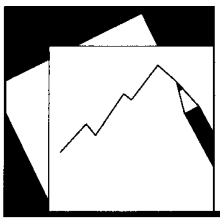


WP/09/77

IMF Working Paper

Optimal Reserves in the Eastern Caribbean Currency Union

Mario Dehesa, Emilio Pineda, and Wendell Samuel

INTERNATIONAL MONETARY FUND

 WP/09/77

IMF Working Paper

Western Hemisphere Department

Optimal Reserves in the Eastern Caribbean Currency Union[1]

Prepared by Mario Dehesa, Emilio Pineda, and Wendell Samuel

Authorized for distribution by Paul Cashin

April 2009

Abstract

Recent turbulence in global and Caribbean regional financial markets underscore the importance of reassessing the adequacy of international reserves held by the Eastern Caribbean Central Bank (ECCB). Using the Jeanne (2007) optimization framework, this paper finds that international reserves held by the ECCB are generally adequate for a variety of external current account and capital account shocks. However, the ECCB would be challenged in the event of moderate to severe deposit outflows.

JEL Classification Numbers: F31, F32, F41

Keywords: Optimal Reserves, ECCU, Reserve Adequacy

Authors' E-Mail Addresses: mdehesa@imf.org; wsamuel@imf.org

[1] We are grateful to Paul Cashin, and seminar participants in the September 2008 and April 2009 ECCB-IMF Research Workshops for helpful comments and suggestions. All errors are authors' responsibilities.

Contents **Page**

I. INTRODUCTION

In recent years many emerging market countries have increased their holdings of international reserves. These increases in international reserves appear to be extremely high by traditional standards of reserve adequacy. However, when insurance against the effects of sudden stops in external capital flows is introduced as a motive for holding reserves, they do not appear to be inordinately high (Jeanne, 2007). Moreover, the current state of the global economy is testing the adequacy of reserve levels in many countries, and what appeared to be excessively large reserves in the benign international environment that existed before the onset of financial sector turbulence two years ago, now do not appear to be so extravagant.

International reserves of the Eastern Caribbean Currency Union (ECCU) have also increased in recent years, and questions have been raised whether such levels of reserves are excessive in view of the opportunity cost of holding them.[2] A comparison of reserve levels in similar economies, i.e. currency unions among developing countries, and tourism dependent economies, reveals that reserves in the ECCU are not out of line with these economies. In fact, international reserves in the ECCU appear to be lower than in comparator countries. However for the ECCU the opportunity cost of holding increased reserves is not the only consideration. The ECCU has fully liberalized its capital account since 2005, hence insurance against adverse capital movements would be an additional motive for holding reserves.

In the context of a significantly weaker global environment, this paper discusses the level and adequacy of international reserves in the ECCU using a variant of the Jeanne (2007) model. It shows that current reserve levels in the ECCU are adequate to cover a variety of external sector shocks, including shocks to the current account, and small to moderate capital outflows. However, the potential onset of moderate to severe capital outflows could prove to be a challenge for the ECCU. Severe capital outflows are probably once-in-a-century events against which it could prove too costly to self-insure with greatly increased reserves. Historically, reserve levels in the ECCU have been comfortably above the calculated optimal level, but over time actual reserves have converged on the optimal, because the reserve cover rule used by the Eastern Caribbean Central Bank (ECCB) for reserve holding has focused on demand liabilities of the bank (which is a narrower operational concept than one which is required for reserve holding as insurance against capital flows). The paper shows that over time the gap between actual and optimal reserves has declined, and projects that if the same reserve cover rule is used in the future actual reserves could become inadequate (less than optimal).

This paper contributes to the literature by applying the optimal reserve model in the context of a reserve pooling arrangement, a unique feature of the ECCU. It also explores the implications of maintaining a specific reserve management rule under a quasi-currency board

[2] The ECCU comprises Anguilla, Antigua and Barbuda, Dominica, Grenada, Montserrat, St. Kitts and Nevis, St. Lucia and St. Vincent and the Grenadines. The countries use a common currency, the Eastern Caribbean dollar, issued by the Eastern Caribbean Central Bank, which has been pegged to the U.S. dollar since 1976. The ECCB is required to maintain international reserves to cover 60 percent of its demand liabilities, and is often regarded as a quasi-currency board.

with a fully liberalized capital account. Following the introduction, the paper is organized as follows. Section II discusses traditional measures of reserve adequacy. Section III applies the Jeanne (2007) model of optimal reserves to the ECCU, in the presence of a variety of external sector shocks. Section IV discusses the sensitivity of the model to the estimate of output loss and the cost of holding reserves, while Section V discusses the implications of maintaining the existing reserve cover rule. The final section contains some policy implications and concluding remarks.

II. TRADITIONAL MEASURES OF RESERVE ADEQUACY

There are several motives for holding international reserves in the ECCU. Although reserves are used for several reasons, a key function is to act as a buffer absorbing balance of payments shocks where access to borrowing is limited or costly, and the exchange rate is not used to ensure adjustment. Accordingly, reserve adequacy is of particular importance in the case of fixed exchange rates in general, and in currency board arrangements in particular. Reserves also help provide confidence in the commitment by the monetary authorities to support the value of the currency. This paper assesses whether international reserves in the ECCU are optimal from the point of view of self-insurance against current account and financial account shocks.

Assessing Reserve Adequacy

Reserve adequacy issues have been investigated using methodologies ranging from heuristic and regression analyses to optimization models. Traditional or heuristic reserve adequacy measures relate the level of reserves to the potential for balance of payments imbalances.[3] The standard benchmark levels of reserve adequacy have been developed for countries with managed or fixed exchange rates (Winjnholds and Kapteyn, 2001).

