-2.074	0.919
	[-0.545]	[0.198]	[-0.535]	[7.900]
Constant	-10.819	1.265	-4.808	0.410
	[-1.565]	[0.778]	[-0.728]	[2.066]
R-squared	0.051	0.842	0.970	0.868
Adj. R-squared	-0.047	0.826	0.967	0.854

Residual Correlation Matrix

	Foreign interest rate	Domestic interest rate	Growth	log of REER
Foreign interest rate	1.000	0.005	0.035	0.110
Domestic interest rate	0.005	1.000	-0.011	0.002
Growth	0.035	-0.011	1.000	-0.132
Log of REER	0.110	0.002	-0.132	1.000

Source: Authors' calculations.

Table 5d. St. Lucia: VAR Model

	Foreign Interest Rate	Domestic Interest Rate	Growth	Log of REER
Foreign interest rate (-1)	-0.016	0.001	-0.045	-0.002
	[-0.143]	[0.035]	[-0.463]	[-0.656]
Domestic interest rate (-1)	-0.009	1.338	-0.155	-0.008
	[-0.027]	[16.416]	[-0.565]	[-0.760]
Growth (-1)	0.010	0.013	1.612	0.000
	[0.169]	[0.876]	[32.192]	[-0.032]
Log of REER (-1)	-3.023	0.110	-8.876	0.857
	[-0.855]	[0.121]	[-2.929]	[7.454]
Constant	-6.273	-4.723	42.269	0.436
	[-0.668]	[-1.969]	[5.254]	[1.429]
R-squared	0.031	0.860	0.980	0.825
Adj. R-squared	-0.069	0.845	0.977	0.806

Residual Correlation Matrix

	Foreign Interest Rate	Domestic Interest Rate	Growth	Log of REER
Foreign interest rate	1.000	0.036	-0.045	-0.057
Domestic interest rate	0.036	1.000	-0.042	-0.117
Growth	-0.045	-0.042	1.000	-0.299
Log of REER	-0.057	-0.117	-0.299	1.000

Source: Authors' calculations.

Table 5e. St. Vincent and the Grenadines: VAR Model

	Foreign Interest Rate	Domestic Interest Rate	Growth	Log of REER
Foreign interest rate (-1)	-0.019	0.011	-0.009	-0.002
	[-0.171]	[0.284]	[-0.087]	[-0.471]
Domestic interest rate (-1)	-0.003	1.290	0.534	0.006
	[-0.012]	[14.892]	[2.399]	[0.715]
Growth (-1)	0.016	-0.030	1.710	0.000
	[0.342]	[-1.764]	[38.825]	[0.192]
Log of REER (-1)	-3.100	-0.579	-4.187	0.859
	[-0.936]	[-0.478]	[-1.346]	[7.855]
Constant	7.059	-3.727	14.008	0.480
	[0.989]	[-1.426]	[2.088]	[2.033]
R-squared	0.041	0.828	0.971	0.823
Adj. R-squared	-0.054	0.811	0.968	0.805

Residual Correlation Matrix

	Foreign Interest Rate	Domestic Interest Rate	Growth	Log of REER
Foreign interest rate	1.000	0.004	-0.028	0.065
Domestic interest rate	0.004	1.000	0.192	0.002
Growth	-0.028	0.192	1.000	-0.012
Log of REER	0.065	0.002	-0.012	1.000

Source: Authors' calculations.

Table 6. Antigua and Barbuda: Public Debt Risk Assessment 2008–12

	2008	2009	2010	2011	2012
First-Case Scenario					
Maximum	125.77	144.36	166.93	192.56	215.87
Median	102.34	102.98	102.96	103.45	103.35
Average	102.32	103.45	104.71	106.12	107.95
9th decile	111.89	120.81	130.69	140.37	148.28
1st decile	93.04	86.99	81.70	76.87	73.95
Probability that debt ratio is					
below 60 percent	0.00	0.00	0.00	0.01	0.03
above 90 percent	1.00	1.00	1.00	0.99	0.97
Second-Case Scenario					
Maximum	118.84	139.01	161.18	178.78	201.24
Median	100.24	97.63	95.32	92.67	90.50
Average	99.76	97.76	95.88	94.36	93.20
9th decile	108.43	113.46	118.80	123.70	128.26
1st decile	91.05	81.82	72.79	65.88	60.82
Probability that debt ratio is					
below 60 percent	0.00	0.00	0.02	0.05	0.09
above 90 percent	1.00	1.00	0.98	0.95	0.91

Source: Authors' calculations.

Table 6a. Dominica: Public Debt Risk Assessment 2008–12

	2008	2009	2010	2011	2012
First-Case Scenario					
Maximum	120.08	136.39	150.46	164.57	171.12
Median	87.15	81.17	76.69	72.26	69.40
Average	86.93	81.48	77.31	73.56	70.43
9th decile	96.49	97.82	98.03	97.67	97.90
1st decile	76.74	65.42	56.80	49.57	43.04
Probability that debt ratio is					
below 60 percent	0.00	0.05	0.14	0.24	0.32
above 90 percent	1.00	0.95	0.86	0.76	0.68
Second-Case Scenario					
Maximum	99.19	105.06	97.50	95.93	94.51
Median	78.02	65.35	54.74	47.05	40.59
Average	78.03	65.56	55.88	48.33	42.17
9th decile	88.52	81.80	75.17	68.50	61.38
1st decile	67.81	50.58	38.36	30.78	24.99
Probability that debt ratio is					
below 60 percent	0.01	0.33	0.63	0.80	0.88
above 90 percent	0.99	0.67	0.37	0.20	0.12

Source: Authors' calculations.

Table 6b. Grenada: Public Debt Risk Assessment 2008–12

	2008	2009	2010	2011	2012
	First-Case Scenario				
Maximum	131.61	168.57	201.29	254.36	335.56
Median	95.84	90.99	87.16	83.48	81.62
Average	95.60	92.49	90.18	88.44	87.33
9th decile	112.59	122.59	128.06	134.42	140.42
1st decile	79.00	64.62	55.68	48.68	44.22
Probability that debt ratio is					
below 60 percent	0.01	0.07	0.14	0.21	0.27
above 90 percent	0.99	0.93	0.86	0.79	0.73
	Second-Case Scenario				
Maximum	127.61	147.87	181.33	205.68	226.99
Median	92.30	85.24	78.35	72.49	67.55
Average	91.86	85.74	80.92	76.79	73.09
9th decile	107.03	111.62	115.28	118.16	118.41
1st decile	76.78	60.39	49.49	41.52	34.67
Probability that debt ratio is					
below 60 percent	0.01	0.09	0.22	0.31	0.40
above 90 percent	0.99	0.91	0.78	0.69	0.60

Source: Fund staff calculations.

Table 6c. St. Kitts and Nevis: Public Debt Risk Assessment 2008–12

	2008	2009	2010	2011	2012
	First-Case Scenario				
Maximum	250.89	353.93	470.96	577.63	738.19
Median	173.05	165.26	157.21	149.74	145.90
Average	169.83	166.86	167.29	169.09	170.61
9th decile	211.27	243.27	275.99	311.27	335.13
1st decile	123.31	90.01	70.92	57.19	47.86
Probability that debt ratio is					
below 60 percent	0.00	0.03	0.07	0.11	0.15
above 90 percent	1.00	0.97	0.93	0.90	0.85
	Second-Case Scenario				
Maximum	246.24	335.45	448.47	531.57	674.30
Median	172.01	162.23	156.61	146.42	136.54
Average	168.22	164.15	162.73	161.86	161.02
9th decile	209.79	242.33	271.61	288.76	314.24
1st decile	124.92	90.07	67.61	54.22	44.25
Probability that debt ratio is					
below 60 percent	0.00	0.03	0.08	0.13	0.17
above 90 percent	1.00	0.97	0.92	0.87	0.83

Source: Authors' calculations.

