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# Assessing Banking and Currency Crisis Risk in Small States

## An application to the Eastern Caribbean Currency Union

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**ABSTRACT:** To complement the early warning signals literature, we study the determinants of banking and currency crises for small states and currency boards. Building on the crisis dataset by Laeven and Valencia (2020), we estimate a binomial logit model to identify the determinants of crises, and as a case study, we apply our models to the Eastern Caribbean Currency Union (ECCU). Our findings largely confirm past studies' results that both external and domestic fundamentals matter in predicting crisis likelihood, but we find that small states and fixed exchange rate regimes are more sensitive to these fundamentals, compared to larger economies. Our empirical results also suggest that for currency board economies, keeping a high level of the foreign reserve cover—the “backing ratio” defined as official foreign reserves as a share of central bank demand liabilities—is critical to reduce the likelihood of both banking and currency crises. The backing ratio is particularly important during years of global economic downturn.

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WORKING PAPERS

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An Application to the Eastern Caribbean Currency  
Union

Prepared by Carlo Pizzinelli, Kotaro Ishi, and Tariq Khan

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# I. Introduction

The COVID-19 pandemic crisis starting in early 2020 took a heavy toll on human lives and the global economy, and the Eastern Caribbean Currency Union (ECCU) economies were no exception. The ECCU comprises six independent countries (Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, Saint Lucia, and St. Vincent and the Grenadines) as well as two overseas territories of the United Kingdom (Anguilla and Montserrat). These islands are small, middle-income, and heavily dependent on tourism income. Following the outbreak of the global pandemic in Spring 2020, as tourist arrivals plummeted by 70 percent and cruise ship travel completely halted, the ECCU economy entered a deep recession in 2020. With sizable revenue losses and increased spending, fiscal positions deteriorated sharply in 2020, with public debt rising steeply. The external accounts also deteriorated, although the official foreign reserve position held up relatively well, partly reflecting increased official financing (IMF, 2021).

Despite the severe shock and deep economic recession, the Eastern Caribbean Central Bank (ECCB) maintained strong confidence in its currency, the Eastern Caribbean dollar. The ECCB was established in October 1983 as the monetary authority for the ECCU. The ECCB manages a common pool of reserves in the ECCU and operates the quasi-currency board arrangement. The ECCB's important operational target is to maintain a high level of the foreign reserve cover—the “backing ratio” defined as the ECCB's foreign assets as percent of its demand liabilities (see Section II). This mechanism has served to limit the risk of a currency crisis during the period of significant economic shocks (e.g., the 2008–09 Global Financial Crisis).

This paper revisits the determinants of currency and banking crises for small states and currency boards. In many historical episodes, currency and banking crises were associated with large macroeconomic shocks and imbalances, such as credit bubbles and unsustainable current account deficits, as well as “sudden stops” in capital inflows. Although the occurrence of crises may have been lower in small states, some of these channels may have greater relevance in the macroeconomic developments of this set of countries. Due to high trade openness, global shocks in small states propagate quickly through the domestic economy and exert strong pressures on the external account and foreign exchange market. Furthermore, the financial sector often relies heavily on foreign capital inflows, which exposes the financial sector to spillovers from shocks in the external and domestic sectors. Thus, currency and financial crises can be intertwined.

There is a large body of empirical literature examining the use of macroeconomic variables to predict a crisis as early warning signals (EWS). For example, the seminal work of Kaminsky et al. (1998), Kaminsky (1999), and Kaminsky and Reinhart (1999) proposed a “signal-to-noise approach,” while Demirgüç-Kunt and Detragiache (1998) investigated the joint predictive power of macroeconomic variables through linear and non-linear models. Other key contributions are Rose and Spiegel (2012), Bussiere and Fratzcher (2006), Babecký et al. (2013, 2014), Frankel and Rose (1996), Frankel and Saravelos (2012), Calvo et al. (2004), Manasse et al. (2016), Inekwe (2019), Alessi et al. (2015), Antunes et al. (2018), Coulibaly (2009), Caggiano et al. (2014, 2016). For the review of the recent literature, see Kauko (2014) and Bordo and Messner (2016).

The existing literature has, however, primarily focused on advanced economies and emerging markets, and few studies have considered currency boards and small states, with the exception of, for example, Caggiano et al. (2014). Our contribution is to fill this gap. Building on Laeven and Valencia (2020)'s crisis database, we run a binomial Logit model as in Caggiano et al. (2016) and investigate whether associations between macroeconomic variables and crisis likelihood for fixed exchange rate regimes and small states are different

from those for the other countries. We also investigate how the level of the currency backing ratio is associated with crisis probability. The empirical analysis in this paper covers 173 countries, which include 40 small states, of which six countries are ECCU members.<sup>1</sup>

The main findings in this paper are as follows:

- Higher levels of the backing ratio are strongly and robustly associated with lower probabilities of banking and currency crises. Through alternative specifications and interaction terms, we observe that this relationship is quantitatively more important for fixed exchange rate regimes and small states.
- The estimated model suggests that the ECCU had a low predicted probability of banking and currency crises in “normal times”. The model-implied crisis probability, however, rose somewhat during global economic downturns, like the 2008 Great Financial Crisis, suggesting the ECCU’s potential vulnerability to exogenous shocks.
- Our empirical models broadly confirmed the findings in the existing literature: namely, country-specific macroeconomic conditions, as well as global conditions (including market uncertainty, growth, and interest rates) have predictive power for the likelihood of a crisis.

The rest of the paper is organized as follows. Section II summarizes the crisis episodes in small states and currency boards. Section III describes our dataset and analyzes the data descriptively, and Section IV presents empirical models for currency and banking crises. In Section V, we apply the results of the empirical models to the ECCU. Section VI concludes.

## II. Crises Episodes in Currency Boards and in the Caribbean

The ECCB and its predecessors have maintained the fixed exchange regime for more than 70 years, uninterrupted. The ECCB manages a common pool of reserves and can extend credit to governments and banks, up to a limit determined both by the backing ratio and by individual country limits. Under the ECCB Agreement Act (1983), the ECCB must keep the currency “backing ratio” (defined as ECCB foreign assets as percent of its demand liabilities) at a minimum of 60 percent, but operationally, targets 80 percent. In practice, the backing ratio has been maintained at 95–100 percent over the past two decades, and to this end, the ECCB has limited the extension of credit to governments and banks. This mechanism has served well to maintain currency stability. It has also contributed to financial sector stability by limiting shocks to financial institutions originating from exchange rate fluctuations. There has been no episode of a twin crisis (a currency crisis combined with a systemic banking crisis) in the ECCU.

Other successful examples of currency board regimes include those of Hong Kong and the Baltic countries (Estonia, Latvia, and Lithuania), where constrained monetary policy is supported by disciplined fiscal effort, structural reforms, and the government’s strong commitment to maintaining an exchange rate peg. This credibility of the regimes promoted stability, even in times of serious external pressure. At the same time, there are several historical examples where currency boards could not withstand exogenous shocks, leading to

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<sup>1</sup> These are Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines. The UK territories of Anguilla and Montserrat are excluded.

currency and banking crises, or where inconsistent monetary and fiscal policy stances led to a crisis. Annex II reviews historical episodes of current boards during periods of macroeconomic distress.

There are numerous episodes of banking and currency distress in the Caribbean (Annex III). For instance, Guyana experienced a banking crisis in 1993 resulting from an increase in bank nonperforming loans (NPLs) and a deterioration in bank profitability and capital positions. Haiti experienced a banking crisis in 1994 due to a significant deterioration in economic and social conditions in the three years following the 1991 military coup. In 1996, following financial liberalization, a burst of credit booms resulted in insolvency in many banks in Jamaica. In 2003, weak regulation and surveillance resulted in liquidity problems in the Dominican Republic. Many islands in the Caribbean also experienced a currency crisis. For example, the Dominican Republic experienced a large devaluation in the parallel exchange rate market following its banking crisis in 2003. A weak economy, external shocks, and a disequilibrium in the foreign exchange market also led to large devaluations in several countries, including Trinidad and Tobago (1986), Guyana (1987), Jamaica (1983 and 1991), and Suriname (1990, 1995, 2001, and 2016).

### III. Currency and Banking Crises Data

#### Definition

The ECCB and its predecessors have maintained the fixed exchange regime for more than 70 years, uninterrupted. The ECCB manages a common pool of reserves and can extend credit to governments and banks, up to a limit determined both by the backing ratio and by individual country limits. Under the ECCB Agreement Act (1983), the ECCB must keep the currency “backing ratio” (defined as ECCB foreign assets as percent of its demand liabilities) at a minimum of 60 percent, but operationally, targets 80 percent. In practice, the backing ratio has been maintained at 95–100 percent over the past two decades, and to this end, the ECCB has limited the extension of credit to governments and banks. This mechanism has served well to maintain currency stability. It has also contributed to financial sector stability by limiting shocks to financial institutions originating from exchange rate fluctuations. There has been no episode of a twin crisis (a currency crisis combined with a systemic banking crisis) in the ECCU.