The most common measure relates the level of imports of goods and services to a simple rule of thumb requiring foreign reserves to be equivalent to at least three months of imports. This measure scales international reserves by the size and openness of the economy. Related measures compare foreign reserves with the external current account balance or the variability in foreign exchange revenues (Delechát and Martijn, 2007).

Alternative traditional reserve adequacy measures focus on the link between foreign reserves and the financial sector. Common benchmarks include the ratio of reserves to monetary aggregates (such as reserve money or broad money). The coverage of foreign reserves in terms of reserve money (or the monetary base) indicates the extent to which the central bank can back its liabilities and credibly support the maintenance of the fixed exchange rate arrangement.

[3] The rationale for the reserve-to-imports indicator has no clear theoretical underpinning, but seems to have been derived under the influence of the quantitative theory of money, as an analogy to the role of cash to even out discrepancies between receipts and payments (see Flood and Marion, 2002).

For countries with an open capital account, heuristic measures relate foreign reserves to financial flows. The ratio of short-term external debt to reserves is seen as a particularly useful indicator, especially for countries with significant access to international capital markets; and a benchmark value of one for this ratio can serve as a key vulnerability indicator.[4] The benchmark value of one signals that if reserves equal or exceed short-term debt by remaining maturity, a country can be expected to meet its external debt servicing needs for the forthcoming year, even if market access is curtailed. Furthermore, countries with a high ratio of short-term debt to reserves tend to suffer deeper economic crises following any given shock (Sachs and others, 1996).

Traditional reserve adequacy measures suggest that at end-2007 the ECCU foreign reserves were not markedly high relative to a peer group of countries. Foreign reserves in terms of months of imports of goods and services were lower in the ECCU when compared with other small tourism dependent economies, to Caribbean neighbors, or to monetary unions in Africa. The ECCU clearly has the lowest level of reserves in months of imports and relative to both broad money and reserve money.

Table 1. Comparison of International Reserves Across Regions

	In Months of Imports of Goods and Services				2008 In percent of:	
	2000–05	2006	2007	2008	Broad money	Reserve Money
ECCU	2.8	3.0	2.9	2.6	17.0	101.9
Small tourism dependent economies 1/	4.7	4.7	4.7	3.7	33.9	112.8
Caribbean excluding ECCU 2/	3.2	3.5	3.4	3.2	39.7	135.7
WAEMU 3/	5.1	5.0	5.5	4.4	50.9	110.4
CEMAC 4/	2.6	5.3	4.9	5.5	54.6	156.9

Source: IMF, World Economic Outlook; and IMF, International Financial Statistics.

1/ Includes Croatia, Cyprus, Fiji, The Gambia, Jordan, Lebanon, Maldives, Malta, Netherland Antilles, Samoa, São Tomé & Príncipe, Seychelles, and Vanuatu and Togo.

2/ Includes Bahamas, Barbados, Belize, Guyana, Haiti and Jamaica.

3/ The West African Economic and Monetary Union (WAEMU) includes Benin, Burkina Faso, Cote D'Ivoire, Guinea-Bissau, Mali,Niger,Senegal and Togo.

4/ Economic and Monetary Community of Central Africa (CEMAC) includes Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, and Gabon.

Reserve adequacy has also been assessed through buffer stock models. These models focus on the contribution of international reserves to cushioning output volatility in order to smooth consumption over time (Frankel and Jovanovic, 1981). Reserve holdings are determined by the volatility of international transactions—usually export volatility—and adjustments costs, including the dependence on imports and the financial cost of accumulating reserves. Econometric evidence for the ECCU suggests that the evolution of ECCB foreign reserve holdings could be explained by a buffer stock model (Grenade, 2008). However, in this class

[4] The ratio of reserves-to-external debt is among the better warning indicators of reserve adequacy, by alerting for potential currency crises.

of models the cost of external disequilibria is not explicitly included and the opportunity cost of holding reserves is not clearly defined.

III. Optimal International Reserves

The insurance model based on Jeanne (2007) provides an optimization framework for a cost-benefit analysis of the optimal level of reserves required to deal with an external shock.[5] The model derives optimal international reserve holdings in the context of a small open economy, with a representative consumer, where wealth can be held either in the form of liquid international reserves (R) or a higher yielding, but illiquid asset (I). The economy is assumed to be vulnerable to a currency crisis, where a crisis is defined as a loss of access to external credit that results in a fall in output. International reserves can be used to smooth consumption during a currency crisis (crisis mitigation), and possibly reduce the probability of a currency crisis (crisis prevention) by providing a buffer against potential external shocks. At the same time, holding reserves entails a cost (∂) in the form an opportunity cost of holding liquid assets rather than illiquid assets with higher returns. The optimal reserves minimizes the consumer's welfare loss function, which depends on the sum of the expected welfare cost of a crisis $f(R)$ that occurs with a probability $\pi(R)$ and the opportunity cost of holding reserves ∂R :

$$(1) \qquad \text{Loss} = \partial R + \pi(R)\, f(R)$$

The model assumes a risk averse consumer that lives for three periods. In period 0, the consumer decides what level of reserves to hold. This decision depends on the perceived risk and costs of a future crisis, which could occur in period 1, when an external liability falls due. The country repays its debt L, issues new debt L', and consumes C_1, facing the budget constraint:

$$(2) \qquad Y_1 + L' + R = C_1 + L + R'$$

Period 2 represents the long term, where the country's net foreign wealth is equal to the sum of output Y_2 and the net return on foreign assets:

$$(3) \qquad W_2 = Y_2 + (1+r)^2\,(1+\partial)I + (1+r)(R'-L')$$

The consumer maximizes the expected utility of consumption $u(C_1)$ in period 1 plus the expected wealth W_2, discounted by the interest rate r:

$$(4) \qquad Ui = Ei\left[u(Ci) + \frac{W_2}{1+r} \right]$$

[5] The Jeanne (2007) model has been widely applied in country analysis, see Gonçalves (2007), Goyal and Liu (2006), Drummond and Dashmana (2008), and Floerkemeir and Sumlinski (2008). This paper follows the Floerkemeir and Sumlinki (2008) exposition of the model.