Table 6d. St. Lucia: Public Debt Risk Assessment 2008–12

	2008	2009	2010	2011	2012
	First-Case Scenario				
Maximum	98.70	121.43	154.98	188.93	207.11
Median	68.22	66.37	64.92	64.15	63.45
Average	68.62	67.66	67.22	67.26	67.36
9th decile	78.89	84.64	91.63	97.01	102.41
1st decile	58.50	50.47	44.94	41.43	38.47
Probability that debt ratio is					
below 60 percent	0.14	0.29	0.37	0.41	0.45
above 90 percent	0.86	0.71	0.63	0.59	0.55
	Second-Case Scenario				
Maximum	90.51	114.37	130.30	141.07	140.08
Median	64.56	59.88	55.60	52.04	49.34
Average	64.53	60.08	56.77	53.97	51.71
9th decile	73.98	76.29	77.75	78.08	76.97
1st decile	54.23	43.89	37.58	32.13	28.91
Probability that debt ratio is					
below 60 percent	0.27	0.51	0.60	0.66	0.70
above 90 percent	0.73	0.50	0.40	0.34	0.30

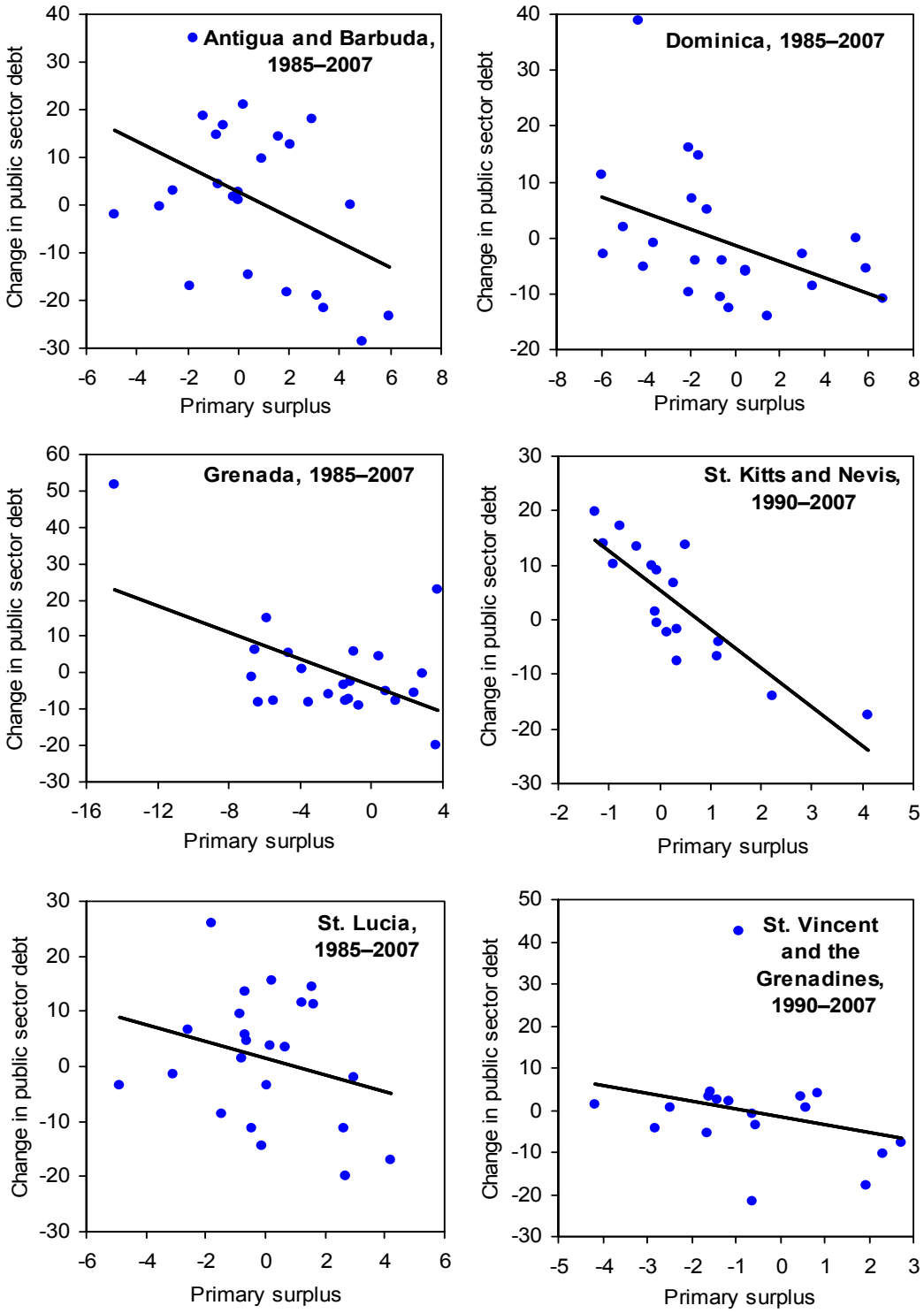
Source: Authors' calculations.

Table 6e. St. Vincent and the Grenadines: Public Debt Risk Assessment 2008–12

	2008	2009	2010	2011	2012
	First-Case Scenario				
Maximum	93.57	122.80	175.53	253.35	341.45
Median	69.75	71.81	73.24	74.73	75.97
Average	69.75	72.53	75.85	79.66	83.97
9th decile	81.29	95.31	109.41	125.23	138.51
1st decile	58.63	52.27	47.45	43.35	40.16
Probability that debt ratio is					
below 60 percent	0.14	0.24	0.27	0.30	0.30
above 90 percent	0.86	0.76	0.73	0.70	0.70
	Second-Case Scenario				
Maximum	93.64	117.62	140.13	169.86	203.57
Median	65.86	64.42	62.71	61.31	59.37
Average	65.85	65.00	64.61	64.93	65.28
9th decile	77.09	85.97	93.65	100.54	106.71
1st decile	54.27	45.51	38.75	33.74	30.45
Probability that debt ratio is					
below 60 percent	0.25	0.40	0.46	0.48	0.51
above 90 percent	0.75	0.60	0.54	0.52	0.49

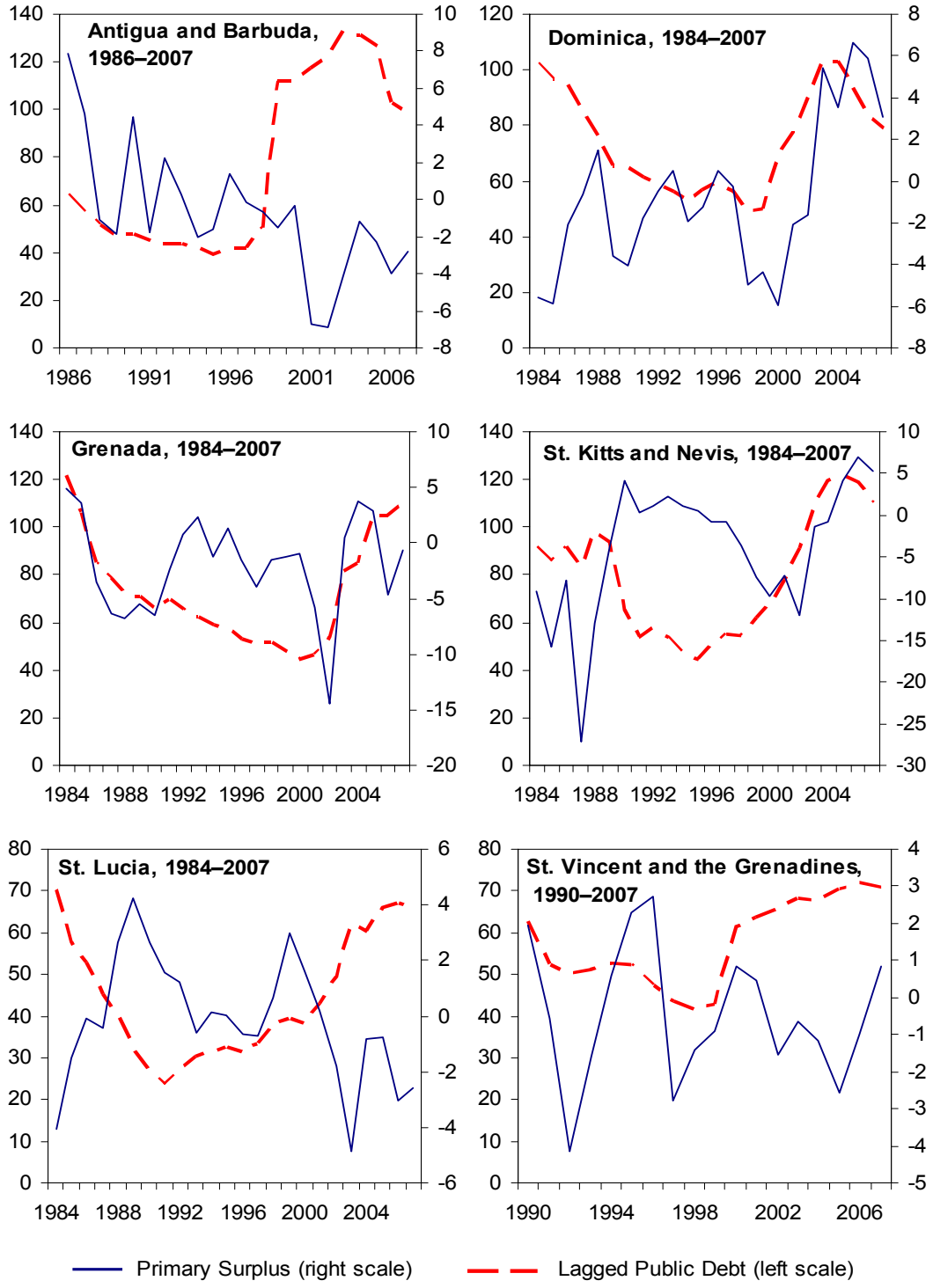
Source: Authors' calculations.