Following Laeven and Valencia (2020), we define currency and banking crises as follows (see Annex I for a more detailed discussion):

- Currency crises are defined as instances of a large exchange rate depreciation (30 percent or more) within a year against the US dollar. In cases in which two consecutive years feature large depreciations, the depreciation in the second year has to be 10 percentage points larger than that in the previous year to qualify as a separate instance of a crisis.
- Banking crises are defined as instances of severe financial distress in a country’s banking system, requiring significant policy interventions that can last for multiple years. The level of distress is quantified by a rise in NPLs, bank losses, bank runs, and bank asset foreclosures. The possible policy interventions include outright fiscal expenditure for bank nationalizations, liquidity support, government guarantees, asset freezes, and bank holidays.

Laeven and Valencia (2020)'s database covers the currency and banking crises of 165 countries from 1970 to 2017, including 26 small states. We expand the sample by adding 14 extra small states (none of which includes a crisis).<sup>2</sup> The sample includes the six sovereign ECCU countries (i.e., U.K. overseas territories, Anguilla and Monserrat, are excluded). A common set of macroeconomic indicators are available only for 1981–2017 for all the countries, and thus, the time horizon of our empirical analysis is restricted to this period.

Table 1 summarizes crisis frequency by grouping the country sample based on the exchange rate regime, the presence of a currency board, income level, economic size, and GDP volatility.<sup>3</sup> Statistical tests for the difference in mean suggest that crisis frequency varies across some of these characteristics. For instance, banking crises are less common for currency boards, low-income countries, and small states, whereas currency crises are less common for fixed exchange rates, currency boards, advanced economies, and countries with low-GDP volatility.<sup>4</sup> Although the occurrence of twin crises is rare, there is evidence that they are less common for advanced economies, small states, and economies with low GDP volatility.

**Table 1. Country Characteristics and Frequency of Banking and Currency Crises**

		Observations	Banking Crises			Currency Crises			Twin Crisis		
			No. Crises	% Crises	P-value	No. Crises	% Crises	P-value	No. Crises	% Crises	P-value
ER Regime t-1	Fixed	1,607	27	1.7%	0.53	23	1.4%	0.00	6	0.4%	0.46
	Managed Peg	1,214	25	2.1%		32	2.6%		8	0.7%	
	Float	1,250	28	2.2%		55	4.4%		8	0.6%	
Currency Board t-1	No Currency Board	3,791	78	2.1%	0.02	116	2.9%	0.00	21	0.6%	0.60
	Currency Board	280	2	0.7%		1	0.3%		1	0.4%	
Income Level	Advanced Economy	915	26	2.8%	0.00	6	0.7%	0.00	2	0.2%	0.03
	Emerging Market	2,095	47	2.2%		72	3.4%		18	0.9%	
	Low-Income Country	1,261	14	1.1%		40	3.2%		4	0.3%	
Economic Size	Small States	720	5	0.7%	0.00	14	1.9%	0.11	1	0.1%	0.01
	Other	3,378	82	2.4%		103	3.0%		23	0.7%	
GDP Volatility <sup>\1</sup>	Low	1,060	22	2.1%	0.98	14	1.3%	0.00	0	0.0%	0.05
	Medium	2,182	42	2.0%		58	2.7%		13	0.6%	
	High	1,029	23	2.1%		46	4.2%		11	1.1%	

Note. P-values refer to the Wald test of equality of means assuming heterogeneous variance across groups.

\1: Volatility categories are based on the 25th and 75th percentiles of the distribution of country-level historical standard deviation of real GDP growth.

Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

<sup>2</sup> Appendix I reports selected indicators for the small states in the sample.

<sup>3</sup> The table is based on the variables and country sample used for the economic analysis discussed in Section IV and Annex I.

<sup>4</sup> Countries with no separate legal tender (e.g., Montenegro and Timor Leste) are included in the fixed exchange rate regime sample.



## IV. Modeling Banking and Currency Crisis Likelihood

### A. Empirical Strategy

To study the power of standard macroeconomic indicators to predict the occurrence of banking and currency crises, we estimate a binomial Logit model following Caggiano et al. (2016). The model postulates that for country  $i$  at time  $t$  the probability of a banking (currency) crisis is represented by a logistic function:

$$\Pr(Crisis_{it} = 1) = \frac{e^{\beta X_{it} + \epsilon_{it}}}{1 + e^{\beta X_{it} + \epsilon_{it}}}$$

where  $X_{it}$  is a vector of country-specific variables,  $e$  is the exponential function, and  $\epsilon_{it}$  is an idiosyncratic error term.

The advantages of this framework are its simplicity and intuitiveness, lending itself well to studying a large set of countries where the availability of annual macroeconomic indicators is limited.

Following the literature, all country-specific variables in  $X_{it}$  are one-year lags. This choice is motivated by two reasons. First, there is reverse causality between the occurrence of a crisis and the macroeconomic outcomes of the same year. Second, the exercise aims to evaluate the ability of macroeconomic indicators to function as “early warning signals.” As many of these indicators represent end-of-year measures and are published by statistical agencies with the lags needed for compilation, the one-year lag closely represents the most up-to-date information available to the public at a given point in time.

For global variables, however, we use the value from the concurrent year. The two problems discussed above for country-specific variables are largely mitigated for global variables. First, these can be conceived as exogenous for most countries in the world, except perhaps major economies like the U.S. and China. Second, these variables are often available in “real time” either as year-to-date average measures (e.g., the VIX) or as projections (e.g., the projected world real GDP growth rate provided by the IMF’s WEO database).

Banking crises may last several years and unleash distinct and often sharp macroeconomic dynamics that bring the country back towards a stable path. Including all the years of a crisis in the analysis would thus introduce bias in the estimates by jointly considering the build-up of the crisis with the ensuing developments. We thus follow Caggiano et al. (2016) and only include in the sample the year in which a crisis begins. Currency crises last only one year based on the definition in Laeven and Valencia (2020), and therefore, the above problem does not apply. Hence, the sample size for the currency crisis analysis is slightly larger than for the banking crisis analysis.

We estimate the model using a Maximum Likelihood approach with robust standard errors. The estimated coefficients do not have an intuitive quantitative interpretation like those of a linear model. However, the sign itself is indicative of the qualitative relationship between a variable and the likelihood of a crisis. The quantitative association of a given variable can still be assessed by computing the predicted probability at different values of the variable itself, holding all other variables constant. Specifically, the marginal effect can be

computed as the partial derivative of the probability function with respect to a variable. Furthermore, the model's non-linearity allows us to assess how the marginal effect varies with the value of the variable itself or of other variables.

For the explanatory variables, we expand on the set considered by Caggiano et al. (2016). For the baseline model, the explanatory variables include: the credit/deposit ratio, the net foreign assets of the banking sector as a share of GDP, the growth rate of the credit/GDP ratio, the real interest rate, the broad money (M2)/GDP ratio, the growth rate of the terms of trade, the log real GDP per capita, and real GDP growth.

We then expand the explanatory variables in three ways:

- Fiscal variables: public debt/GDP ratio and fiscal balance/GDP ratio
- Financial variables: banking sector equity/GDP ratio, banking sector assets/GDP ratio, banking sector equity/assets ratio, and central bank's share of foreign assets to total assets (to proxy for the "backing ratio")
- Exchange rate regime: a binary variable for having a dollarized economy, a currency board, a currency union, or a pegged currency<sup>5</sup>
- Global variables: world real GDP growth rate, global uncertainty index (VIX), the US Federal Reserve's funding rate, and the 10 year–3-month US government bond yield spread.

Details on the data sources are summarized in Annex I.

## B. Descriptive evidence

Figure 1 plots the development of selected explanatory variables around the year  $t$  in which a banking crisis occurs. The black line presents the median value of each variable at a given time for observations in the "crisis sample," and the grey area covers the 25<sup>th</sup>–75<sup>th</sup> percentile range. For comparison, the red dashed line represents the unconditional median for all the country-year observations that are not crises.

For most variables, the median for the crisis event is markedly apart from the non-crisis median in the years preceding the crisis. The latter often lies closer to the 25<sup>th</sup> or the 75<sup>th</sup> percentiles. Only two variables, real GDP growth and public debt to GDP, have a very similar median across the crisis and non-crisis groups prior to the event. For some variables, there are also marked changes in the median in the aftermath of the crisis, suggesting a correction of previous macroeconomic imbalances (e.g., credit/deposit ratio, M2/reserves, and credit/GDP growth) or the impact of the crisis and its response (e.g., real GDP growth, and public debt/GDP).

Similar patterns can be observed in Figure 2 for currency crises, showing similar systematic differences in the pre-crisis distribution of several variables compared to the global non-crisis median.