An external crisis can occur in period 1 with probability π. Its welfare cost $f(R)$ is increasing in the level of debt L coming due and the cost of the crisis in terms of lost output (ΔY), and decreasing in the level of reserves R. A closed-form solution for the optimal reserves exists under the assumption that π is independent of the level of reserves and is given by the expression :

$$(5) \qquad R = L + \Delta Y - \left[1 - \left(1 + \frac{\partial}{\pi}\right)^{\frac{-1}{\sigma}}\right]$$

where σ represents a relative consumer's risk aversion parameter. The optimal level of reserves is equal to the "full insurance" level $R = L+\Delta Y$ (the minimum level sufficient to maintain consumption at the desired level in a crisis), minus a term reflecting the opportunity cost of holding reserves.

The optimal level of reserves could be higher or lower than the policy rule of full coverage of short-term external debt ($R = L$), the so called Greenspan-Guidotti rule (Greenspan, 1999; Winjnholds and Kapteyn, 2001). This result arises because reserves not only lower the probability of debt rollover crisis, but also because they smooth the impact on consumption of the fall in output. Alternatively, the optimal level of reserves could also be lower than the stock of short-term external debt, because the opportunity cost of holding reserves reduces the incentive to maintain them.

The application of the Jeanne (2007) insurance model to the ECCU is based on parameters reported in the literature on currency and banking crises. The size of the output loss (ΔY) is set to 10 percent of GDP—in line with the average output cost of simultaneous currency and banking crises as reported in the literature.[6] The probability of a "sudden stop" is estimated as a function of a country's economic fundamentals, based on a probit estimation of a sample of 34 countries (Jeanne, 2007). For the baseline simulations it is assumed that the probability of a crisis is exogenous. The value for the opportunity cost of reserves is set at ∂=3 percent. This calibration calculates the cost of holding reserves as the historical average cost differential between issuing a ten-year U.S. treasury bond and investing in liquid assets such as three-month U.S. Treasury bills (Jeanne, 2007; Rudebusch, Sack and Swanson, 2007). Alternative measures of holding reserves include using the marginal product of capital to estimate forgone investment opportunities in the domestic economy, or the interest rate on external debt (Rodrik, 2006). These alternatives are investigated in Section IV. The benchmark risk-aversion parameter is set at σ=2, in line with the standard growth and real business cycle literatures (Lucas, 1987; Pemberton, 1996).

[6] Jeanne and Rancière (2006) report the output cost of a sudden stop at 6.5 percent of GDP, for a sample of 34 countries, while Hutchinson and Noy (2006) estimate an output loss of around 13 to 18 percent of GDP over a three-year period for 24 countries.

ECCU: Optimal Reserve Calibration Parameters

Parameter		Baseline	Range of variation
Output loss	ΔY	0.1	[0,0.3]
Opportunity cost of reserves	∂	0.03	[0.01,0.06]
Probabiliy of a sudden stop	π	0.1	[0,0.25]
Risk aversion	σ	2	[1,10]

Source: Jeanne (2007).

The following subsection reports the analysis of the optimal level of reserves given different magnitudes of shocks to the external current account, capital account and banking sector shocks, while maintaining all other benchmark calibrations as provided by Jeanne (2007). The source of data (international reserves, broad money, demand liabilities and output) for the analysis is the ECCB.

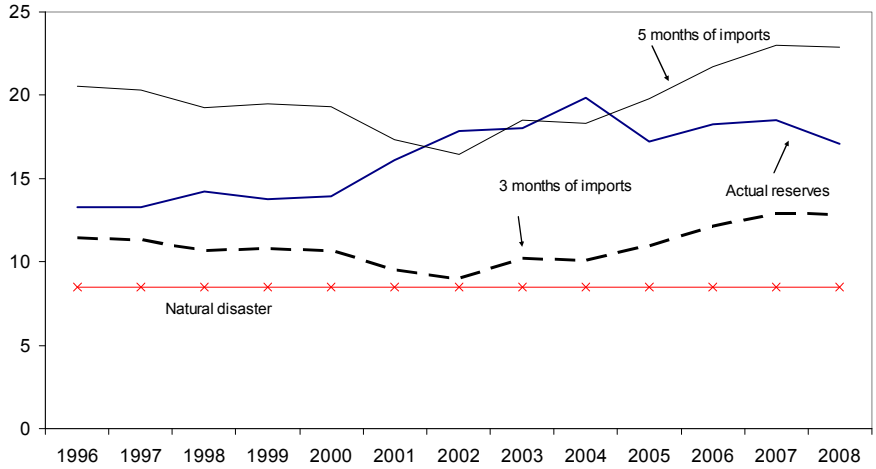
Current Account Shocks

For countries with limited or no exposure to international capital markets the traditional focus on the size and volatility of current account flows in the assessment of reserves remains appropriate, since changes in these flows are the key sources of pressures on reserves. The traditional benchmark of three months of imports of goods and services is often used, but needs to be evaluated in terms of the past and expected volatility of current account flows. A higher level of reserves is typically sought in countries where shocks to current account flows can be particularly strong, for instance in countries where: (i) the export base is narrow and the price of the few key exports is particularly volatile; or (ii) in countries where natural disasters can severely affect export capacity (e.g., tourism services) and import needs (e.g., foodstuffs).

