Optimal Foreign Exchange Reserves in Small Open Economies: The Case of the Caribbean

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OVERVIEW OF PRESENTATION

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Motivation

- The 2007/2008 IFC highlighted the need for countries to hold adequate FX reserves for very large shocks
- Most Caribbean countries have only managed to achieve levels above the 3 month import cover benchmark in the wake of the 2007/2008 international financial crisis
  - concerted effort in the region to increase international reserve buffers to help mitigate the effect of the crisis
  - achieved mostly through significant increases in foreign debt – the regional average external debt to GDP ratio moved from 28.4% in 2007 to 44.8% in 2019
  - Significant heterogeneity - The average import cover for the region over the period was 2.96 months while the standard deviation was 1.92 months - minimum and maximum values were 0.15 and 13.48 months respectively

Chart 1
Caribbean Average Import Cover

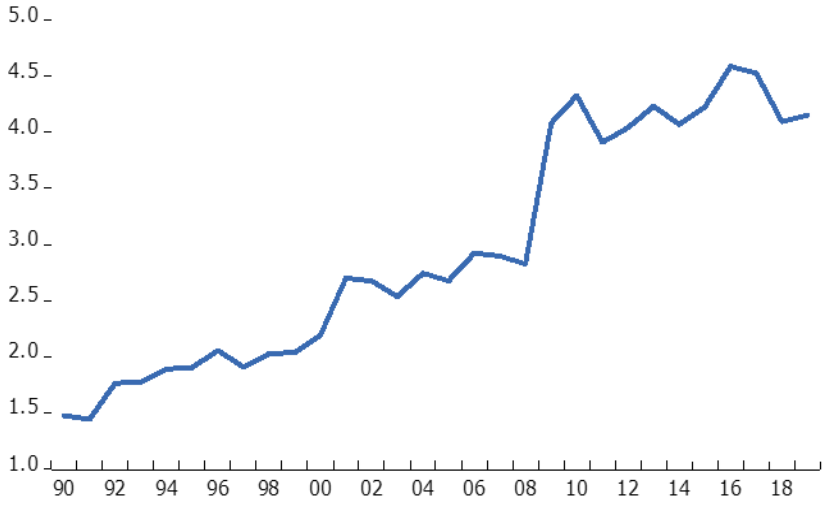
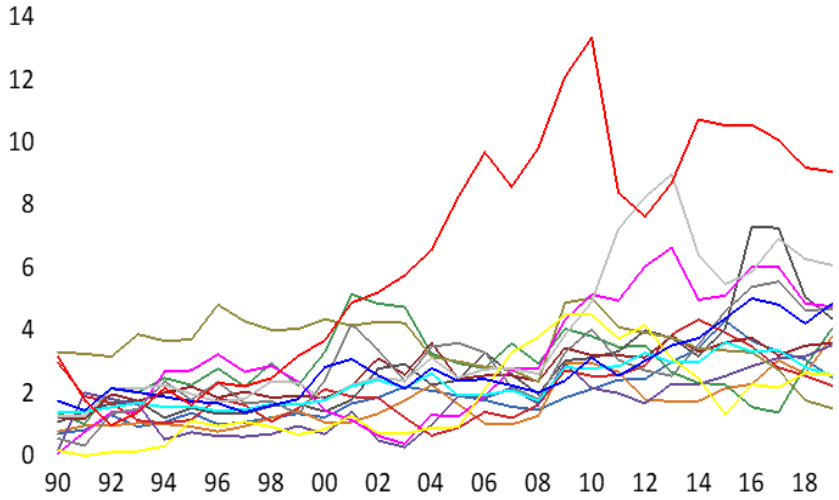