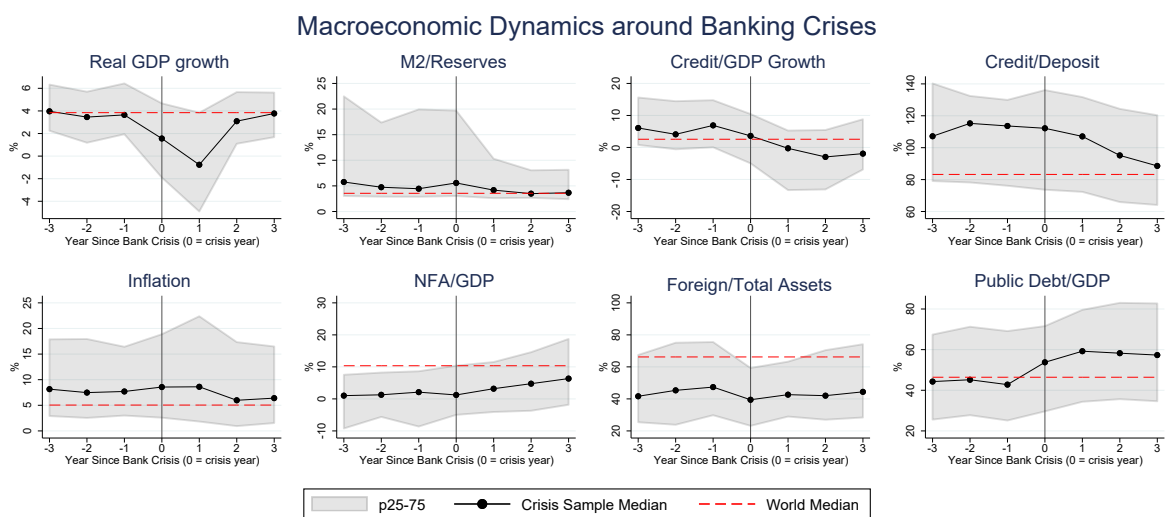
It is also worth observing how some global variables are correlated with the total number of crises occurring in a year. Figure 3 plots the total number of banking and currency crises by year, together with the global

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<sup>5</sup> While exchange rate regimes are very diverse in their operational arrangements and degree of flexibility, we opted for a simple binary variable because of the scarcity of crises for more granular exchange regime categorizations. For instance, Argentina is the only case of a banking crisis in a currency board.

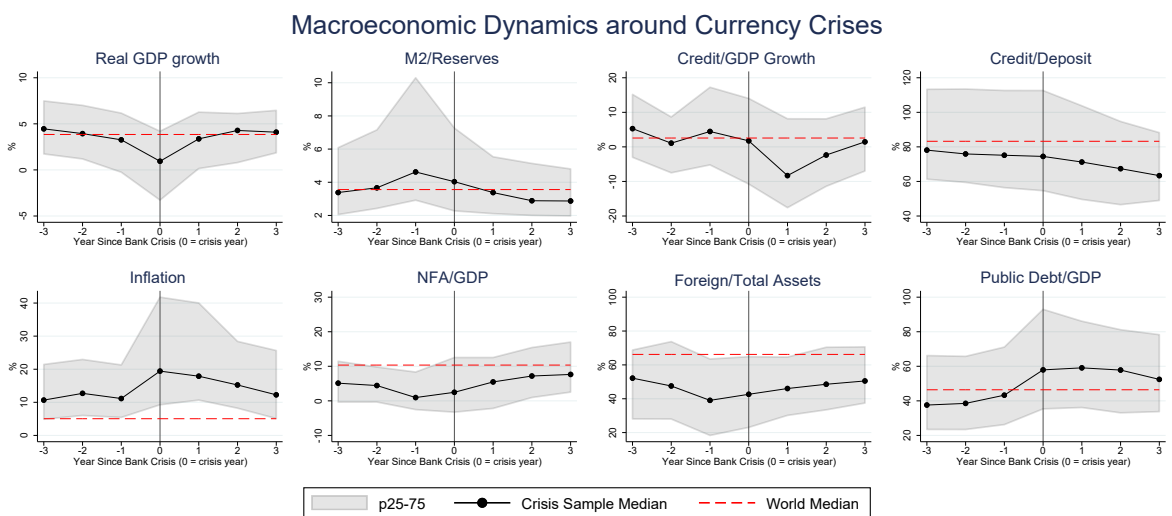
uncertainty index (VIX) and world real GDP growth. Both variables show some correlation with the occurrence of crises worldwide, in particular during the years of the 2008 GFC.

**Figure 1. Macroeconomic Dynamics Around Banking Crises**

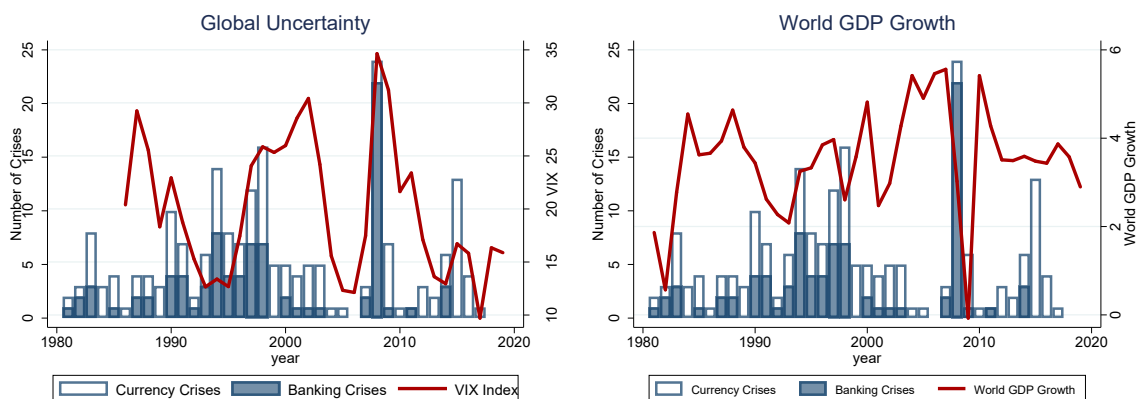


Note. In each panel, the black line plots the median value of the respective variable at  $t$  years before/after a banking crisis event. The grey area reports the interquartile range. The red dashed line reports the mean of the variable in the full sample. Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

**Figure 2. Macroeconomic Dynamics Around Currency Crises**



Note. In each panel, the black line plots the median value of the respective variable at  $t$  years before/after a currency crisis event. The grey area reports the interquartile range. The red dashed line reports the mean of the variable in the full sample. Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

**Figure 3. Global Variables and Total Number of Crises**

Note. In each panel, the red line reports the value of the respective global variable in a given year. The blue (white) bars report the number of banking (currency) crises occurring the year.

Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

## C. Econometric Results

### Main results

Table 2 reports the results of the Logit model for banking crises. Column 1 contains the results from the same specification as Caggiano et al. (2016). The sign and value of the coefficients are broadly consistent with the original paper despite the expanded sample of countries and years. Six variables out of nine have statistically significant coefficients. The two credit variables—the credit/deposit ratio and the credit/GDP growth rate—have positive coefficients, suggesting that higher levels are associated with a higher likelihood of a crisis in the following year. The same holds for the two “monetary” variables, inflation and M2/reserves. Finally, the banking sector’s NFA/GDP ratio has a negative coefficient, indicating that a larger holding of foreign assets is associated with lower chances of a financial crisis.<sup>6</sup>

The specifications in the following columns expand the set of explanatory variables. Three out of four global variables are statistically significant. Tighter US monetary policy and global uncertainty have a positive coefficient, whereas world real GDP growth has a negative coefficient. Overall, this implies that adverse global conditions are associated with a higher occurrence of banking crises.

Among the fiscal variables, only the coefficient on public debt is significant but with a negative coefficient. This is a surprising result, given that sovereign debt crises often spill over to the banking sector. However, in the context of the reduced-form relationship captured by the Logit model, the coefficient could reflect the greater market access enjoyed by economies with a more developed and stabilized financial sector.<sup>7</sup>

<sup>6</sup> Our results suggest that positive terms of trade shocks (i.e., an increase in export prices over import prices) are also associated with a higher crisis probability. This result is not intuitive. A possible explanation would be that with higher commodity prices, economic prospects strengthen, leading to large capital inflows, increased indebtedness, and thereby a build-up of vulnerabilities in the financial sector.

<sup>7</sup> We also ran robustness checks using as fiscal variables the primary balance and the deviation of the primary balance from its debt-stabilizing level.

Among the financial variables, bank equity/GDP has a positive and significant coefficient, suggesting that larger banking systems relative to the size of the economy may be more prone to crisis events. Additionally, the central bank's share of foreign assets, the "backing ratio," is negative and significant.

Once controlling for membership to the European Monetary Union, a fixed exchange rate regime is not associated with a higher crisis probability than more flexible regimes. Finally, when including all these extra variables together (Column 6), most coefficients remain significant.