ECCU countries are particularly exposed to current account shocks given their reliance on tourism as the main source of foreign exchange, and their vulnerability to natural disasters (see Randall, 2006; Rasmussen, 2006). As evidence, tourism receipts account for over 70 percent of total exports in the ECCU. Although banana and sugar exports have declined recently, all oil and oil derivatives are imported, as are a large share of food consumption goods, making the ECCU particularly vulnerable to terms of trade shocks. In addition, the ECCU is among the most disaster-prone areas of the world. Rasmussen (2006) estimates that between 1970 and 2002 ECCU countries were affected by 12 major natural disasters (mostly hurricanes), with a median impact on the current account of 10.8 percent of GDP.

Figure 1 shows that ECCU international reserves are close to or 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. The actual level of reserves has consistently exceeded this level over the last decade. However the actual level of reserves falls short of the level required to resist a shock equivalent to five months of imports.

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



Source: Fund staff calculations.

Capital Account Shocks

For countries with access to international capital markets, the focus of reserve adequacy is on assessing reserve cushions against risks stemming from the capital account. Capital account crises—characterized by a sudden cessation or reversal of capital inflows that forces a large and abrupt current account adjustment together with a large depreciation in the exchange rate—have commonly been associated with severe output contractions. During the emerging market crises of the 1990s, the decline in real GDP growth averaged 10 percentage points in the most directly-affected countries, reflecting capital outflows which in some cases amounted to as much as 15–20 percent of GDP (at annualized rates). The short-term adjustment typically took place mainly through import compression and a corresponding slump in domestic demand, as well as through severe balance sheet effects stemming from corporate and financial sector exposures to exchange rate and interest rate changes.

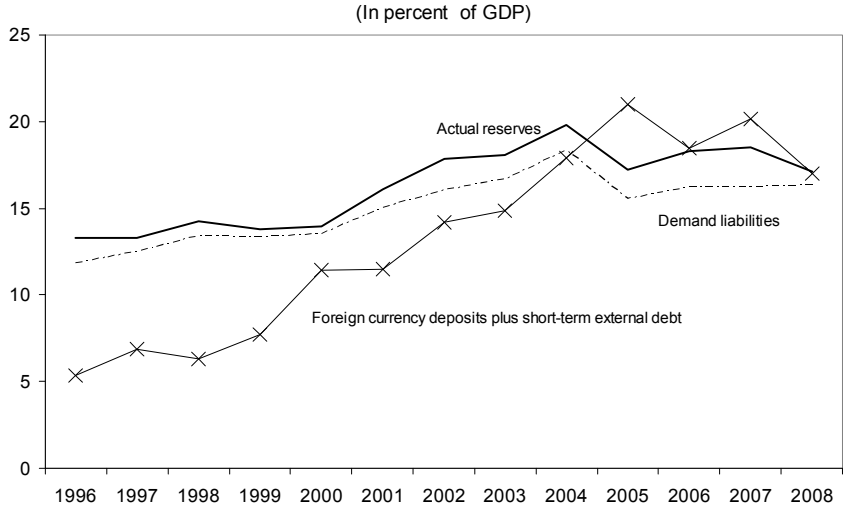
International financial integration is proceeding apace in the ECCU. In late 2005 the ECCU countries repealed the Exchange Control Act which required, among other things, prior approval for outward remittances greater than about US$ 250,000 (Kwon et al, 2008). Public debt, most of which has been externally funded, is among the highest in the world (see Sahay, 2006). Foreign currency deposits in the banking sector have expanded substantially over the last decade to reach about 17 percent of total deposits, in line with a growing tourism sector driven by foreign direct investment.

The amount of short-term external and foreign currency debt, as well as foreign currency deposits in the banking system, are particularly useful in assessing the potential size of any sudden capital reversal. If reserves equal, or exceed, short-term external debt, a country can be expected to meet its external debt-servicing needs, even without market access. Augmenting this ratio with defense against sudden changes in foreign currency deposits in the banking system provides an additional layer of protection in countries where the banking

system shows a growing dollarization, arising from its increasing integration with the international financial system.

Figure 2 shows that ECCB reserves are currently close to the optimal size required to insure the region against capital account shocks. ECCB reserves are currently around the optimal size to insure the region against capital flight of the magnitude of all short-term external debt plus foreign currency deposits. Actual reserves also cover a shock equivalent to all demand liabilities, as expected in a currency board arrangement.

Figure 2. ECCU: Optimal Level of Reserves: Different Shocks to the Capital Account
(In percent of GDP)



Source: Fund staff calculations.

Lender of Last Resort

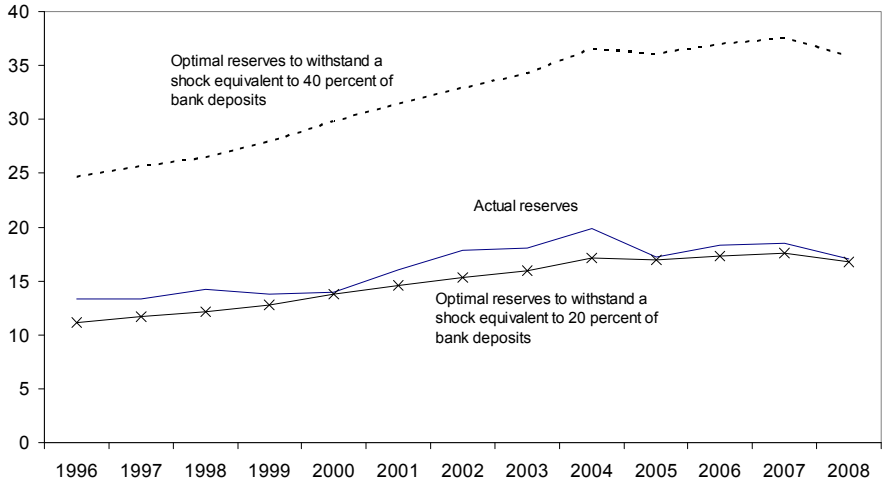
The ECCB faces specific challenges to protect the economy against a banking crisis. The quasi-currency board architecture constrains the ECCB's ability to act as a lender of last resort (LOLR), as by design the monetary base has to be covered by international reserves (Dehesa and Druck, 2008). The ECCB's potential to finance a LOLR facility is bounded by the liquidity supply from international capital markets, and/or by the tradeoff between using excess international reserve holdings and protecting the fixed exchange rate regime[7]. In addition, the ECCB's ability to act as LOLR is constrained by its institutional architecture, as its key decision-making body, the Monetary Council, which consists of the Minister of Finance of each member country, can block the use of any LOLR facility if such lending may endanger the stability of the exchange rate.