Chart 2
Caribbean Import Cover



Motivation

- The vulnerability of Caribbean countries to a wide range of international shocks and structural weaknesses – imply they need more international reserves than the 3-month import cover benchmark
- The IMF (2011) and (2015) have signalled that the adequacy of reserves and external vulnerability discussions during Article IV consultation may be undertaken in a particular analytical context
  - Should have independent regional research to determine if these new metrics are appropriate
- Bussiere, Cheng, Chinn and Lisack (2015), Dominguez, Hashimoto and Ito (2012) and Feldstien (1999) – FX reserves was the best way to protect countries from the impact of external shocks relative to other form of FX liquidity
- Holding reserves above the optimum incurs costs related to productive investment forgone to hold low yielding reserve assets
  - In Caribbean countries where returns to capital are very high this can be especially damaging to growth prospects
- An optimal level of reserves that balances the marginal benefits and costs of FX reserves to address contingencies created by their unique vulnerabilities is therefore a critical development policy issue in the Caribbean

Methodological Approach

- This paper uses a cost-benefit approach predicated on the insurance role of reserves (Dabla-Norris et. al. 2011, Calvo et. al. 2012 and Moore and Glean 2015) and provides data driven estimates of
  - the benefit of reserves in terms of the mitigation of the impact of negative shocks
  - the opportunity cost in terms of growth forgone by holding excessive reserves
- This approach is preferred to other insurance or precautionary based approaches to the determination of optimal reserves (Jeanne and Rancière 2011 and Dehesa, Pineda, and Samuel 2009) because it is based more on data driven estimates of important model parameters rather than on assumptions and sensitivity analysis
- It also provides a rationale for including FX reserves both as a determinant of the probability of crisis (benefit) and output losses from crisis (cost)

Methodological Approach

- The monetary authority is seeking to minimize the following loss function
- $L(R) = P(S = 1|R)OC(R|S = 1) + \rho R$
- where R is international reserves, P is the probability of a shock conditional on reserves, OC is the output cost conditional on a shock and ρR is the opportunity cost of reserves. Optimal reserves can therefore be defined as:
- $R^* = arg \min_{R>0} L(R) = P(R)OC(R) + \rho R$
- Optimal reserves are therefore dependent on the balance between the marginal benefit reserves confer in terms of the minimization of output losses when large shocks occur against the opportunity costs of holding too many reserves
- The opportunity cost of reserves is not only the financial cost related to investing in lower return reserve assets rather than higher return alternative financial assets available to the monetary authorities but also the costs related to using resources for reserves rather than growth enhancing public domestic investments
- In the Caribbean the 2nd component is likely to be much greater than the former because
  - huge infrastructural gaps
  - many Caribbean countries are dependent on concessional financing and may actually have negative financial costs associated with reserves since the interest rate on concessional financing may be lower than the return on the reserve portfolio (Dabla-Norris et. al. 2011)

Methodological Approach

- The paper therefore estimates the benefits of reserves via a Probit model of the probability of crises conditional on the level of reserves
- The expected losses for growth due to crises and the cost of reserves on growth from public investments forgone to hold reserves is estimated through a fixed effects panel growth model
- The empirical work also focuses on how structural features of Caribbean countries such as vulnerability to natural disasters, weak international competitiveness, trade openness and exchange rate regimes impact on the estimated benefits and costs of FX reserves
- This paper uses annual data spanning the period 1990 – 2019 for 15 Caribbean countries
- Data were sourced from the World Bank World Development Indicators Database, the IMF World Economic Outlook Database, the UNECLAC Database and regional central banks. The data on natural disasters were sourced from the EM-DAT database

Methodological Approach

- Identification of crises
  - Shocks are identified as values that fall below the 10 percentile in the left tail of country specific distributions in the case of FDI, remittances and gross capital formation
  - In the case of natural disaster (where we only include hurricanes and major earthquakes) we modify the way shocks are defined by including each events as a shock due to their general destructive impact
  - Identifying shocks this ways leads to shocks being 26.2% of all observations
  - Crisis events are then identified from these shocks when they are accompanied by negative growth - crisis events constitute 19.1% of all observations when identified this way