Overall, these results are in line with the empirical literature discussed above on the predictive power of several macroeconomic indicators. In particular, with respect to international reserves and the backing ratio, Frankel and Sarvelos (2012) find that they are an important predictor of banking crises in the 1990s and 2000s, including the GCF. The fact that several financial variables do not have a significant effect may be more surprising. However, given the reduced-form nature of the Logit model, these variables also capture a country's overall level of financial development and hence may mask confounding effects.

Table 3 reports the results of the same specifications for currency crises. For all specifications, fewer coefficients are statistically significant, and the pseudo-R-squared is lower than for banking crises. Among the variables in the baseline specification, there is no robust evidence of credit variables being significantly associated with currency crises, while banks' net foreign assets and inflation have significant and negative coefficients. The negative coefficient on log real GDP per capita suggests that higher-income countries are less exposed to severe currency volatility.

Among global variables, only world real GDP growth is significant, suggesting that currency crises are more likely during global downturns. The negative and significant coefficient on the public debt and the overall fiscal balance confirms that fiscal prudence may be associated with lower chances of a currency run.

Among the financial variables, once again, the backing ratio has a significant negative coefficient. The coefficient for bank assets to GDP is also significantly negative. When all extra variables are included together, bank equity to GDP is also significant. Finally, a fixed exchange rate is associated with lower chances of a currency crisis.

Once again, these results are broadly consistent with the empirical and theoretical literature on currency crises. The importance of the backing ratio to support currency stability has been the subject of large empirical evidence. Moreover, the importance of fiscal variables is consistent with theoretical work on the external imbalances caused by sustained government deficits.

**Table 2. Estimated Logit Model for Banking Crises**

	(1) Baseline	(2) World	(3) Fiscal	(4) Financial	(5) Peg	(6) All
<b>Domestic macro variables</b>						
Credit/Deposit t-1	0.00650*** (0.00174)	0.00673*** (0.00180)	0.00672*** (0.00169)	0.00714*** (0.00197)	0.00649*** (0.00177)	0.00654*** (0.00193)
NFA/GDP t-1	-0.0104** (0.00451)	-0.00990** (0.00492)	-0.0129*** (0.00438)	-0.0113*** (0.00420)	-0.00841* (0.00466)	-0.0110*** (0.00383)
Credit/GDP Growth t-1	0.0208*** (0.00557)	0.0160*** (0.00579)	0.0212*** (0.00653)	0.0257*** (0.00548)	0.0214*** (0.00568)	0.0223*** (0.00612)
Real Int. Rate t-1	0.00435 (0.00608)	0.00827 (0.00650)	0.0287*** (0.00798)	0.0160** (0.00728)	0.00391 (0.00602)	0.0182* (0.0108)
M2/Reserves t-1	0.0129*** (0.00267)	0.0153*** (0.00264)	0.0154*** (0.00269)	0.00947*** (0.00332)	0.0116*** (0.00280)	0.00825** (0.00399)
ToT Growth t-1	0.0174** (0.00859)	0.0177* (0.00911)	0.0178** (0.00868)	0.0268*** (0.00930)	0.0171* (0.00894)	0.0230** (0.0109)
Inflation t-1	0.0156*** (0.00373)	0.0132*** (0.00458)	0.0370*** (0.00792)	0.0145*** (0.00543)	0.0153*** (0.00373)	0.0120 (0.0120)
Log GDP per capita t-1	0.159 (0.103)	0.214** (0.104)	0.222 (0.139)	0.229* (0.138)	0.112 (0.108)	0.128 (0.184)
Real GDP growth t-1	-0.00778 (0.0288)	-0.0326 (0.0322)	-0.00269 (0.0355)	-0.0134 (0.0331)	-0.00607 (0.0306)	-0.00708 (0.0456)
<b>Global variables</b>						
Fed Funds Rate t		0.132** (0.0567)				0.195** (0.0759)
Spread 10y-3m US t		-0.196 (0.135)				-0.146 (0.159)
VIX t		0.0908*** (0.0270)				0.0835** (0.0325)
World Real GDP Growth t		-0.284*** (0.104)				-0.346*** (0.119)
<b>Fiscal variables</b>						
Public Debt/GDP t-1			-0.0110*** (0.00424)			-0.0156*** (0.00514)
Overall Balance / GDP t-1			-0.0142 (0.0250)			-0.0245 (0.0350)
<b>Financial variables</b>						
Foreign/Total CB Assets t-1				-0.0107** (0.00453)		-0.0127** (0.00591)
Bank Equity / Assets t-1				0.00229 (0.00626)		0.00790 (0.00722)
Bank Equity/GDP t-1				0.0354* (0.0204)		0.0146 (0.0210)
Bank Assets / GDP t-1				-0.00682 (0.00556)		-4.85e-05 (0.00631)
Euro					0.830* (0.466)	1.317*** (0.489)
Peg t-1					-0.463 (0.316)	-0.299 (0.382)
Constant	-6.512*** (1.023)	-8.131*** (1.571)	-7.089*** (1.451)	-6.821*** (1.243)	-5.989*** (1.033)	-6.366*** (2.135)
Observations	3,867	3,717	3,302	3,495	3,849	2,976
Pseudo R-squared	0.0886	0.157	0.103	0.117	0.0931	0.210

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

**Table 3. Estimated Logit Model for Currency Crises**

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline	World	Fiscal	Financial	Peg	All
<b>Domestic macro variables</b>						
Credit/Deposit t-1	-0.00123 (0.00244)	-0.000966 (0.00256)	0.000452 (0.00272)	0.000596 (0.00235)	-0.000879 (0.00231)	0.00203 (0.00270)
NFA/GDP t-1	-0.0102*** (0.00343)	-0.0103*** (0.00390)	-0.0178*** (0.00336)	-0.00326 (0.00494)	-0.00922*** (0.00353)	-0.0171*** (0.00639)
Credit/GDP Growth t-1	0.0101* (0.00520)	0.00755 (0.00551)	0.00929 (0.00702)	0.0119** (0.00534)	0.0104** (0.00524)	0.00920 (0.00744)
Real Int. Rate t-1	0.00947** (0.00424)	0.0101** (0.00473)	0.0238*** (0.00721)	0.00899* (0.00500)	0.00813* (0.00427)	0.0159* (0.00826)
M2/Reserves t-1	0.000980 (0.00360)	0.00109 (0.00382)	-0.000773 (0.00487)	-0.00123 (0.00421)	0.00251 (0.00383)	-0.0102 (0.0104)
ToT Growth t-1	-0.0103 (0.00841)	-0.0147* (0.00888)	-0.0119 (0.0110)	-0.00120 (0.00800)	-0.0105 (0.00852)	-0.00517 (0.0110)
Inflation t-1	0.0153*** (0.00293)	0.0137*** (0.00335)	0.0309*** (0.00608)	0.0100** (0.00433)	0.0135*** (0.00303)	0.0225** (0.00966)
Log GDP per capita t-1	-0.265*** (0.0811)	-0.262*** (0.0865)	-0.322*** (0.106)	-0.0899 (0.123)	-0.236*** (0.0841)	-0.0985 (0.150)
Real GDP growth t-1	-0.0408 (0.0251)	-0.0392 (0.0272)	-0.0289 (0.0327)	-0.0409 (0.0261)	-0.0415 (0.0256)	-0.0157 (0.0359)
<b>Global variables</b>						
Fed Funds Rate t		0.0188 (0.0583)				-0.0674 (0.0730)
Spread 10y-3m US t		-0.131 (0.124)				-0.302* (0.168)
VIX t		-0.00403 (0.0156)				-0.0231 (0.0191)
World Real GDP Growth t		-0.344*** (0.0974)				-0.539*** (0.124)
<b>Fiscal variables</b>						
Public Debt/GDP t-1			-0.0108*** (0.00398)			-0.0117** (0.00519)
Overall Balance / GDP t-1			-0.0768** (0.0301)			-0.0877** (0.0363)
<b>Financial variables</b>						
Foreign/Total CB Assets t-1				-0.0228*** (0.00422)		-0.0302*** (0.00568)
Bank Equity / Assets t-1				-0.00468 (0.00510)		-0.0129 (0.00847)
Bank Equity/GDP t-1				0.0240 (0.0204)		0.0649** (0.0299)
Bank Assets / GDP t-1				-0.0137** (0.00578)		-0.0195*** (0.00753)
Peg t-1					-0.602** (0.262)	-0.250 (0.376)
Constant	-1.242* (0.678)	0.147 (1.042)	-0.873 (1.039)	-1.308 (0.957)	-1.335* (0.694)	2.406 (1.743)
Observations	4,057	3,895	3,454	3,671	4,043	3,121
Pseudo R-squared	0.0639	0.0756	0.0836	0.0998	0.0700	0.176

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

### Small states and fixed exchange rate countries

We now ask whether the predictive power of some of these macroeconomic indicators may differ for small states and for fixed exchange rates, two features of the ECCU. Overall, the results provide evidence that the backing ratio is a significant predictor of banking and currency crises for fixed exchange rate regimes and small states but less so for flexible regimes and larger economies. Furthermore, crises in pegged regimes are somewhat more linked to global conditions, while small states appear to be less linked than larger economies.