[7] The February 2009 run on the Bank of Antigua (BOA), following fraud charges against its owner, was specific to that institution and did not raise systemic liquidity concerns. While most deposits were moved to other banks in Antigua, the large and rapid deposit run is instructive for the size of possible deposit outflows in a crisis situation.

In a fixed exchange rate regime, international reserves are necessary for the central bank to perform the role of a LOLR. If reserves are intended to enable the central bank to perform the role a LOLR, then it should maintain sufficient reserves to cover some fraction of banking system liabilities, as this would represent the potential reserve loss in the event of a run on the banking system.[8] A useful benchmark on the potential size of a bank-run in a heavily dollarized banking system is Uruguay in 2002, where after a severe exogenous shock (spillover from the Argentine crisis which caused an output loss of about 18 percent of GDP), about 40 percent of the banking system's total deposits were withdrawn in 2002 (Gonçalves 2008).[9]

Figure 3 shows that the ECCB's international reserves may be insufficient to provide banks with a substantial buffer to deal with large-scale deposit outflows. While current international reserves are adequate to withstand an outflow equivalent to 20 percent of deposits, reserves would be insufficient in the event of a systemic shock to the banking system that leads to the withdrawal of 40 percent of banking system deposits.[10]

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



Source: Fund staff calculations.

[8] For a more detailed discussion of these issues see Jeanne and Wyplosz (2003) and Calvo (2006).

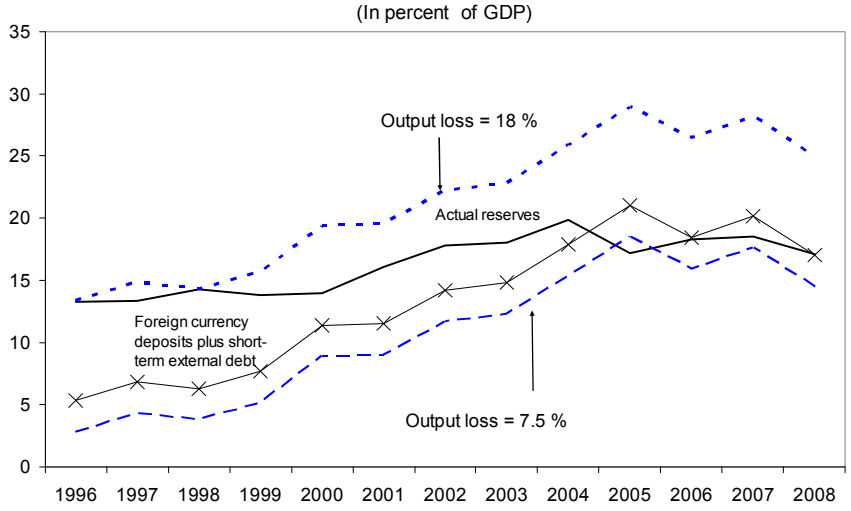
[9] While the level of dollarization in the ECCU is much smaller than that of Uruguay, the small size of the economies and open capital accounts imply significant vulnerabilities. Foreign currency deposits in the ECCU were equivalent to about 15 percent of GDP in 2008, compared with non resident foreign currency deposits of around 25 percent of GDP in Uruguay in 2000, two years before the crisis.

[10] The presence of strong foreign commercial banks that are able to draw on resources from their head offices could reduce the amount reserves the ECCB needs to hold, but this would require carefully coordinated contingency plans that define the roles of each institution in a crisis situation.

IV. SENSITIVITY ANALYSIS (SIMULATION EXERCISES)

The Jeanne (2007) insurance model can be calibrated with different parameters, to further highlight the adequacy of international reserves. Figure 4 shows the international reserves that would be required to smooth the impact of a sudden stop of capital inflows equivalent to the roll over of ECCU external public debt combined with the outflow of all foreign currency deposits. In addition, to cover output losses international reserves would have to increase to about 25 percent of GDP, if an external shock causes an output loss of about 18 percent of ECCU GDP as in the case of Uruguay in 2002. Alternatively, international reserves need to be about 15 percent of GDP if the output loss derived from the external shock is relatively modest, equivalent to about 7½ percent of ECCU GDP.