Figure 1. Change in Public Debt and Primary Surplus
(In percent of GDP)



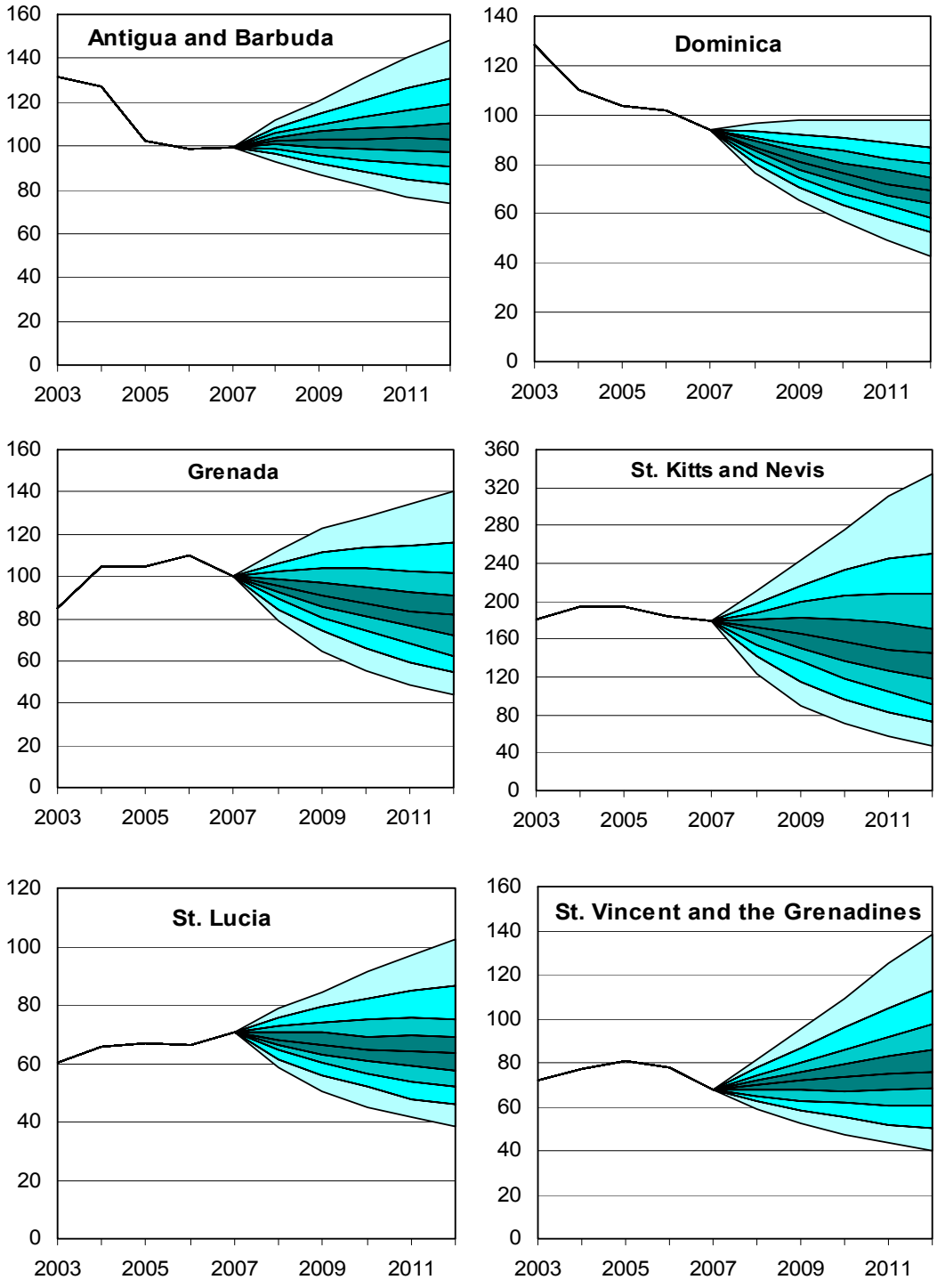
Sources: ECCB; and authors' calculations.

Figure 2. Primary Surplus and Lagged Public Debt
(In percent of GDP)



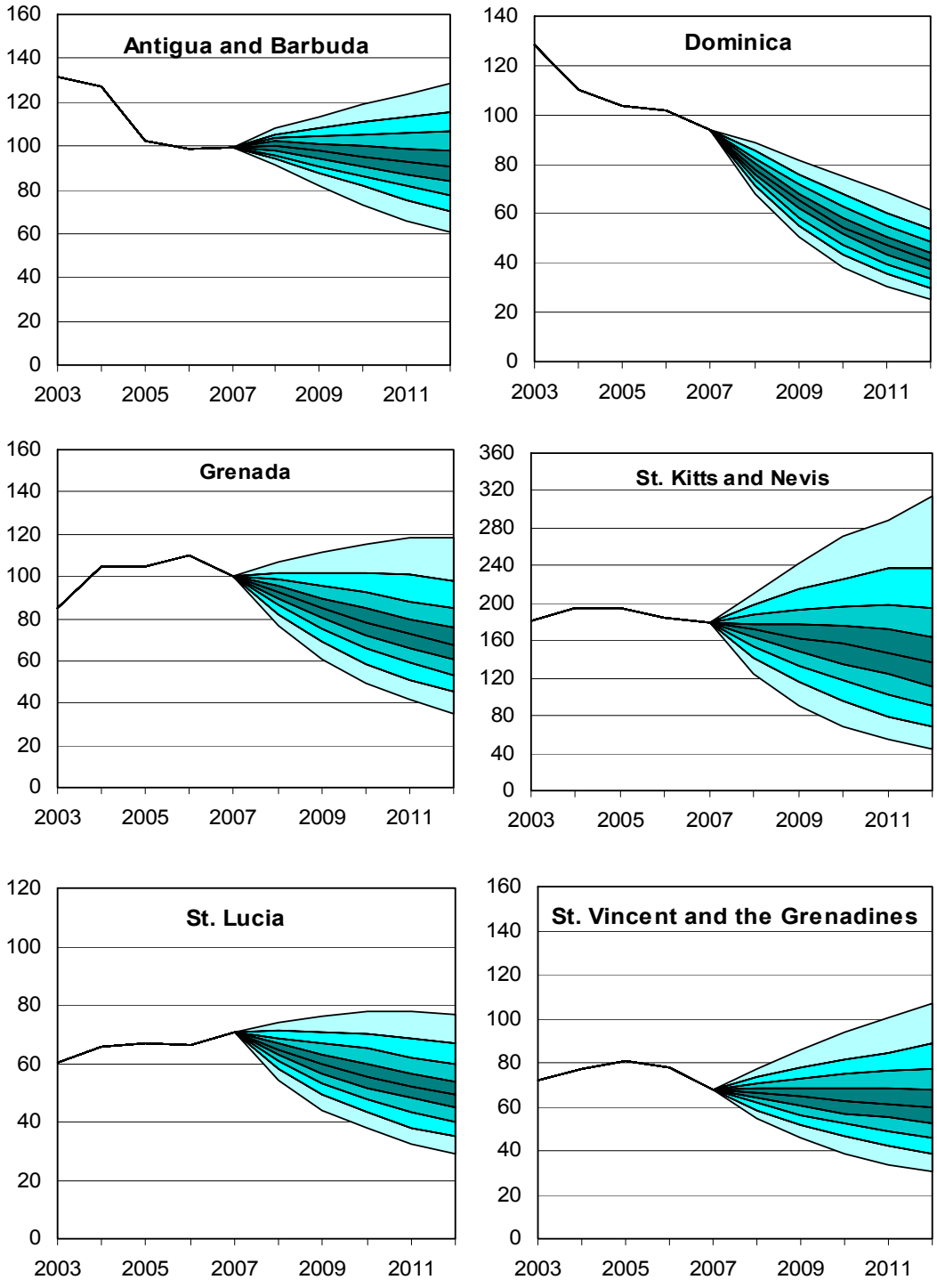
Sources: ECCB; and authors' calculations.

Figure 3. Public Debt Under the First-Case Scenario, 2008–12
(In percent of GDP)



Sources: Country authorities; and authors' calculations.

Figure 4. Public Debt Under the Best-Case Scenario, 2008–12
(In percent of GDP)



Sources: Country authorities; and authors' calculations.