Table 4 presents a set of regressions where we expand on Column 6 from Tables 2 and 3 by interacting key global and country-specific variables.<sup>8</sup> For presentational purposes, we focus on a subset of variables that are relevant for small states and economies with fixed exchange rates: world real GDP growth, global uncertainty, and a central bank's backing ratio. As the coefficient of each variable is estimated separately for fixed and flexible regimes, the difference between the two coefficients is indicative of a difference in the association of the variable with the probability of crisis across regimes. With regards to banking crises, fixed exchange regimes appear to be more exposed to global uncertainty than flexible regimes, while both regimes are exposed to global growth (Columns 1 and 3). With respect to currency crises, coefficients on global uncertainty are not significant, but exposure to global growth is significant for both regimes. (Columns 4 and 6).

For banking crises, the backing ratio is significant only for fixed exchange regimes, suggesting that the central bank's ability to sustain the fixed exchange rate may have repercussions on the stability of the country's financial system (Columns 2 and 3). In flexible regimes this channel seems absent, as the coefficient is not significant. Meanwhile, the backing ratio matters for currency crises regardless of exchange rate arrangement as the coefficient is very similar across regimes in both Columns 5 and 6.

Table 5 presents the same set of regressions interacting the variables of interest with a binary variable for small states. The results are less robust across specifications. Overall, however, they suggest that crises of either type in small states are less associated with global growth but more strongly with the backing ratio. The backing ratio coefficient for small states is twice as large as for other countries for banking crises. However, the backing ratio appears to be comparably important in predicting currency crises for both small and large states or only slightly more relevant for the former group, depending on the specification.

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<sup>8</sup> An alternative approach to assess systematic differences in the relationship between the macroeconomic variables and the crisis likelihood would be to estimate the model separately for the fixed and flexible exchange rate regimes. This approach also broadly confirmed our results presented in Tables 4 and 5, but due to the smaller sample size, the results were less robust, depending on specifications.



**Table 4. Estimated Logit Model for Banking and Currency Crises: Heterogeneity Across Exchange Rate Regimes**

	Banking Crisis			Currency Crisis		
	(1) World	(2) Backing Ratio	(3) All	(4) World	(5) Backing Ratio	(6) All
Peg t-1	-3.156 (2.400)	1.059 (0.767)	-1.544 (2.427)	0.879 (1.376)	-0.0982 (0.692)	1.741 (1.512)
No Peg t-1 * VIX t	0.0428 (0.0373)		0.0403 (0.0370)	-0.0275 (0.0216)		-0.0182 (0.0214)
Peg t-1 * VIX t	0.140** (0.0563)		0.147*** (0.0547)	-0.0634 (0.0390)		-0.0522 (0.0396)
No Peg t-1 * World Growth t	-0.342** (0.148)		-0.350** (0.147)	-0.406*** (0.117)		-0.398*** (0.122)
Peg t-1 * World Growth t	-0.255 (0.161)		-0.305* (0.173)	-0.637*** (0.189)		-0.667*** (0.205)
No Peg t-1 * CB Foreign Assets Share t-1		-0.00413 (0.00795)	-0.00342 (0.00795)		-0.0271*** (0.00612)	-0.0227*** (0.00601)
Peg t-1 * CB Foreign Assets Share t-1		-0.0261*** (0.00756)	-0.0298*** (0.00812)		-0.0270*** (0.00966)	-0.0265*** (0.00874)
Euro	1.557*** (0.459)	1.361*** (0.458)	1.436*** (0.435)			
Constant	-5.850*** (2.169)	-7.930*** (2.332)	-5.129** (2.066)	0.856 (1.414)	2.683* (1.517)	1.261 (1.514)
Observations	3,246	3,149	3,225	3,401	3,304	3,123
Pseudo R-squared	0.194	0.210	0.212	0.119	0.153	0.155

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Coefficients not reported: Credit-Deposit Ratio, Net Foreign Assets, Credit-GDP Growth, Real Interest Rate, M2-Reserves Ratio, Terms of Trade Growth, Inflation Rate, Real GDP Growth, Fed Funds Rate, 10 year-3 month Interest Spread, Public Debt, Fiscal Surplus

Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

**Table 5. Estimated Logit Model for Banking and Currency Crises: Heterogeneity for Small States**

	Banking Crisis			Currency Crisis		
	(1) World	(2) Backing Ratio	(3) All	(4) World	(5) Backing Ratio	(6) All
Small State t-1	1.297 (2.962)	0.187 (1.093)	1.674 (2.444)	-0.492 (1.928)	1.506* (0.875)	0.890 (1.981)
Not Small State t-1 * VIX t	0.0895*** (0.0326)		0.0880*** (0.0320)	-0.0362* (0.0192)		-0.0257 (0.0190)
Small State t-1 * VIX t	-0.0554 (0.0868)		-0.0482 (0.0914)	-0.0358 (0.0643)		-0.0266 (0.0676)
Not Small State t-1 * World Growth t	-0.343*** (0.119)		-0.362*** (0.118)	-0.490*** (0.111)		-0.482*** (0.116)
Small State t-1 * World Growth t	-0.0533 (0.310)		-0.0264 (0.322)	-0.370* (0.223)		-0.342 (0.234)
Not Small State t-1 * CB Foreign Assets Share t-1		-0.0107* (0.00548)	-0.0111** (0.00550)		-0.0235*** (0.00530)	-0.0200*** (0.00490)
Small State t-1 * CB Foreign Assets Share t-1		-0.0255* (0.0135)	-0.0213 (0.0149)		-0.0525*** (0.0177)	-0.0471*** (0.0177)
Euro	1.183*** (0.441)	1.206*** (0.442)	1.308*** (0.432)			
Constant	-7.442*** (2.095)	-8.014*** (2.391)	-6.761*** (2.003)	1.024 (1.328)	2.414 (1.496)	1.419 (1.383)
Observations	3,117	3,021	3,097	3,277	3,181	3,004
Pseudo R-squared	0.192	0.205	0.201	0.109	0.153	0.154

Robust standard errors in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Coefficients not reported: Credit-Deposit Ratio, Net Foreign Assets, Credit-GDP Growth, Real Interest Rate, M2-Reserves Ratio, Terms of Trade Growth Inflation Rate, Real GDP Growth, Fed Funds Rate, 10 year-3 month Interest Spread, Public Debt, Fiscal Surplus.

Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

## V. Application to the ECCU

We apply the estimated models to study more closely the case of the ECCU. We first discuss where the ECCU stood in 2019, the year before the global pandemic crisis, with respect to some of these key indicators. We then derive the implied crisis probability over the period 1995–2018 for ECCU countries and assess its main historical drivers of fluctuations.

Figure 4 shows the non-parametric density of six of the key macroeconomic indicators, divided across two samples. The solid blue lines report the distribution for all the country-year observations that do not experience a banking crisis in the following year. The dashed red lines report the distribution for country-year observations where a crisis occurs in the following year. The shaded grey area represents the range of values of the respective variables for the ECCU countries in 2019, while the vertical dash line represents the ECCU mean. For all the six indicators, the distribution for the crisis and the non-crisis samples are markedly different, not just in their means but also in their overall shapes.<sup>9</sup>

Comparing the range of values for ECCU countries to these distributions, the ECCU mostly lay in the “safe” areas of these distributions. For instance, for the credit/deposit ratio, the ECCU mean was just below the mode

<sup>9</sup> For all variables Figure 4 reports the P-value from a Smirnov test of the null hypothesis that the two distributions are the same. For all variables, the tests reject the null hypothesis at least at the 5 percent level.

of the distribution of the non-crisis sample. The distribution for the crisis sample is shifted to the right, implying that higher ratios are associated with crises. The value of the ECCU mean was thus in the lower tail of the crisis distribution, implying that such a value of the credit/deposit ratio would not be very common before a banking crisis. An even clearer case in point is the distribution of the backing ratio (bottom right panel). The ECCU countries all had backing ratios above 90 percent, while the crisis distribution is markedly shifted towards lower levels of the ratios.<sup>10</sup>

These observations also hold for Figure 5, which plots the same non-parametric distributions for currency crises.

The econometric model can further shed light on how the implied crisis probability for ECCU countries evolved over time and its main drivers. To this end, Figure 6 plots the predicted probability of banking (left panel) and currency crises (right panel) for ECCU countries using the estimated specifications in Columns 3 and 6 of Table 4. The solid black lines represent the mean probability across ECCU countries, while the shaded area encompasses the minimum and maximum probabilities in each period. In most years, the crisis probabilities are well below 1 percent and stable over time. However, there are short-lived spikes, and in particular around the years of the GFC, suggesting that global conditions induce substantial fluctuations in the likelihood of a crisis. Moreover, the widening of the grey area around 2008 implies that there is heterogeneity in how global conditions amplify the chances of crisis across individual countries.