Empirical Models Probit –Estimating the Probability of Crises

- The crisis variable is the dependent variable and takes on a value of 1 in crisis years and 0 otherwise
  - $P(C_{it} = 1) = \Phi(\beta_0 + \beta_1 X_{it} + \cdots + \beta_n X_{it}), i = 1,..,N, t = 1,..,T$
- Where P is the probability of crisis, Φ is the standard normal cumulative distribution and X_{it} are economic variables that determine crises
- Using general to specific modelling the final model included natural disasters, per capita GDP growth, global growth, as well as reserves, FDI inflows, trade openness, increases in sovereign debt and broad money (M2) all as a percentage of GDP
- Reserves, domestic economic growth, global growth FDI inflows and trade openness are expected to be negatively related to the probability of crises while natural disasters, increases in debt and M2 (the size of domestic financial liabilities that can be converted into foreign currency and therefore negatively impact financial stability through capital flight) and external sector weakness (imports/exports) are expected to increase the probability of crises
- As a robustness check a logit model was also employed to see if results differed significantly. Further checks involved including sequentially lagged government expenditure (+ve), an exchange rate regime dummy which is 1 for flexible regimes and zero otherwise (-ve) and a broader definition natural disasters (+ve) to check whether it affected the results in a significant way

Results

Table 1: Caribbean Probability of Crises Models

Variable	Probit1	Logit	Probit2	Probit3	Probit4
C	-0.8467* (0.4957)	-1.4512* (0.8574)	-0.9215* (0.5167)	-0.7630 (0.5553)	-0.8749* (0.4918)
Lagged Reserves/GDP	-2.3816** (1.1272)	-4.4095** (2.1111)	-2.6472** (1.2418)	-2.2448** (1.2004)	-2.5241** (1.1125)
Natural Disaster	0.4134*** (0.1129)	0.7207*** (0.2068)	0.4170*** (0.1130)	0.4150*** (0.1131)	
Lagged Per Capita Growth	-0.0669*** (0.0220)	-0.1163*** (0.0396)	-0.0669*** (0.0220)	-0.0671*** (0.0220)	-0.0618*** (0.0217)
FDI/GDP	-0.0456*** (0.0181)	-0.0802*** (0.0321)	-0.0467*** (0.0181)	-0.0468*** (0.0185)	-0.0437*** (0.0177)
M2/GDP	0.0137*** (0.0043)	0.0251*** (0.0078)	0.0131*** (0.0044)	0.0130*** (0.0048)	0.0135*** (0.0043)
Growth of Debt	0.0195*** (0.0051)	0.0359*** (0.0098)	0.0192*** (0.0051)	0.0195*** (0.0051)	0.0193*** (0.0050)
External Weakness	0.2698* (0.1481)	0.4800* (0.2533)	0.2789* (0.1491)	0.2716* (0.1482)	0.2340 (0.1561)
Global Growth	-0.3389*** (0.0686)	-0.6093*** (0.1231)	-0.3393*** (0.0686)	-0.3391*** (0.0687)	-0.3077*** (0.0671)
Trade Openness	0.0029 (0.0030)	0.0052 (0.0051)	0.0028 (0.0029)	0.0027 (0.0031)	0.0034 (0.0029)
Lagged Government Exp.			0.006137 (0.0119)		
Exchange Rate Regime				-0.0743 (0.2229)	
Natural Disaster2					0.1702** (0.0755)
Pseudo R-Squared	0.2005	0.2002	0.2011	0.2007	0.1816
1. Standard errors are in parentheses.					
2. *, ** and *** denotes significance at the 10, 5 and 1 percent levels respectively.					

Empirical Models – Augmented Panel Growth Model

- Augmenting the basic growth model with the crisis variable and Gross capital investments (our proxy for public investment and the output opportunity costs of holding reserves)
  - same sample from the estimation of the probability of crises
- Using a general to specific modelling approach the final model included some of the usual variable included in the growth literature as well as variables that capture the impact of Caribbean structural weaknesses on growth
  - population growth
  - gross capital formation (our proxy for public investment)
  - global growth
  - FDI inflows
  - external sector weakness
  - the crisis dummy variable
  - the growth of sovereign debt
  - M2 as a percentage of GDP (to capture the propensity for financial instability as discussed above)
  - Remittances
  - the dependent variable growth is measured as per capita GDP growth
- Crises, external sector weakness, the growth of debt, M2/GDP and population growth are expected to be negatively related to growth
- FDI, global growth and gross capital formation are expected to be positively related to growth
- The impact of remittances can be positive if the increase in foreign exchange liquidity effect overshadows the negative effects of brain drain on human capital development associated with migration. Remittances can also have negative consequence in terms of labour market participation. If these negative influences dominate then remittances can be negatively related to growth (Beaton *et. al.* 2017)
- The most important coefficients include the coefficients on the crises dummy and gross capital formation
  - The size and significance of these coefficients will drive our estimates of the expected loss from the crises and the growth forgone to hold reserves rather than using the resources for investment respectively
- The results from the panel fixed effects are discussed - pooled OLS and random effects are included to check the robustness of the results