VI. INSURING AGAINST NATURAL DISASTERS IN THE CARIBBEAN[1]

A. Introduction

1. **This paper examines the vulnerability of public finances in the Caribbean to the occurrence of natural disasters (in particular, hurricanes), and illustrates how catastrophic risk insurance could significantly improve public debt sustainability through optimal insurance coverage.**[2] We apply the model used in Borensztein, Cavallo, and Valenzuela (2008) to fiscal debt sustainability analysis for the six highly-indebted Fund member countries of the ECCU.[3]

B. Debt Dynamics and Natural Disasters in the ECCU

2. **The origin of unsustainable public debt in the ECCU countries has been attributed to a combination of exogenous shocks and policy slippages.** Previous studies such as Sahay (2006) concluded that the rapid increase in debt reflected fiscal expansion related to both policy slippages and insufficient fiscal planning for anticipated (e.g., decline in preferential access) and unanticipated (e.g., reconstruction costs after natural disasters) adverse shocks. With the ECCU countries among the world's most vulnerable to natural disasters (Table 1), Rasmussen (2006) found that natural disasters have had a pronounced macroeconomic impact on these countries' fiscal and external balances, suggesting an important role for preventive measures.

3. **Small island economies face larger constraints in absorbing the fiscal impact of natural disasters.** The limited size of these economies prevents sufficient economic diversification that could help to mitigate economic losses and facilitate the recovery process. More importantly, high public indebtedness has left little or no fiscal room for maneuver in the event of an adverse economic shock. At the same time, high indebtedness often limits further access to borrowing or implies significantly higher borrowing costs to meet reconstruction expenses after natural disasters.

4. **Reliance on donor assistance in the aftermath of a natural disaster is often problematic, with aid transfers being too late and too little**. Table 2 shows the aggregate change in transfers from donors in the year (and two subsequent years) that the natural disaster occurs. The data suggest that while overall average transfers per hurricane year are higher than in an average year, transfers, in many cases, failed to pick up promptly in the

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[1] Prepared by Yu Ching Wong, Anthony Lemus, and Nancy Wagner.

[2] While the Caribbean countries are also exposed to earthquakes, this paper focuses on the example of hurricanes, as they represent the most frequent threat for these countries.

[3] Antigua and Barbuda (ATG), Dominica (DMA), Grenada (GRD), St. Kitts and Nevis (KNA), St. Lucia (LCA), and St. Vincent and the Grenadines (VCT).

year or immediate year following the occurrence of natural disasters, thus reducing the relief impact of such assistance in meeting liquidity gaps.

C. Improving Debt Sustainability with Disaster Insurance

5. **Historical data indicate that the probability of occurrence of a hurricane of any category in a given year is about 18 percent for the ECCU region**. For each of the ECCU countries, Figure 1 shows the probable maximum loss from hurricanes for return periods of one in 18, 20, 30, 50, 100, 200, 250 and 500 years, respectively, as estimated by the World Bank (2006).[4] [5] As summarized in Table 3, historical data would imply that Dominica is the most vulnerable while Grenada is the least affected by hurricanes among the ECCU countries.[6] The estimated fiscal loss caused by a hurricane with a return period of 1-in-30 years would be the highest in Dominica at 11 percent of GDP and the lowest in Grenada at less than 1 percent of GDP.

6. **In the event of a natural disaster, revenue losses and expenditure increases due to reconstruction needs could easily lead to explosive debt paths given the already high indebtedness of ECCU countries**. Central government debt-to-GDP ratios ranged from about 55–70 percent of GDP in St. Vincent and the Grenadines, St. Lucia, and Dominica, close to 100 percent of GDP in Grenada and Antigua and Barbuda, and about 140 percent of GDP in the case of St. Kitts and Nevis in 2007. Moreover, taking into account government-guaranteed debt of public enterprises, total public debt-to-GDP ratios would be higher by about 10–40 percent of GDP.

7. **ECCU governments' capacity to pursue specific fiscal targets over the medium- to long-term is subject to significant risks, particularly in light of the vulnerability to natural disasters.** This can be shown using the standard debt equation, modified with a term to account for the impact of a hurricane. As shown in equation (1), the debt-to-GDP ratio (D_t) at time t is the product of the increase in the interest rate (r_t) over real GDP growth (y_t) and the debt-to-GDP ratio of the previous period, reduced by the fiscal primary surplus-to-GDP (ps_t), but increased by the fiscal cost of a hurricane, $H(\text{category})_t$ (as a percent of GDP):

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[4] The return period is an estimate of the interval of time between given disaster events (such as a hurricane) of a certain intensity or size.

[5] The estimates for the high probability event of 1-in-18-years are extrapolated from data points for the other return periods available from the World Bank (2006). The probable maximum loss estimated by EQECAT for Caribbean Catastrophe Risk Insurance Facility (CCRIF) countries includes estimated direct losses to government-owned assets caused by hurricanes, and estimated indirect losses due to lost tax revenue and disaster relief expenditures. Due to the lack of data such as property tax records and building code classifications, the exposure database is constructed based on field data and a series of assumptions. In this regard, the CCRIF recognizes the need to improve the exposure database in order to raise the quality of risk assessment. See also Box 1 on the CCRIF.

[6] Historical data are from 1900 to 2005.

$$D_t = [(1+r_t)/(1+y_t)]\, D_{t-1} - ps_t + H\,(\text{category})_t \qquad (1)$$

8. **To illustrate the risks, we generate a complete distribution of probable outcomes of debt ratios arising from random shocks to the economy for each ECCU member country**. This is done by generating 1000 random outcomes for the stochastic variables r_t , y_t, ps_t , and H_t for each year from 2008–2020, using projections for 2008–13 as the baseline values.[7] The occurrence of a hurricane for a particular year would increase the debt ratio by the estimated cost of the hurricane of the respective intensity, based on the data in Table 3. The results are shown in Figure 2, indicating the range of debt-to-GDP ratios with a 98 percent probability of occurrence. For example, in the case of St. Lucia, the projected baseline central government debt ratio without hurricanes could be between 73 to 128 percent of GDP by 2020, with the median at 99 percent. When the impact of hurricanes is taken into consideration, however, this range is projected to widen to 78–168 percent of GDP.

9. **Reflecting the vulnerability to natural disasters, the public debt paths in ECCU countries are greatly affected by the incidence of unanticipated fiscal losses from additional expenditures and reductions in tax revenue**. Our analysis also illustrates that, for Dominica and to a lesser extent Grenada, the occurrence of natural disasters could potentially reverse the direction of a declining debt trajectory.

10. **Insurance coverage against natural disasters could provide some fiscal space for governments to deal with the consequences and help to reduce the associated accumulation of public debt**. We consider parametric risk insurance that could be purchased on an individual country basis. The net effect on the debt-to-GDP ratio of the government's purchase of catastrophic risk insurance is modeled by adding to equation (1) the insurance premium as a percent of GDP, $P(M)_t$, and the insurance payout as a percent of GDP, $I(M, \text{category})_t$:

$$D_t = [(1+r_t)/(1+y_t)]\, D_{t-1} - ps_t + H\,(\text{category})_t + P(M)_t - I(M, \text{category})_t \qquad (2)$$

In the event that a hurricane of a specific intensity occurs and triggers the specific preset insurance payout, the insured government would receive an amount that is equal to or less than the hurricane costs depending on the level of insurance coverage.[8] In our calculations, we assume a minimum annual insurance premium of 0.23 percent of GDP corresponding to an annual insurance coverage limit equivalent to 2.5 percent of GDP for all the ECCU

[7] The stochastic shocks to each variable are assumed to follow a normal distribution with mean zero and standard deviation based on historical volatility from 1997 to 2013.

[8] In the case of the CCRIF, disbursement of an insurance payout is contingent on pre-established trigger events measured in terms of wind speed (for hurricane) and ground shaking (for earthquake) thresholds. This allows the insurance payment to meet the liquidity gap immediately following the aftermath of a disaster, without the need for an on-site loss assessment, which is usually time-consuming and costly (see World Bank 2006, 2007).

countries.[9] For instance, in the case of St. Kitts and Nevis, the occurrence of a 1-in-30 year event, corresponding to an estimated cost of 9.7 percent of GDP, would trigger an insurance payout equivalent to 2.5 percent of GDP if the government pays an insurance premium of 0.23 percent of GDP; a payout amount equivalent to 7.5 percent of GDP if the government pays a premium of 0.69 percent of GDP; or the maximum payout limit of 9.7 percent of GDP corresponding to a premium in the amount of 0.92 percent of GDP.