The susceptibility of the crisis probability to global conditions is confirmed by the green dashed lines, which report the mean implied probabilities from excluding all global variables from the Logit model. For both banking and currency crises, the probability from this alternative specification has a slight downward trend but no spikes around worldwide downturns.

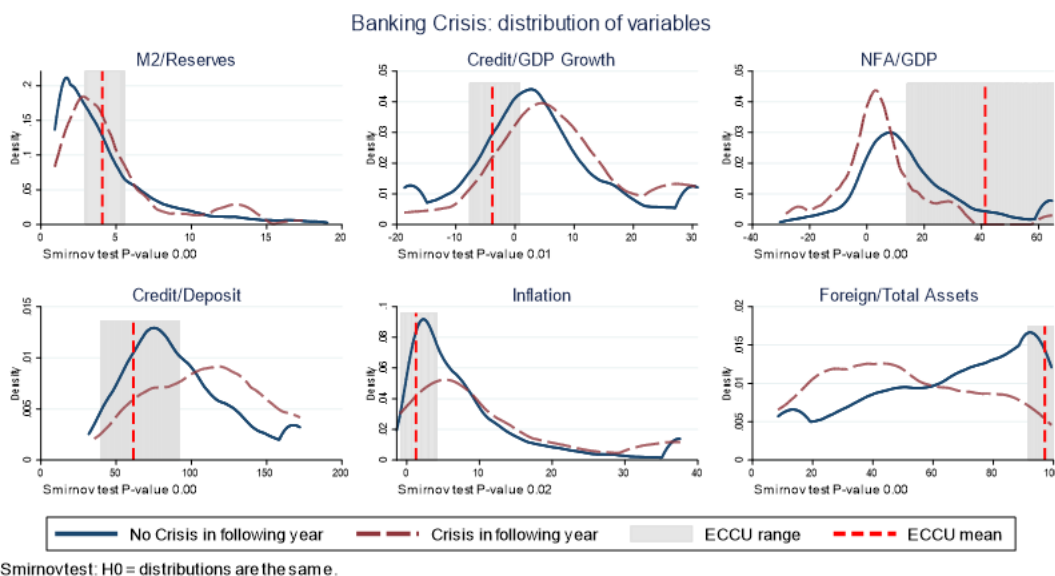
Finally, the red dotted lines present the predicted probabilities excluding the backing ratio from the model. For both types of crisis, the mean probability without the backing ratio is higher than the baseline one. Although the difference is small in “tranquil times,” when both probabilities are below 1 (i.e., 2003–2007 and 2010–2018), the difference becomes substantial during global downturns. In 2008 the dashed line was more than twice as high as the solid one for both banking and currency crises. These results suggest that the ECCU’s high backing ratio may be particularly important to maintain macroeconomic stability during slowdowns in the global economy and spells of uncertainty in the international markets.<sup>11</sup>

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<sup>10</sup> Individual countries’ backing ratios within the ECCU are based on the ECCB’s measures of imputed reserves.

<sup>11</sup> It is worth noting that, due to the institutional framework, ECCU countries have historically maintained a high backing ratio throughout the 2000s. Therefore, there were no variations in the ratio that were positively or negatively correlated with global conditions.

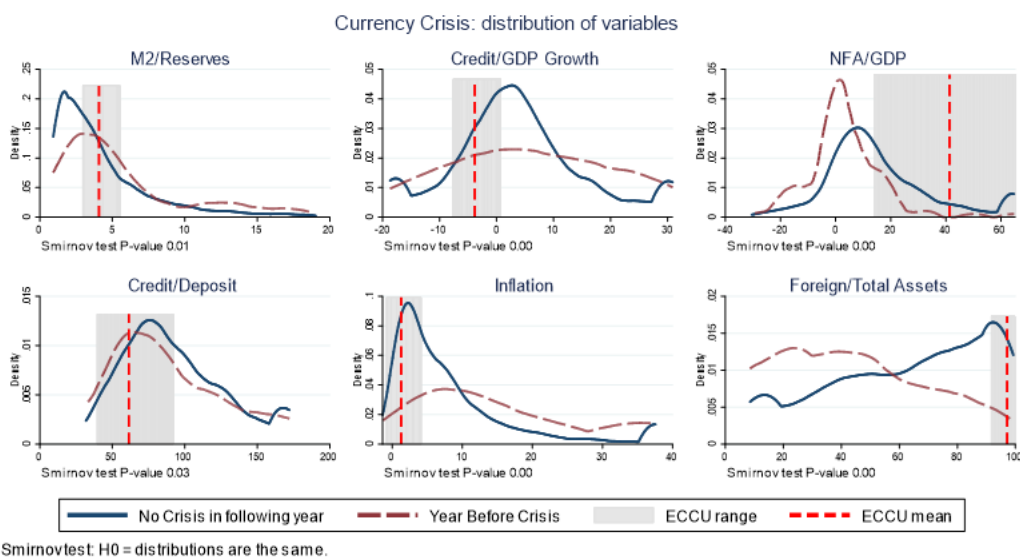
**Figure 4. Non-Parametric Distribution of Key Macroeconomic Indicators in the Year Preceding a Banking Crisis and in Regular Years**



Note. In each panel, the solid blue (dashed red) line reports the non-parametric density function of the respective variable in the sample of country-year observations that did not experience (experienced) a banking crisis in the following year. The grey area reports the range of values among ECCU countries in 2019, and the red vertical line reports the ECCU mean.

Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

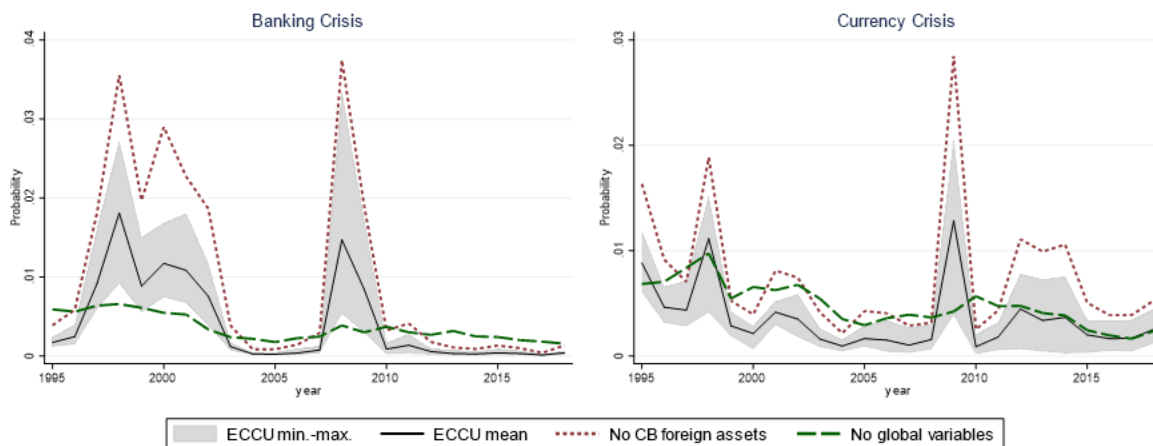
**Figure 5. Non-Parametric Distribution of Key Macroeconomic Indicators in the Year Preceding a Currency Crisis and in Regular Years**



Note. In each panel, the solid blue (dashed red) line reports the non-parametric density function of the respective variable in the sample of country-year observations that did not experience (experienced) a currency crisis in the following year. The grey area reports the range of values among ECCU countries in 2019, and the red vertical line reports the ECCU mean.

Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

**Figure 6. Predicted Probability of Banking and Currency Crises in the ECCU Over 1995-2017 for the Baseline Logit Model and Alternative Specifications**



Note. The black line reports the mean predicted probability of a banking or currency crisis among ECCU countries, computed through the baseline Logit regression. The grey area reports the minimum-maximum range of the probability across ECCU countries. The red dotted line reports the mean predicted probability from an alternative model where the variable relating to the backing ratio is excluded. The dashed green line reports the mean predicted probability from an alternative model where global variables (world real GDP growth, VIX, Fed Funds Rate, and US 10 year-3 month bond spread) are excluded.

Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

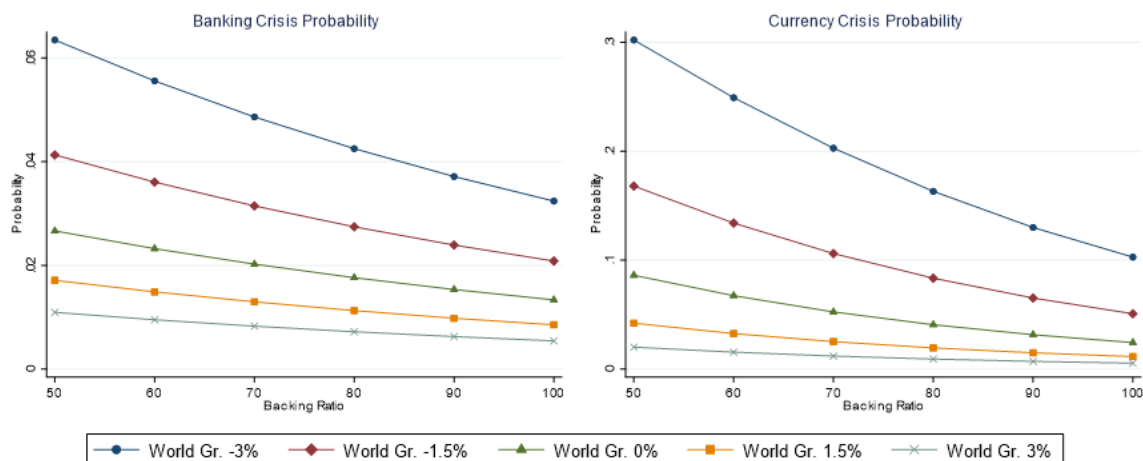
### The importance of the backing ratio

Comparing the historical crisis probability for the ECCU predicted by alternative model specifications, the previous section highlighted the key role of the backing ratio and its interaction with global conditions. The high backing ratio mitigates the impact of the “global cycle” by reducing the probability of banking and currency crises.

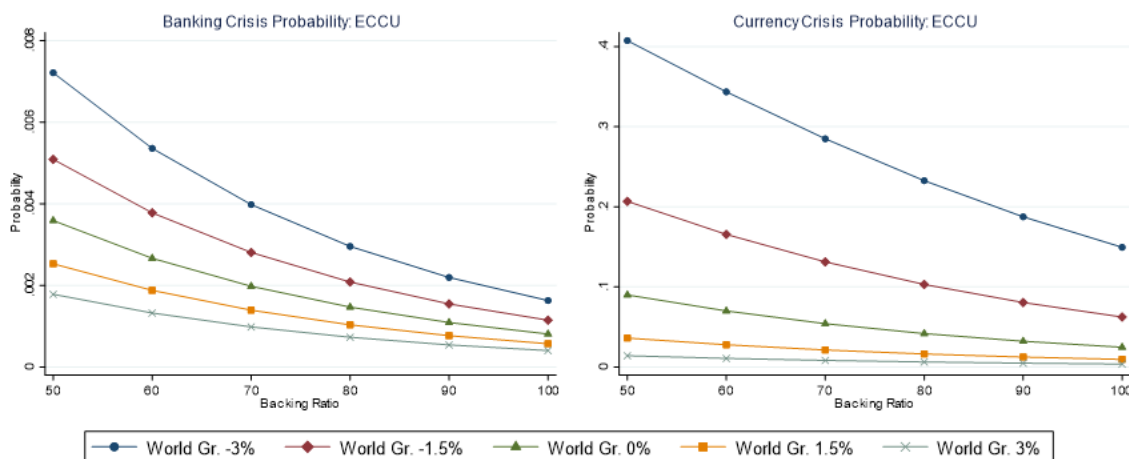
This interaction between the effect of domestic and external variables can be explained by the inherent non-linearity of the Logit function. To inspect it in greater detail, Figure 7 plots the predicted probability of banking (left panel) and currency crises (right panel) along with the backing ratio for different values of world real GDP growth.<sup>12</sup> The same qualitative observations can be derived from either panel. Consistent with the regression analysis, the downward-sloped lines indicate that a lower backing ratio is associated with a higher probability. Moreover, the negative gradient of the lines becomes steeper for lower values of world real GDP growth, which means that crisis propensity is more susceptible to global downturns for a low backing ratio than for a high one. Quantitatively this result is more pronounced for currency crises, where, for instance, a fall in world real GDP growth from 0 percent to -3 percent raises the probability by less than 10 percentage points at full backing and by more than 20 points at a 60 percent backing ratio.

<sup>12</sup> The predicted probabilities are computed using the specifications in Columns 3 and 6 of Table 4, holding all other variables at their historical sample means for all countries.

**Figure 7. Predicted Probability of Banking and Currency Crisis by Backing Ratio and World Real GDP Growth**  
Sample mean of all countries



ECCU Countries Mean in 2019



Note. Each line reports the predicted probability of a banking (currency) crisis along the backing ratio for a given value of world real GDP growth, holding other variables constant at the small country (upper panel) and ECCU (lower panel) means in 2019.

Sources: Haver Analytics, IMF WEO database, IMF International Financial Statistics, Global Financial Data, World Bank World Development Indicators, and authors' calculations.

## VI. Conclusions

In this paper, we applied a logit model to examine which macroeconomic indicators hold predictive power for the historical occurrence of banking and currency crises. There is a large empirical literature on early warning indicators, together with a theoretical debate on the causes of crises and their channels. We focused on the experience of small economies and fixed exchange rate regimes to provide context for the analysis of the ECCU.

We find that one of the key crisis predictors for small states and fixed exchange rates is the foreign reserve cover (the “backing ratio”). Lower values of this variable are more strongly associated with higher chances of crises among these countries. We also find a quantitative interaction between global developments and a country’s backing ratio that is important for our countries of interest. The negative association between a country’s backing ratio and crisis risk is larger in periods of low world real GDP growth. In other words, the degree to which a currency may be supported by foreign reserves is more relevant to economic stability during global downturns.

With the qualifications that our analysis focused on prediction rather than causality, the results provide some policy recommendations for the ECCU. The global pandemic crisis has tested the stability of the currency board regime in the ECCU. In line with historical averages, most macroeconomic indicators on fundamentals in the ECCU pointed to low probabilities of crises, prior to the pandemic. In particular, the ECCB has persistently maintained a high backing ratio by tightly containing credit provision to ECCU member governments, whereas demand for central bank credit from banks has been quite limited as banks maintain a large amount of liquidity. Our empirical analysis supports that the ECCB’s prudence in maintaining high backing ratios has contributed to maintaining currency and financial stability in the ECCU even during times of turmoil.

## Annex I. Data Description

### A. Crisis definitions from Laeven and Valencia (2020)

Banking crises must satisfy two requirements:

1. Significant financial distress in the banking system, if at least one of the following occurs: (1) non-performing loans rise above 20 percent of total loans or bank closures of at least 20 percent of banking system assets or (2) fiscal costs of restructuring the banking sector exceed 5 percent of GDP.
2. Significant policy interventions if at least three of the following measures are applied:
  - a. deposit freezes and/or bank holidays,
  - b. significant bank nationalizations,
  - c. bank restructuring fiscal costs (at least 3 percent of GDP),
  - d. extensive liquidity support (at least 5 percent of deposits and liabilities to non-residents),
  - e. significant guarantees put in place, and
  - f. significant asset purchases (at least 5 percent of GDP).

Currency crises must satisfy two criteria:

1. A year-on-year depreciation against of the US dollar of 30 percent or more.
2. A year-on-year depreciation against of the US dollar that is at least 10 percentage points higher than the rate of depreciation in the previous year.

### B. Details of variables used for the analysis

The macroeconomic indicators are derived based on data from several sources, including Have Analytics, the IMF's World Economic Outlook (WEO) Database and International and Financial Statistics (IFS) Database, the World Bank's Global Financial Development (GFD) Database and World Development Indicators (WDI) Database.

- **Bank Assets.** Monetary and Financial Accounts, Central Bank, Assets IMF, Monetary and Financial Statistics Database.
- **Bank Equity.** Depository Corporations Survey, Shares and Other Equity. IMF, Monetary and Financial Statistics Database. Where unavailable, Capital Accounts are used. IMF, Monetary and Financial Statistics Database, from the old presentation of money and banking statistics, monetary survey.
- **Central Bank (CB) Foreign Assets.** Central bank claims on nonresidents. IMF, Monetary and Financial Statistics Database. Foreign assets of monetary authorities were used prior to 2001 from IMF, Monetary and Financial Statistics Database, from the old presentation of money and banking statistics.
- **Credit.** Private credit by deposit money banks. World Bank, World Development Indicators and Global Financial Development Indicators.
- **Credit/Deposits.** Private credit by deposit money banks divided by bank deposits. World Bank, World Development Indicators and Global Financial Development Indicators.