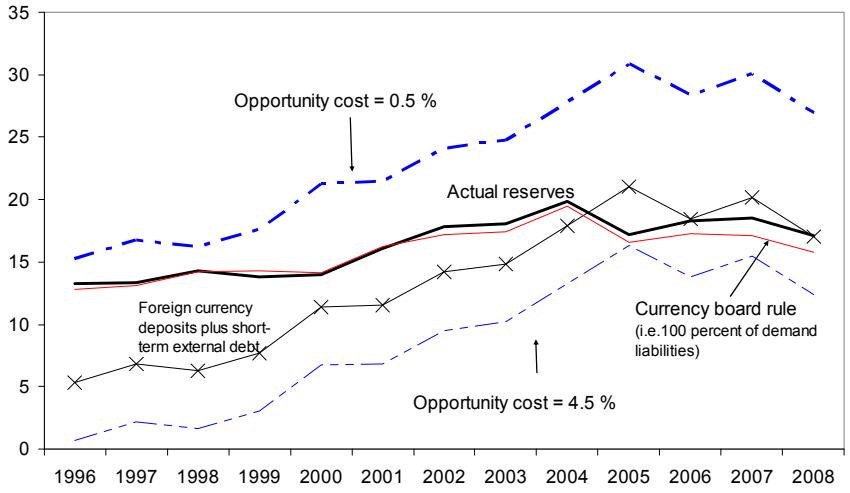
Figure 4. ECCU: Optimal Level of Reserves Sensitivity to Output Loss
(In percent of GDP)



Source: Fund staff calculations.

The cost of holding international reserves has a significant impact on the optimal level of reserves (Figure 5). The higher the cost, the more important it would be to develop alternative shock absorbers, or to limit the incidence of adverse shocks in order to contain reserve needs. In the baseline scenario (described in Section II) the opportunity cost amounts to 3 percent in yield forgone. If the cost of holding reserves increases to 4.5 percent, then optimal reserves decline to about 12 percent of GDP compared with 17 percent of GDP in the baseline for 2008. Optimal reserve holdings would reach 27 percent of GDP at end-2008 if their holding cost declines to 0.5 percent of GDP.

Figure 5. ECCU: Optimal Level of Reserves: Sensitivity to Cost of Holding Reserves
(In percent of GDP)



Source: Fund staff calculations.

The cost of holding reserves is sensitive to the underlying methodology. One approach is to consider alternative investment opportunities, including building public infrastructure, by computing the marginal product of capital. A preliminary estimate based on various assumptions on the production technology suggest that the marginal product of capital in the ECCU is about 8 percent.[11] By this measure, holding reserves appears to carry an average net cost of about 1 percent of GDP, after netting out a short-term real return of about 2 percent in U.S. assets. An alternative approach is to focus on external debt repayment, but this measurement may overstate the true opportunity cots of holding reserves, because the cost of external debt includes a default risk premium.

V. Implications of Central Bank Reserve Rule

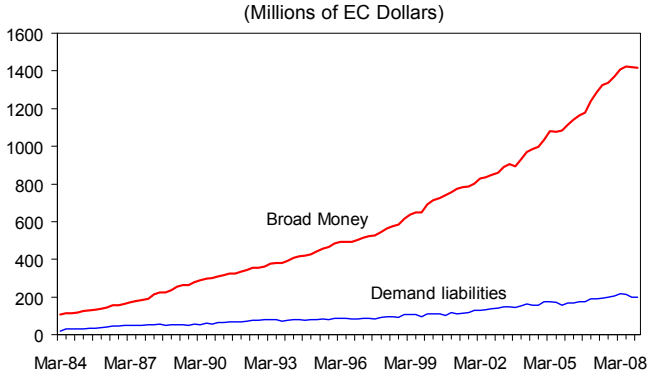
The ECCB operates as a quasi-currency board and pools the international reserves of its eight member countries. By law, the ECCB is required to maintain international reserves equivalent to 60 percent of the central bank's demand liabilities. Operationally, the ECCB is committed to maintaining a reserve cover greater than or equal to 80 percent of demand liabilities, and in practice the reserves have been close to 100 percent of demand liabilities, occasionally exceeding that figure. The reserve cover rule was brought over from the Eastern Caribbean Currency Authority which preceded the establishment of the ECCB in 1983. The reserve cover rule had served the ECCU well during the earlier period when capital account transactions were constrained by moderate exchange control regulations. For example, under the previous exchange control regulations, responsibility for current account transactions was devolved to commercial banks which are not required to surrender foreign

[11] Preliminary estimates of the average ECCU marginal product of capital (MPC) assume a standard Cobb-Douglas production function, a capital income share of 0.35 and a 5 percent depreciation rate. The MPC estimates are somewhat below the estimates in the CFA Franc Zone, as reported in Delèchat and Martijn (2006).

exchange receipts to the central bank. The reserve rule has remained unchanged with the full liberalization of the capital account in 2005. It is therefore useful to explore the implications of the rule in this new context.

The ECCU has experienced a period of rapid financial deepening, as measured by the rise in the ratio of broad money to GDP since 1984. This has resulted in a divergence between the growth of broad money and the growth of demand liabilities (Figure 6). The paper therefore estimates the possible path of optimal reserves to insure against a currency crisis that results in a deposit loss, using the 80 percent of demand liabilities 'reserve cover rule' practiced by the ECCB. The projections for broad money are based on regression estimates of real money demand over the period 1984Q1 to 2008 Q4. Following Judd and Scadding (1982) and Taufiq (2002), both broad money and demand liabilities are estimated as functions of real income and interest rates.

Figure 6. ECCU: Broad Money and Demand Liabilities 1984–2008
(Millions of EC Dollars)



Source: IMF, International Financial Statistics.

The empirical evidence suggests that the income elasticity of broad money is much higher than that of base money (Table 2). Unit root tests reveal that all variables appear to be non-stationary in levels and stationary in first differences. The money equations are estimated using a vector error correction model since the Johansen cointegration test shows that the two concepts of money are cointegrated with income and interest rates. The estimated long-run relationships and short-run dynamics are presented in Table 2. All variables display the correct theoretical signs and are statistically significant. The long-run income elasticity is estimated at about 1.5 for broad money and 1.1 for demand liabilities. These estimates are robust to different specifications and are largely unchanged when instead the log of nominal money is used. The higher income elasticity of demand for broad money is partially related to the rise in foreign currency deposits, and implies that the store of wealth demand for money is a superior good. The short-term dynamics suggest that money returns to its long-run equilibrium level after about 10 quarters.