11. **Catastrophic insurance at optimum coverage could help to improve debt sustainability.** The results of our simulations are summarized in Figure 2 and Table 4. In the case of Dominica, which is the country most exposed to hurricanes, the maximum level of the debt-to-GDP ratio in 2020 is projected to increase from 69 percent in the absence of hurricanes to 150 percent, while optimum insurance coverage limits of 20 percent of GDP per annum (see last column of Table 4) could reduce the maximum level of the debt ratio to about 114 percent. The optimum insurance coverage is the point at which the benefits from a higher level of insurance coverage in terms of reducing the debt ratio are exactly offset by the cost of higher premiums. The optimum insurance coverage ranges from 5 percent of GDP for Grenada, 10 percent of GDP for St. Lucia, 12.5 percent of GDP for St. Kitts and Nevis and Antigua and Barbuda, 15 percent of GDP for St. Vincent and the Grenadines, and 20 percent of GDP per annum for Dominica (see Figure 2). Table 6 summarizes the optimum insurance coverage for each of the ECCU countries. The table also indicates the associated premium, based on commercial hurricane insurance coverage.

12. **The Caribbean Catastrophe Risk Insurance Facility (CCRIF) is a recent development which significantly improves Caribbean countries' access to disaster insurance.** As a multi-country risk pool, this parametric insurance facility is able to offer disaster insurance at a significant discount relative to policies purchased on an individual basis (see Box). As shown in Table 6, the rate-on-line (the ratio of the premium to the maximum payout) is typically less than half that available from commercial insurers. Despite this deep discount, Table 6 indicates that the ECCU countries, with the exception of Grenada, are purchasing insurance coverage well below the optimum level. Indeed, using the lower rate-on-line in the simulations would yield even higher optimal insurance coverage levels at lower cost. For example, we estimate that Dominica's optimal insurance level under the CCRIF would be 25 percent of GDP with a premium cost of about 1.2 percent of GDP, compared with 20 percent and 1.8 percent, respectively, under individual commercial insurance coverage.

[9] This corresponds to an estimated commercial hurricane insurance premium and coverage ratio in World Bank (2006).

D. What Impact From Climate Change?

13. **The frequency and intensity of hurricanes occurring in the ECCU region appear to have increased during the last decade, perhaps due to the nascent effects of climate change.** As shown in Table 1, the number of natural disaster events has risen in the ten-year period to 2007 for Dominica, Grenada, and St. Vincent and the Grenadines. Data from EM-DAT suggest that half of the top ten natural disasters in the ECCU region, measured in terms of damage as a percent of GDP, occurred after 1990. Most recently, as noted in the Caribbean Natural Hazards Review 2008, the number of hurricane-strength storms in 2008 was much higher than the long-term average, with the year becoming the fourth most severe season since data has been collected.

14. **The benefits of catastrophic insurance have also received greater attention given the prospects of climate change and its implications for more frequent and intense hurricane activity**. Grenada is a case in point. Grenada had been traditionally regarded as located south of the Atlantic hurricane belt. Accordingly, it served as a safe haven for yachts and ships during the Caribbean hurricane season. However, the pattern of hurricane activity may have changed, possibly reflecting the effect of climate change. Following 50 hurricane-free years, Hurricane Ivan struck Grenada in 2004, causing damages estimated in excess of 200 percent of GDP, among the highest estimated loss ever from a natural disaster (see IMF 2006). The following year, another hurricane struck Grenada, this time causing damage on the order of 12 percent of GDP. In our simulation exercise in Table 5, and in contrast to the historical data in Table 3, we examine the possible impact of climate change for two cases:

- Assuming that the costs of hurricanes for ***Grenada*** were to increase and approach the average level of its three northern neighbor counties—Antigua and Barbuda, Dominica, and St. Kitts and Nevis—then the projected maximum debt ratio in 2020 would widen to 188 percent of GDP from 144 percent, requiring a tripling of optimum insurance coverage to 15 percent of GDP per annum.

- Assuming that climate change further heightened the vulnerability of ***Dominica*** and raised the cost of hurricanes by 33 percent, the projected maximum debt ratio in 2020 would increase to 181 percent of GDP from 150 percent. A doubling of the insurance coverage limit to 40 percent of GDP per year would help to bring down the upper bound to 132 percent of GDP.

E. Conclusions

15. **The analysis illustrates that catastrophic risk insurance not only helps to reduce liquidity gaps in the aftermath of a natural disaster but also reduces resource gaps over the long run**. In the case of the highly-indebted ECCU countries, insurance against natural disasters, which represents a transfer or pooling of fiscal risks, could contribute significantly

to a lowering of public debt levels, and thus improve debt sustainability. Not surprisingly, our analysis also shows that countries that are most vulnerable to the occurrence of natural disasters benefit the most from insurance coverage. Moreover, this analysis attempts to determine an optimal level of insurance to improve the overall efficiency of resource allocation. This optimal level would be higher to the extent that climate change is expected to increase the frequency and intensity of hurricanes in the region.

16. **While the CCRIF was designed to meet a government's immediate liquidity needs, our analysis suggests that this multi-country risk pool could play a larger role in contributing to long-term debt sustainability**. Indeed, owing to the deeply discounted premia, the optimal levels of insurance would be even higher, at lower costs, than those calculated based on estimated individual insurance rates.

17. **A decision to purchase disaster insurance implies balancing the amount of risk the country could assume against the fiscal space available**. So far, donor assistance to pay for insurance premia has been key to enabling some of the countries to participate in the CCRIF. However, looking ahead, countries may need to fully finance their participation from their own resources. Given the ECCU countries' limited fiscal space, some may choose to forgo participation. Our analysis indicates that these countries are currently purchasing sub-optimal levels of insurance, all the more so given the conservative assumptions regarding premium costs and historical hurricane data (i.e., no impact from climate change).

18. **The CCRIF is being adapted to be even more attractive to participants, thereby allowing for a potentially larger role in insuring against fiscal risk associated with catastrophes**. Thus, in early 2008, the CCRIF lowered its premia and broadened its hurricane coverage. Premia were reduced by 10 percent, while maximum payouts were doubled. The insurance was also expanded to cover catastrophes expected to occur once every 15 years rather than 1-in-20-year events. Initiatives are also underway to improve the risk modeling framework and to consider adding coverage for floods/excess rainfall and agricultural damage. These changes would further raise the optimal level of insurance that should be purchased to maximize the benefits with respect to debt sustainability in the ECCU. Thus, despite the high debt levels in the ECCU, this analysis highlights the benefits to be gained by finding the fiscal space to fully participate in the CCRIF.

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Box 1. The Caribbean Catastrophe Risk Insurance Facility (CCRIF)

The CCRIF is a regional insurance fund that allows Caribbean governments to purchase insurance coverage to finance immediate post-disaster recovery needs.[1/] The CCRIF, the first multi-country risk pool in the world, was established in May 2007, the result of a collaboration between the region's governments and key donor partners, based on a request by the CARICOM Heads of Government to the World Bank for assistance in improving access to catastrophe insurance after the severe devastation caused by hurricanes in the Caribbean in 2004. As of April 2009, the total value of the insurance facility stood at US$130 million.

Made possible by the use of parametric insurance instruments, the CCRIF provides quick claims settlement to a participating government affected by an earthquake or hurricane. Payouts are contingent on pre-established trigger events measured in terms of wind speed or ground acceleration and proportional to the estimated loss derived from a hazard impact model.

Functioning as a pooled reserve controlled by participating governments, the CCRIF retains risk from participating governments through its own reserves, and transfers risks that exceed its own capacity to reinsurance markets. The leveraging of its own reserve pool to purchase additional risk financing capacity directly in the reinsurance market allows the CCRIF to secure sufficient financial capacity to finance major losses. This structure also provides participating governments with insurance coverage at about half the price they would face if they approached the reinsurance industry independently. Other nonmembers of the CCRIF which have donated to the facility's reserve pool are Bermuda, Canada, France, Ireland, the United Kingdom, the Caribbean Development Bank, the European Union, and the World Bank.

Insurance coverage under the CCRIF is typically capped at 20 percent of total estimated losses, a proportion which is believed to be sufficient to cover a government's immediate liquidity needs to begin emergency operations after an adverse event until other financial resources are mobilized.

The CCRIF made two payouts in its first year of operation in 2007. St. Lucia received US$0.4 million (0.04 percent of GDP), and Dominica received US$0.5 million (0.1 percent of GDP) due to damages from the magnitude 7.4 earthquake which shook the eastern Caribbean on November 29. In October 2008, the CCRIF made its first hurricane payout to Turks and Caicos in the amount of US$6.3 million due to damages from Hurricane Ike.

In light of suggestions from various stakeholders, the CCRIF is considering the possibility of insuring more frequent events and widening its coverage to include flood coverage and agricultural damage.

[1/] The CCRIF currently includes 16 CARICOM members; remaining members that have not joined the CCRIF are Guyana, Montserrat, Suriname, and the British Virgin Islands.