Results

Table 2: Caribbean Panel Growth Model

Variable	Pooled OLS	Panel Fixed Effects	Panel Random effects
C	4.7359 *** (0.6761)	6.7026 *** (0.9824)	5.7295 *** (0.8545)
Crises	-4.2009 *** (0.3589)	-3.9700 *** (0.3544)	-4.0599 *** (0.3509)
FDI	0.1458 *** (0.0240)	0.1296 *** (0.0284)	0.1341 *** (0.0265)
Gross capital Formation	0.0226 *** (0.0078)	0.0269 *** (0.0077)	0.0250 *** (0.0076)
Global Growth	0.3752 *** (0.1132)	0.4395 *** (0.1114)	0.4113 *** (0.1102)
External Sector Weakness	-1.0017 *** (0.2659)	-1.5282 ** (0.4675)	-1.2284 *** (0.3643)
Growth in Sovereign Debt	-0.0335 *** (0.0086)	-0.0289 *** (0.0086)	-0.0308 *** (0.0085)
M2/GDP	-0.0407 *** (0.0061)	-0.0531 *** (0.0087)	-0.0483 *** (0.0075)
Population growth	-0.4161** (0.1885)	-0.8688 ** (0.4388)	-0.6192 ** (0.2974)
Remittances	-0.0398 (0.0362)	-0.0891 (0.0561)	-0.0621 (0.0467)
Observations	450	450	450
R-Squared	48.9	54.1	48.1
1. Standard errors are in parentheses.			
2. *, ** and *** denotes significance at the 10, 5 and 1 percent levels respectively.			

Estimation of Optimal FX Reserves

- The results from the two models above allow us to generate empirical estimates of the expected loss in growth from the crisis conditional on reserves (the benefit of reserves) and the growth forgone from investing in reserve assets rather than growth enhancing public investments (the cost of reserves)
- The optimal level of reserves estimated at the point where costs balances benefits was 6.9 months of import cover
- Incorporating the purely financial aspect of costs - the difference between the return on low yield reserve assets and the return on alternative assets available to the monetary authorities yields an optimal reserve level of 5 months of import cover
- Increases in ND would increase the optimal level of FX reserves while a 10% increase in FDI or a 10% decrease in debt would reduce the level of reserves deemed optimal
- Policies designed to increase FDI or decrease debt could therefore be used as substitutes for increasing FX reserves for optimality

Scenarios	Historical average	10% Increase in Natural Disasters	10% Increase in FDI	10% decrease in Debt
Optimal Reserves without Financial Cost	6.9	7.3	3.9	5.6
Optimal Reserves with Financial Cost	5.0	5.2	2.7	3.9

Conclusions

- Economic crises in the Caribbean is driven by natural disasters and structural economic vulnerabilities which lower growth
- The paper also demonstrated that the determination of optimal reserves is not only contingent on the level of reserves and the probability of crises but is also conditional on structural features of these economies
- Economic realities such as high and unsustainable levels of sovereign debt, low FDI inflows, low levels of international competitiveness and financial instability risks can increase the level of reserves that is needed for optimality
- Can substitute better fundamentals for more reserves
- The probability of crises is significantly lowered by international reserves but growth is also hampered by too many reserves being invested in low return assets instead of growth inducing public investments
- The optimal reserve level for the Caribbean was 6.9 months of import cover but could be as low as 5.0 months of import cover if the financial opportunity costs are included – average reserves are inadequate in the region
- Only Trinidad and Tobago, Jamaica, St. Kitts and Nevis and Haiti have demonstrated any ability to maintain reserves above the 5.0 months of import cover benchmark and only for the latter part of the period under review

THANK YOU FOR YOUR ATTENTION

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