Table 2. ECCU: Regression Results for Money Demand , 1984-2008 1/

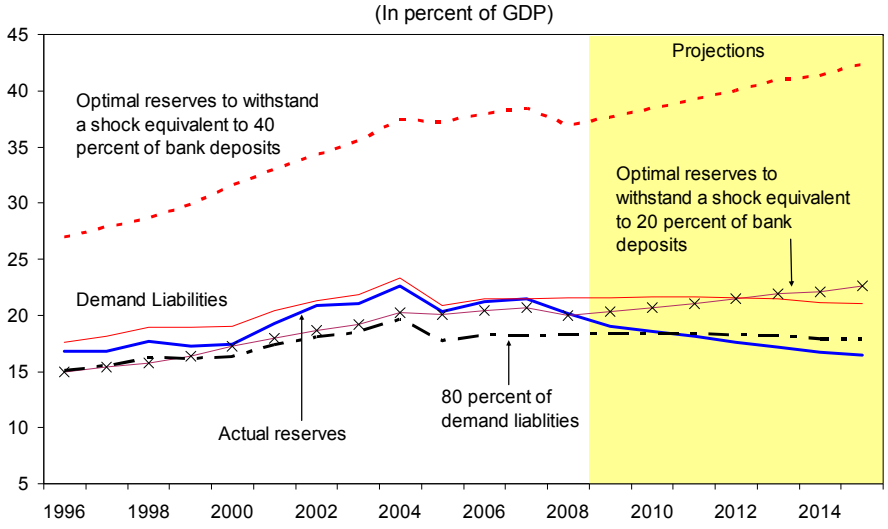
Variables	Broad Money		Demand Liabilities	
Long-run relationship				
Constant	8.95	***	9.37	***
	(16.94)		(17.98)	
Income	1.47	***	1.07	***
	(25.53)		(17.54)	
Interest rate differential	-0.08	***	-0.09	***
	(-6.21)		(-8.92)	
Short-run dynamics				
Change in broad money	0.01		-0.08	
	(0.44)		(-1.18)	
Change in income	0.00		0.00	
	(-0.04)		(3.09)	
Change in interest rate	-4.11		-3.12	
	(-5,00)		(-4.19)	
Summary statistics				
R^2	0.62		0.51	
Adj. R^2	0.47		0.39	
S.E.	0.01		0.04	
Observations	87		87	
*** significant at 1 percent level				
** significant at 5 percent level				
* significant at 10 percent level				

Source: Authors' calculations.

1/ Bracketed numbers are the t-statistics. All variables are in logarithmic form, except the interest rate.

Projected reserves based on the 80 percent reserve cover rule continue to fall short of the optimal level of reserves needed to withstand a potential moderate-to-severe deposit withdrawal (Figure 7). The estimated coefficients from the model are used to project broad money and base money to 2015. Projections for income and prices are based on the medium-term framework for ECCU Common Policies surveillance and WEO projections of US interest rates. The level of reserves implied by the 80 percent rule and the optimal level of reserves are then calculated from the projections. They show that even with 100 percent coverage of demand liabilities, the gap between reserves and potential bank deposit runs continues to widen.

Figure 7. ECCU: Optimal Level of Reserves: Different Intensities of Projected Bank Run
(In percent of GDP)



Source: Fund staff calculations.

Challenges from the Ongoing Global Financial Turmoil

The global financial market turbulence observed since mid-2007 highlights the urgency of strengthening contingency planning in all countries, especially those with large financial systems. Initial actions to prevent a systemic banking crisis include the provision of sufficient liquidity to protect the payments system, but simultaneously policy makers must seek to limit the impact on prices and the exchange rate (Hoelscher and Quintyn, 2003). Further tools include protection for creditors, including depositors through blanket or limited guarantees to stop bank runs, upfront closure of clearly insolvent banks, and the adoption of a comprehensive macroeconomic stabilization plan. Administrative measures are a last resort option if all other measures fail.

VI. Conclusion and Policy Implications

The current level of reserves held by the ECCB appears to be adequate for a variety of current account and capital account shocks, when measured by traditional ratios and using an optimal reserve framework. The level of reserves held by ECCU countries is in line with similar small, tourism-dependent economies and monetary unions based in developing countries. However, moderate-to-severe deposit withdrawals in the context of an open capital account could prove to be a challenge for the ECCB. The ECCB's operating rule of holding a minimum of 80 percent of demand liabilities as reserves has been more than adequate historically to cover most shocks, but in recent years the cushion has decreased.

Greater international integration through capital account liberalization and rapid financial deepening in recent years suggest that the ECCB's traditional reserve cover rule may need to be augmented to help insure against adverse capital flows. The rate of growth of broad money has consistently surpassed the growth rate of base money, resulting in a higher income elasticity for broad money. As a result, a reserve rule that is focused only on demand liabilities would tend to systematically under-insure for potential deposit outflows. The

ECCU could consider modifying the reserve cover rule to take into consideration the effects of capital account liberalization. This would mean modifying the rule to take account of some level of adverse capital movements, given the openness of the capital account.

The main difficulty facing the ECCU in seeking to build international reserves is the absence of effective tools to influence the level of 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 one 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.

References

Aizenman, J. and N. Marion, 2004, International Reserve Holdings with Sovereign Risk and Costly Tax Collection", *The Economic Journal*, Vol. 114, pp. 569–91.

Calvo, G., 2006, "Monetary Policy Challenges in Emerging Markets: Sudden Stop, Liability Dollarization, and Lender of last Resort," Working Paper 12788. Cambridge, Mass.: National Bureau of Economic Reserch (December).