Table 1. ECCU: Exogeneous Shocks and Economic Policy Outcomes, 1988–2007

	Global Shocks			Country Specific Shocks		Policies/Outcomes		
	LIBOR (In percent)	Oil Prices (U.S. dollars per barrel)	World GDP Growth (In percent)	Decline in Preferential Agreements	Natural Disasters (Number of events)	GDP Growth (In percent)	Central government Noninterest Expenditures (In percent of GDP)	Central Government Interest Expenditures (In percent of GDP)
Antigua and Barbuda				No				
1988-1997	6.18	18.36	2.95		3	3.34	18.4	3.5
1998-2007	4.07	36.40	4.03		3	4.97	21.2	4.4
Change	-2.11	18.03	1.08		0	1.63	2.7	0.8
Dominica				Yes (Banana)				
1988-1997	6.18	18.36	2.95		3	2.29	23.6	2.2
1998-2007	4.07	36.40	4.03		4	0.58	25.6	4.3
Change	-2.11	18.03	1.08		1	-1.71	2.0	2.1
Grenada				No				
1988-1997	6.18	18.36	2.95		1	3.11	21.7	2.5
1998-2007	4.07	36.40	4.03		3	3.08	19.6	3.0
Change	-2.11	18.03	1.08		2	-0.04	-2.0	0.5
St. Kitts and Nevis				Yes (Sugar)				
1988-1997	6.18	18.36	2.95		3	4.70	22.6	2.7
1998-2007	4.07	36.40	4.03		2	3.69	27.7	6.6
Change	-2.11	18.03	1.08		-1	-1.01	5.1	3.9
St. Lucia				Yes (Banana)				
1988-1997	6.18	18.36	2.95		4	3.51	17.7	0.8
1998-2007	4.07	36.40	4.03		4	2.01	18.7	2.4
Change	-2.11	18.03	1.08		0	-1.51	1.0	1.6
St. Vincent and the Grenadines				Yes (Banana)				
1988-1997	6.18	18.36	2.95		1	3.23	21.9	1.3
1998-2007	4.07	36.40	4.03		4	3.80	23.7	2.7
Change	-2.11	18.03	1.08		3	0.57	1.8	1.4

Sources: Country authorities' data; IMF, World Economic Outlook; EM-DAT, Emergency Events Database; and authors' calculations.

Table 2. Transfer Inflows in the Aftermath of Natural Disasters, 1970–2008
(In percent of GDP)

	Antigua and Barbuda	Dominica	Grenada	St. Kitts and Nevis	St. Lucia	St. Vincent and the Grenadines
1970	3.6	**4.0**	2.0	5.5	4.3	6.2
1971	8.1	9.0	5.3	11.8	11.9	9.0
1972	7.4	9.3	8.1	10.7	20.2	10.7
1973	8.3	12.6	9.5	12.7	27.4	11.6
1974	9.8	18.3	5.1	17.6	12.9	2.2
1975	8.1	19.8	**-0.4**	17.1	-6.6	-7.0
1976	11.3	30.0	16.3	8.3	-13.9	4.3
1977	19.2	117.8	46.6	11.1	-1.2	**9.1**
1978	26.5	147.8	75.5	11.1	3.6	17.5
1979	20.1	**105.9**	55.8	14.4	16.4	18.4
1980	0.2	**53.2**	**33.1**	-0.7	**17.2**	**61.6**
1981	0.1	-74.5	10.6	-5.2	11.0	10.1
1982	2.6	-11.5	20.2	4.8	2.4	-0.1
1983	8.1	24.6	17.5	2.7	**28.8**	-4.4
1984	8.7	**23.3**	34.7	**10.5**	7.7	-14.9
1985	1.9	0.9	-11.3	4.3	3.2	-4.3
1986	0.5	-13.1	-31.8	7.3	**35.4**	**-0.7**
1987	-3.5	6.6	-30.0	**26.5**	**28.1**	**2.0**
1988	-3.2	12.6	8.6	2.5	**16.2**	11.9
1989	**0.6**	**1.8**	17.0	**19.6**	-1.9	3.3
1990	**-2.0**	-4.8	**5.0**	**11.9**	**17.6**	1.4
1991	-7.1	-2.0	7.5	-6.0	4.3	-1.3
1992	-0.7	-4.3	0.5	0.9	1.5	**-1.6**
1993	17.0	6.7	9.7	9.2	4.4	0.2
1994	23.2	13.3	9.8	14.7	**-0.5**	7.4
1995	**18.1**	**27.6**	15.8	**13.5**	0.6	-4.1
1996	1.5	-0.6	12.4	-1.8	1.5	0.1
1997	22.1	-9.0	3.3	5.6	7.0	6.8
1998	**49.2**	-7.1	-0.2	**41.1**	9.5	4.8
1999	**20.6**	**2.8**	**-2.0**	**38.9**	**-2.2**	**-4.5**
2000	-3.2	9.9	5.5	16.3	-3.6	-0.2
2001	-23.7	**9.9**	9.9	-36.6	-0.3	1.7
2002	0.3	10.5	23.1	-3.7	-5.8	**1.0**
2003	28.7	16.2	50.5	-2.6	-4.2	6.7
2004	30.1	28.4	**45.0**	6.3	**-3.1**	**4.4**
2005	22.2	1.2	**36.7**	7.9	6.0	**10.3**
2006	-65.3	11.9	-10.2	-3.0	7.0	9.5
2007	-6.4	**3.1**	-13.3	-3.3	**4.1**	18.8
2008	-0.8	-4.8	8.3	-1.4	-5.0	7.4
Average inflow per year	6.7	15.6	13.1	7.7	6.7	5.5
Average inflow per hurricane year	17.3	28.6	19.6	23.1	15.3	9.1

Source: IMF, World Economic Outlook; Araujo (forthcoming, 2009); and authors' calculations.

Note: Years in bold denote the existence of either storms or floods. The transfer index is defined as :

$$\frac{tr_0^d}{y_{-1}} = \frac{tr_0 - tr_{-1}}{y_{-1}} + \frac{tr_1 - tr_{-1}}{y_{-1}} + \frac{tr_2 - tr_{-1}}{y_{-1}}$$

where tr_t^d denotes the total accumulated transfers due to the disaster in period t,
tr_t denotes the actual transfer that occurred in period t and y_t denotes GDP in period t.

Table 3. Probability Distribution and Cost of Hurricanes

Hurricane by return period (years) 1/	18	20	30	50	100	200	250	500
Probability of occurrence (percent)	5.6	5.0	3.3	2.0	1.0	0.5	0.4	0.2
Cost (percent of GDP)								
Antigua and Barbuda	0.2	2.6	6.9	14.1	24.9	33.7	39.0	47.6
Dominica	2.2	3.8	11.1	20.8	31.5	42.3	45.3	60.9
Grenada	0	0.1	0.8	2.3	8.0	19.1	21.8	32.6
St. Kitts and Nevis	2.1	2.9	9.7	17.4	27.8	35.8	38.8	50.4
St. Lucia	0	0.7	3.5	8.2	19.3	26.5	32.5	40.0
St. Vincent and the Grenadines	0	0.6	3.5	7.0	18.0	29.9	31.5	39.4

Sources: World Bank (2006), Table A5.2; and authors' calculations.

1/ The return period is an estimate of the interval of time between given disaster events of a certain intensity or size.

Table 4. Central Government Debt in 2020
(In percent of GDP)

	No hurricane			Hurricane with				
				No insurance		Optimal Insurance		
	Lower	Baseline	Upper	Lower	Upper	Lower	Upper	Insurance Amount
Antigua and Barbuda	135	176	228	144	270	151	257	12.5
Dominica	-4	32	69	7	150	21	114	20.0
Grenada	29	74	129	32	145	36	143	5.0
St. Kitts and Nevis	199	265	344	210	394	215	379	12.5
St. Lucia	73	99	128	78	168	89	157	10.0
St. Vincent and the Grenadines	61	76	92	65	134	75	125	15.0

Source: Authors' calculations.

Table 5. Probability Distribution and Cost of Hurricanes: Simulation for Dominica and Grenada

Hurricane by return period (years) 1/	18	20	30	50	100	200	250	500
Probability of occurrence (percent)	5.6	5.0	3.3	2.0	1.0	0.5	0.4	0.2
Cost (percent of GDP)								
Dominica (increase by one-third)	2.9	5.1	14.7	27.6	41.9	56.3	60.2	81.0
Grenada (average of ATG, DMA, and KNA)	1.5	3.1	9.2	17.4	28.1	37.3	41.0	53.0

Source: Authors' calculations.

1/ The return period is an estimate of the interval of time between given disaster events of a certain intensity or size.

Note: ATG denotes Antigua and Barbuda, DMA denotes Dominica, and KNA denotes St. Kitts and Nevis.

Table 6. Estimated Optimum Insurance Coverage and the CCRIF

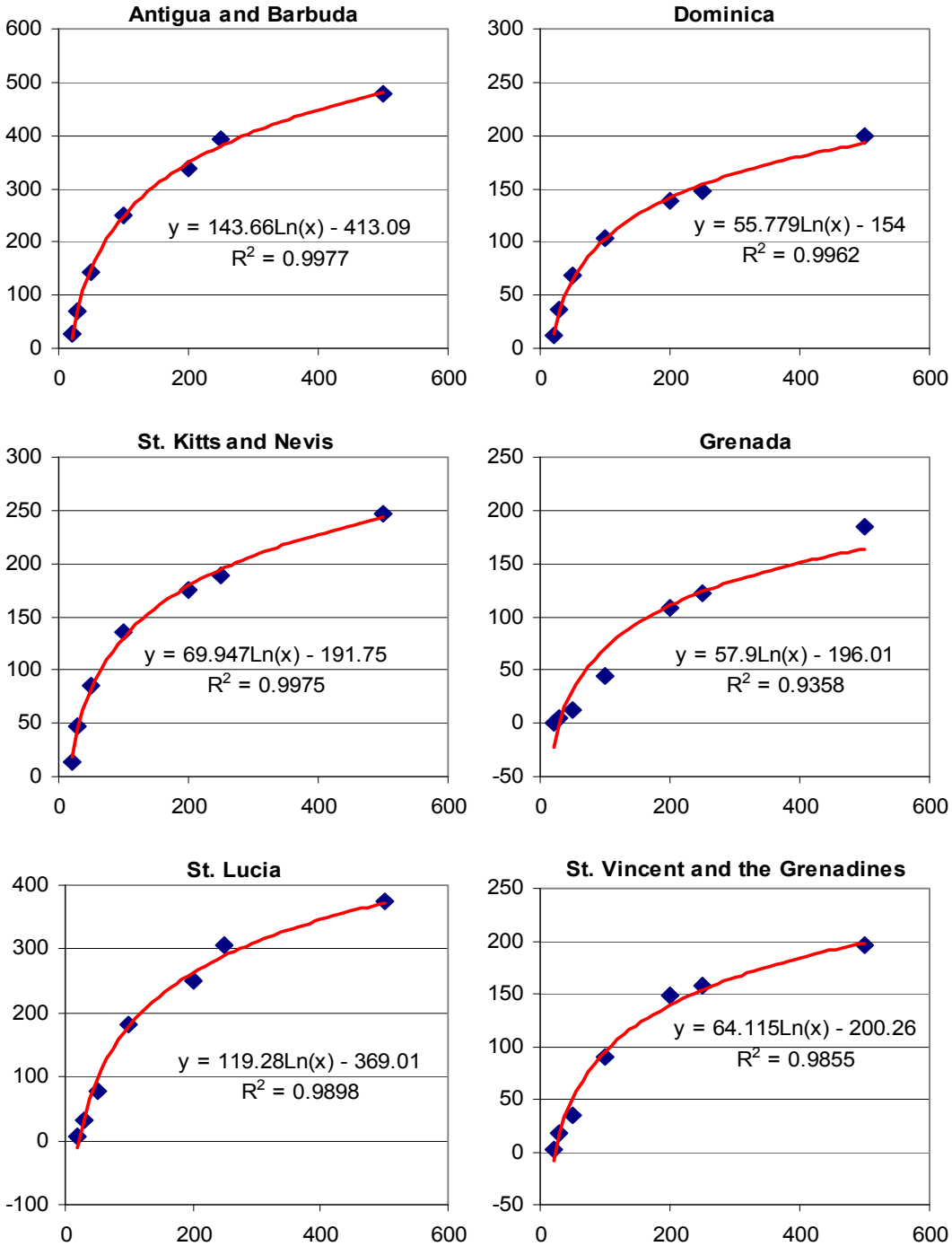
	Insurance coverage		Insurance Premium		Rates-of-line 1/
	(In percent of GDP)	(Millions of U.S. dollars)	(In percent of GDP)	(Millions of U.S. dollars)	(In percent)
Estimated optimum insurance coverage 2/					
Antigua and Barbuda	12.5	125.8	1.2	11.6	9.2
Dominica	20.0	65.3	1.8	6.0	9.2
Grenada	5.0	28.2	0.5	2.6	9.2
St. Kitts and Nevis	12.5	61.0	1.2	5.6	9.2
St. Lucia	10.0	94.0	0.9	8.6	9.2
St. Vincent and the Grenadines	15.0	74.7	1.4	6.9	9.2
Estimated at inception of CCRIF					
Antigua and Barbuda	0.5	5.0	0.02	0.2	4.6
Dominica	8.4	27.4	0.4	1.3	4.6
Grenada	5.6	31.6	0.2	1.2	3.8
St. Kitts and Nevis	0.9	4.2	0.04	0.2	4.5
St. Lucia	3.1	29.1	0.1	1.2	4.1
St. Vincent and the Grenadines	0.8	4.0	0.03	0.2	4.1

Sources: World Bank (2007), Table A7.1-A7.2; and authors' calculations.

1/ Rates-of-line denote the ratios of the premia to the maximum payouts.

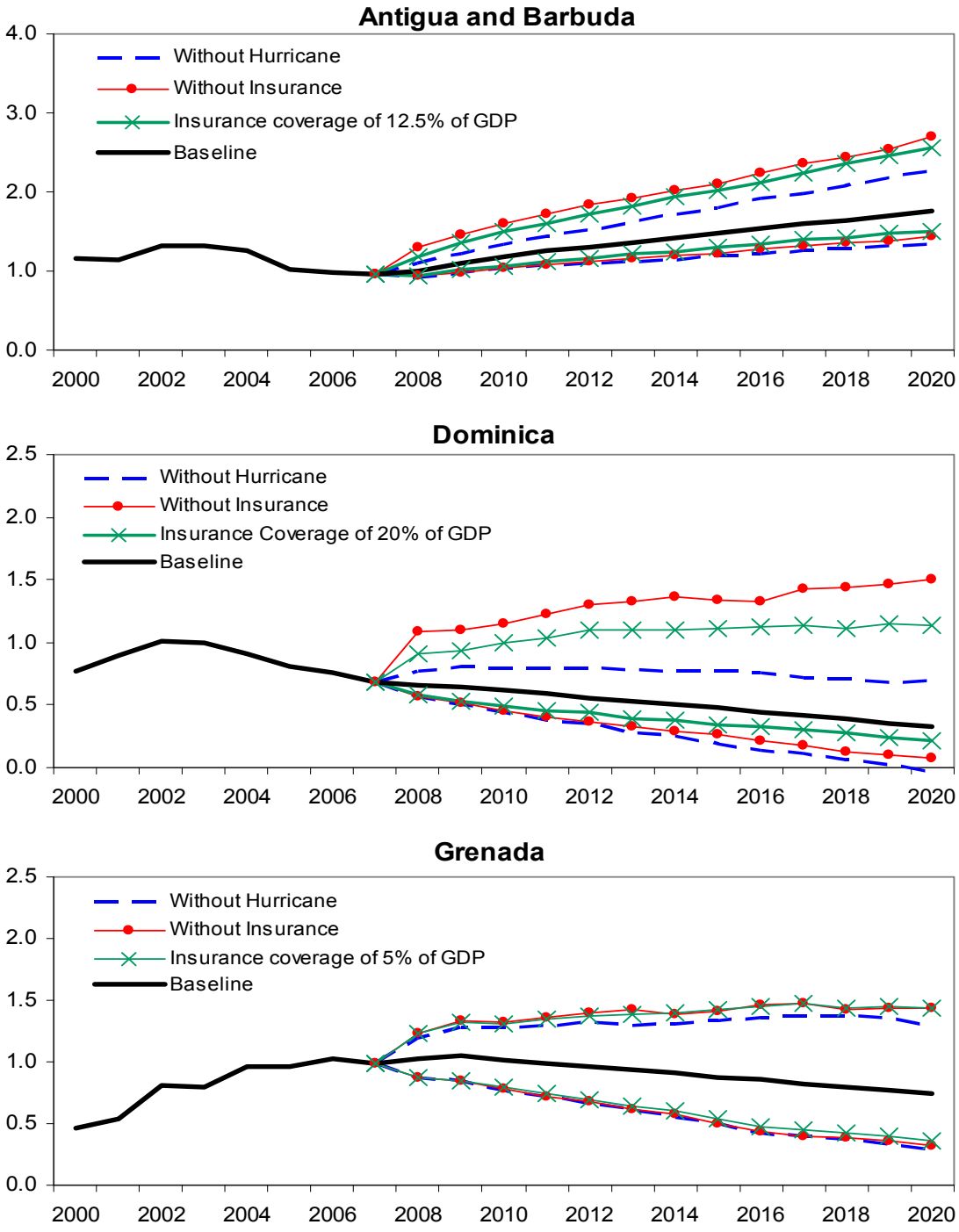
2/ Based on hypothetical individual commercial insurance premium and coverage.