Dehesa, M. and P. Druck, 2008, "The Eastern Caribbean Central Bank: Challenges to An Effective Lender of Last Resort," IMF Working Paper 08/214, Washington DC: International Monetary Fund.

Delèchat, C. and J.K. Martijn, 2007, "Reserve Adequacy in the CFA Franc Zone," in A.M. Gulde and C. Tsangarides (editors), *The CFA Franc Zone. Common Currency, Uncommon Challenges,* Washington DC: International Monetary Fund.

Drummond, P. and A. Dhasmana, 2008, "Foreign Reserve Adequacy in Sub-Saharan Africa," IMF Working Paper 08/150, Washington DC: International Monetary Fund.

Floerkemeir H. and M. Sumlinski, 2008, "International Reserve Trends in the South Caucasus and Central Asia Region," IMF Working Paper 08/41, Washington DC: International Monetary Fund.

Flood, R. and N. Marion, 2002, "Holding International Reserves in an Era of High Capital Mobility," IMF Working Paper 02/62, Washington DC: International Monetary Fund.

Frankel, J. and B. Jovanovic, 1981, "Optimal International Reserves: A Stochastic Framework," *The Economic Journal,* Vol. 91, pp. 507–14.

Gonçalves, F.M., 2007, "The Optimal Level of Reserves in Financially Dollarized Economies: The Case of Uruguay." IMF Working Paper 07/625, Washington DC: International Monetary Fund.

Goyal, R. and P. Liu, 2006, "Foreign Exchange Reserve Accumulation in Brazil", mimeo, IMF Western Hemisphere Department. Washington DC: International Monetary Fund.

Greenspan, A., 1999, "Currency Reserves and Debt," remarks before the World Bank Conference on Recent Trends in Reserve Management, Washington DC, April 29, 1999.

Grenade, K., 2008, "The Optimal Level of Foreign Reserves for the ECCB," mimeo, Research Department, Eastern Caribbean Central Bank, St. Kitts and Nevis.

Hoelscher, D.S. and M. Quityn, 2003, *Managing Systemic Banking Crises*, Occasional Paper 224, Washington DC: International Monetary Fund.

Hutchison, M. and I. Noy, 2005, "How Bad are the Twins? Output Costs of Currency and Banking Crisis," *Journal of Money,Credit and Banking*, Vol. 37, no.4 (August).

Jeanne, O. and R. Rancière, 2006, "The Optimal Level of Reserves For Emerging Markets: Formulas and Applications," IMF Working Paper 06/229, Washington DC: International Monetary Fund.

Jeanne, O., 2007, "International Reserves In Emerging Market Countries: Too Much of a Good Thing?" *Brookings Papers in Economic Activity*, 1: 2007, pp. 1–79.

Jeanne, O. and C. Wyplosz, 2003, "The International Lender of Last Resort: How Large is Large Enough?" In *Managing Currency Crises in Emerging Markets*, edited by Michael P. Dooley and Jeffry A. Frankel, Chicago: University of Chicago Press.

Judd, J.P. and J.L. Scadding, 1982, "The Search for a Stable Money Demand Function: A Survey of the Post 1973 Literature," *Journal of Economic Literature*, Vol. XX, pp. 993–1023.

Kwon, G., S. Panth, J. Chai, A. Gerson, G.M. Casselle, R. Espinoza, 2008, "Financial Integration in the Caribbean," in A. Bauer, P. Cashin and S. Panth (editors), *The Caribbean: Enhancing Economic Integration*, IMF Western Hemisphere Department, Washington DC: International Monetary Fund, pp. 3-43.

Lucas, R.E., 1987, *Models of Business Cycles,* Oxford: Blackwell.

Pemberton, J., 1996, "Growth Trends, Cyclical Fluctuations, and Welfare With Non-expected Utility Preferences" *Economic Letters* Vol. 50, pp.387–92.

Randall, R., 2006, "Eastern Caribbean Tourism: Developments and Outlook," in R. Sahay, D.O. Robinson and P. Cashin (editors), *The Caribbean: From Vulnerability to Sustained Growth*, Washington DC: International Monetary Fund, pp. 285–306.

Rasmussen, T., 2006, "Natural Disasters and their Macroeconomic Implications," in R. Sahay, D.O. Robinson and P. Cashin (editors), *The Caribbean: From Vulnerability to Sustained Growth*, Washington DC: International Monetary Fund, pp. 181–205.

Rudebusch, G., B.P. Sack, and E.T. Swanson, 2007, "Macroeconomic Implications of Changes in the Term Premium," *Federal Reserve Bank of St. Louis Review* Vol. 89, No. 4, pp. 241–69.

Rodrik, D., 2006, " The Social Cost of Foreign Exchange Reserves," *International Economic Journal,* Vol. 15, pp. 253–66.

Sachs, J., A. Tornell, and Z.A. Velasco, 1996, "Financial Crisis in Emerging Markets: The Lessons from 1995," *Brookings Papers on Economic Activity,* Vol.1, pp. 177–215.

Sahay, R., 2006, "Stabilization, Debt, and Fiscal Policy in the Caribbean," in R. Sahay, D.O. Robinson and P. Cashin (editors), *The Caribbean: From Vulnerability to Sustained Growth*, Washington DC: International Monetary Fund, pp. 17–57.

Taufiq, C., 2002, "Financial Innovations and the Demand for United States M1 and M2 Components", *International Economic Journal,* March, 2002.

Wijnholds, J., and A. Kapteyn, 2001, "Reserve Adequacy in Emerging Market Economies", IMF Working Paper 01/143, Washington DC: International Monetary Fund.