Figure 1: ECCU: Estimated Cost of Hurricanes
Probable Maximum Loss (in million U.S. dollars) by Return Period (years)



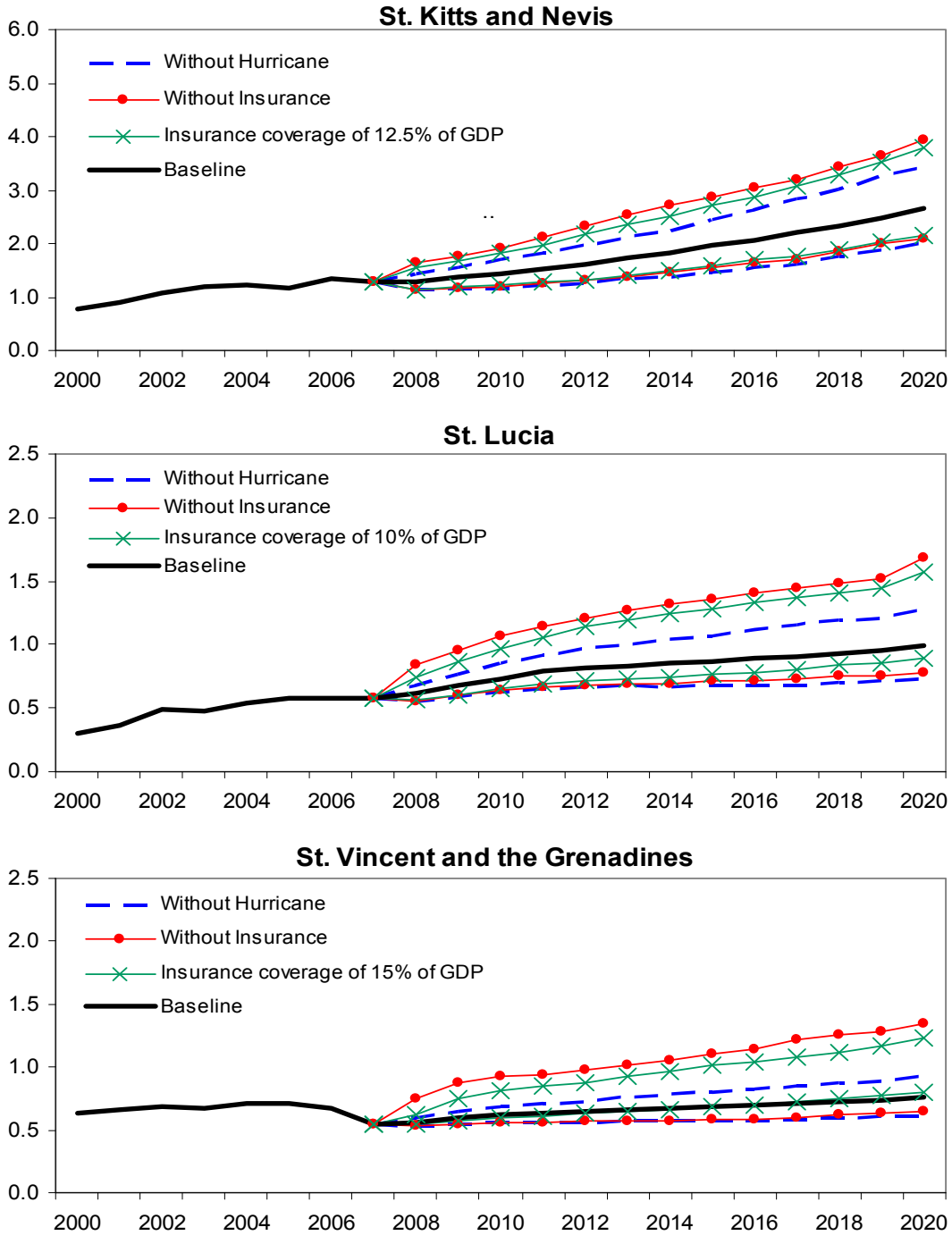
Sources: World Bank (2006); and authors' calculations.

Figure 2. Debt Sustainability Analysis: Central Government Debt to GDP
(Confidence intervals at 98%)



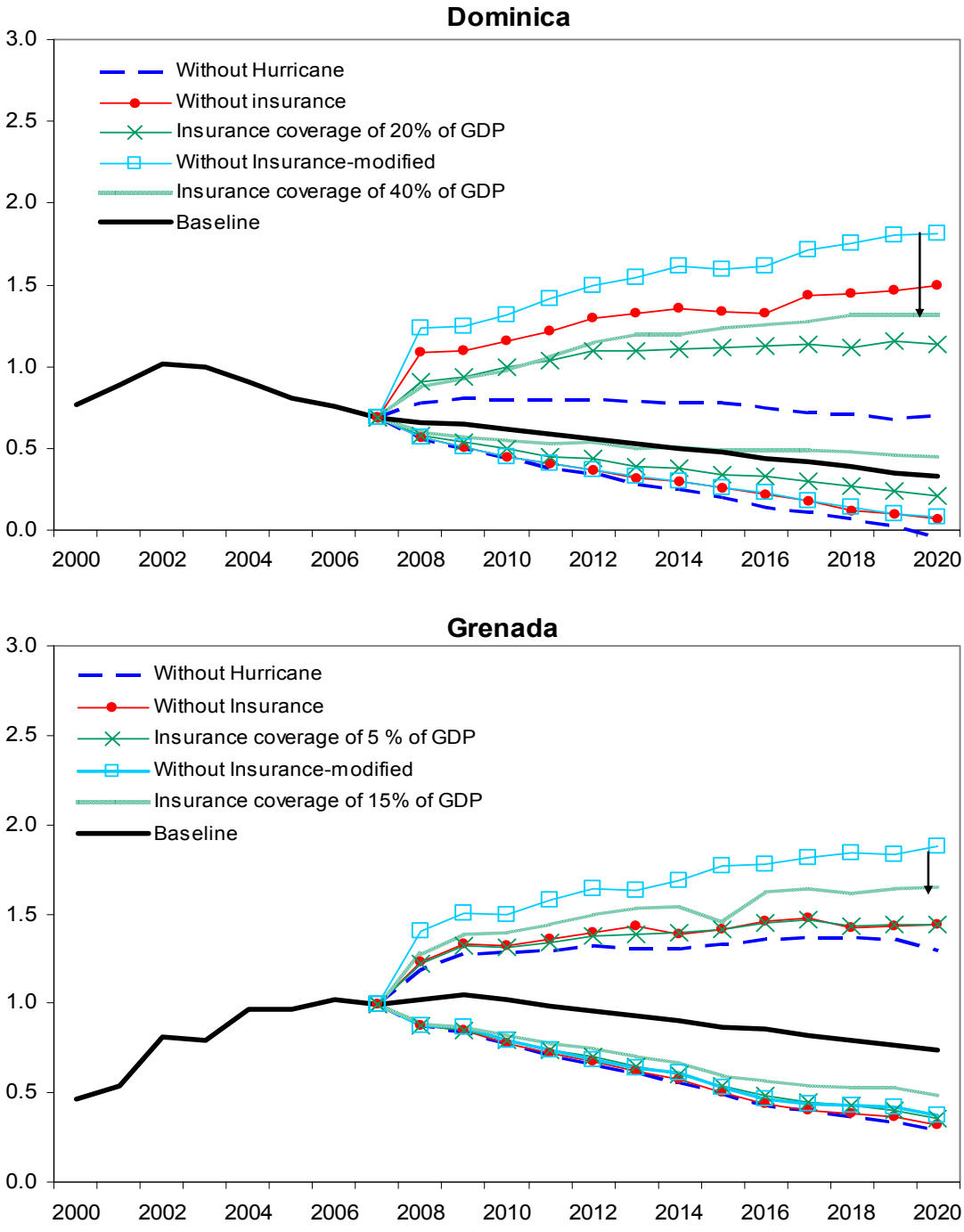
Source: Authors' calculations.

Figure 2a. Debt Sustainability Analysis: Central Government Debt to GDP
(Confidence intervals at 98%)



Source: Authors' calculations.

Figure 3. Debt Sustainability Analysis: Central Government Debt to GDP– Impact of Climate Change on Dominica and Grenada 1/
(Confidence intervals at 98%)



Source: Authors' calculations.
1/ Arrows represent change in debt trajectory with optimum insurance.