- **Federal Funds Rate.** Average overnight federal funds interest rate at which depository corporations trade balances held at the Federal Reserve with each other overnight. Federal Reserve Board, H.15 Selected Interest Rates.
- **GDP per Capita.** In logarithm. Gross domestic product, PPP 2011 US dollars per capita. IMF, World Economic Outlook Database.
- **Inflation.** Change in GDP deflator. IMF, World Economic Outlook Database.
- **M2.** National definitions of broad money, M2. IMF, Monetary and Financial Statistics Database.
- **Net Foreign Assets (NFA).** Monetary and Financial Accounts, Depository Corporations, Net Foreign Assets, Claims on Non-residents. Net foreign assets held by monetary authorities and deposit money were used when unavailable, from World Bank, World Development Indicators.
- **Nominal GDP.** Gross domestic product at current prices. IMF, World Economic Outlook Database.
- **Overall Balance.** General government net lending/borrowing. IMF, World Economic Outlook Database.
- **Public Debt.** General Government Gross Debt. IMF, World Economic Outlook Database.
- **Real GDP.** Growth. Gross domestic product at constant prices. IMF, World Economic Outlook Database.
- **Real Interest Rate.** Lending rate minus inflation monetary and financial accounts, interest Rates, other depository corporations' rates, lending rate. IMF, Monetary and Financial Statistics Database.
- **Foreign Reserves.** Stock of official international reserve assets. IMF, International Financial Statistics Database.
- **Spread 10y – 3m US t.** Average difference between the daily 10-year US Treasury bill yield to maturity and 3-month US Treasury bill. Haver Analytics.
- **Terms of Trade.** Growth. The ratio between a country's export prices as a share of export volumes (average export price index) and its import prices as a share of import volumes (average import price index). IMF, World Economic Outlook Database.
- **Total CB Assets.** Central Bank, total assets. IMF, Monetary and Financial Statistics Database. Foreign assets plus domestic assets of monetary authorities are used prior to 2001. IMF, Monetary and Financial Statistics Database, from the old presentation of money and banking statistics.
- **VIX.** Annual average of daily the Cboe Volatility Index, or VIX, which is a measure investor sentiment, based on the US stock market's expectation of 30-day forward-looking volatility derived from mid-quote prices of S&P 500 Index (SPX) call and put options. Cboe Global Markets, Inc. Prior to 1990, the Cboe VXO index was used, which uses the old methodology based on the S&P 100 index.

## Annex II. Banking and Currency Crises in Currency Boards

Banking Crises			
Country	Crisis period	Nature/Cause of Crisis	End of Crisis/Reforms
Argentina	1995	Following the 1994 Mexican peso crisis, small investment banks highly exposed to government bonds – which saw prices declining dramatically due to the rise in interest rates – were found to have hidden heavy losses in offshore companies. An erosion of confidence in Argentinian bonds led most banks to cut credit to bond traders, which in turn affected banks with large bond and open trading positions. Argentina experienced a short but profound banking crisis and massive capital outflows. Furthermore, provincial banks faced difficulties in raising capital while investors started moving funds towards larger banks, and by March 1995 capital flight intensified.	After severe deposit losses, several measures were implemented to alleviate liquidity pressures, numerous banks collapsed or consolidated, and transparency measures were improved.
Baltics (Estonia, Latvia, Lithuania)	1990s	The move to a more restrictive monetary policy, coupled with systemic problems faced by ex-Soviet Union nations, exposed weaknesses in private banks, leading to a banking crisis, triggered by a sharp fall in liquidity.	Impacts on the economy were less severe than traditional banking crises, due to the transitory nature of the sector which benefited from gradually improving legislation, regulation, and supervision that strengthened and consolidated local banks. The Baltics eventually saw the benefits of reduced inflation, steady growth, and their currency pegs which delivered front-loaded credibility to monetary authorities, accompanied by structural reforms and disciplined fiscal policies.
Bulgaria	1996-1997	Following the buildup in bad loans between 1991-1995, the erosion of confidence began after the collapse of pyramid schemes in some cities. Underdeveloped legislation to take action against insolvent banks, weak banking supervision, and non-compliance with prudential regulations were major problems. In late 1995, withdrawals of deposits, especially from First Private Bank (the largest private bank), resulted in substantial central bank refinancing and the loss of foreign reserves. Solvency and liquidity problems ensued. By early 1996, the banking system had a negative net worth with significant nonperforming loans. Eventually, the banking system experienced a run in early 1996.	The government stopped providing bailouts, prompting the closure of 19 banks accounting for one-third of sector assets. Surviving banks were recapitalized by 1997.
Djibouti	1991-1995	Liquidity problems forced the closures of two commercial banks, with the others facing serious prudential deficiencies.	A deposit insurance scheme was set up, and a policy scheme to ensure guarantees from parent banks were established (many distressed banks were subsidiaries of larger foreign banks). Corrective fiscal and monetary policy actions helped stabilize the exchange market and ease inflation pressures.

Source: IMF Article IV, IMF Selected Issues, Laeven and Valencia (2020).

### Currency Crises

Country	Crisis period	Nature/Cause of Crisis	End of Crisis/Reforms
Argentina	2002	Under the Convertibility law that linked the peso to the US dollar at parity, inflation was curtailed over time. But this exposed a major flaw as the peso could not depreciate when necessary, in order to align monetary policy with the US. The current account widened as exports became less competitive after the currency crisis in Asia, followed by the removal of its currency peg in Brazil, and the appreciation of the US dollar. Since 1998, economic growth had been negative in every year as the current deficit increased. Eventually access to markets were diminished due to a sharp and sustained rise in spreads on Argentine bonds over US Treasuries. Exceptional financing support was provided by the IMF but weak implementation of reforms, political instability, and the turbulent global economy intensified capital flight. Argentina defaulted on its international obligations.	The convertibility regime was formally ended in January 2002, and a sharp peso devaluation and banking crisis followed.
Bulgaria	1996-1997	Due to the banking crisis, official reserves fell sharply to service large external debt repayments. The exchange rate rapidly depreciated, in part because the public preferred to keep foreign currency savings outside banks and withdrew local currency deposits, despite temporary relief provided by IMF assistance. Inflation escalated and the system-wide liquidity problems resulted in a confidence crisis by summer 1996 as reserves fell below the critical threshold, with expected debt repayments soon due.	Only until the exchange rate stabilized in 1997 did bank runs abate, when interest rates were raised and bank regulation improved. In early 1997, a currency board arrangement was set up. The lev was pegged to the deutschemark with the prospect of EU admittance.

Source: IMF Article IV, IMF Selected Issues.

## Annex III. Banking and Currency Crises in Small States

Banking crises			
Country	Crisis period	Nature/Cause of Crisis	End of Crisis/Reforms
Dominican Republic	2003-2004	Triggered by the collapse of one large bank (Baninter) in 2003, the banking crisis spread to two others (Bancredito and Banco Mercantil), with a rapid withdrawal of deposits. These banks were found to be undercapitalized as their rue level of assets and risks were hidden through the use of offshore banks and accounting manipulation.	The Central Bank stepped in to provide liquidity support, imposed additional capital requirements and new regulations, strengthened the regulatory framework, and improved transparency.
Guyana	1993	Commercial lending became risky, while government owned banks were burdened with non-performing loans as directed credit programs had resulted in investments with low rates of return. By 1993, nonperforming loans rose to a unsustainably high level, and bank profitability declined due to increased provisions for bad loans and narrow opportunities to invest.	To quell the crisis, state-owned banks were privatized and merged, and fundamental changes were made to regulatory and legal frameworks through the Financial Institutions Act. Reserve and liquid asset requirements also helped to improve the effectiveness of monetary policy.
Guinea Bissau	2014	In the wake of the 2012 coup and falling cashew prices in 2012-13, nonperforming loans ballooned in the banking system, and bank credit contracted heavily.	The two banks were required to fully provision nonperforming loans (leading to negative earnings and large drops in equity capital) and inject sufficient funds to meet capital requirements.
Haiti	1994-1998	The banking system's net domestic assets increased significantly in 1993-94 due to increased lending to the public sector. The Central Bank also registered considerable losses as the majority of its assets, represented by credit to the government, were nonperforming. Loosening fiscal and credit policy and political uncertainty contributed to soaring inflation, adding further pressure to bank deposits.	Upon the return of constitutional rule by the end of 1994, steps were taken to strengthen the banking system by modernizing the Central Bank, regaining control over monetary policy through the use of more indirect instruments, increasing competition, and improving regulation and supervision.
Jamaica	1996-1998	The rapid expansion and emergence of large financial conglomerates resulted in a surge of credit to the private sector. Many commercial banks were not adequately capitalized, which resulted in impending insolvency, followed by a credit crunch and then the fall in profitability of the sector and increase in nonperforming loans. The crisis reached its peak when real estate and equity markets triggered illiquidity in the life insurance industry, which soon spread to affiliated banks whose depositors quickly moved funds into foreign banks.	In 1996, FINSAC, a government resolution agency, was established to resuscitate, reorganize, and consolidate the financial industry. Government recapitalized numerous troubled institutions.
Source: IMF Article IV, IMF Selected Issues, Laeven and Valencia (2020).			

<b>Currency crises</b>			
Country	Crisis period	Nature/Cause of Crisis	End of Crisis/Reforms
Dominican Republic	2003	The 2003 banking crisis led to a substantial depreciation of the peso, a sharp increase in inflation, a rise in debt, and a deceleration in GDP growth.	The exchange market was unified, and authorities were committed to a fully flexible exchange rate policy. Monetary policy was tightened, and fiscal consolidation measures were implemented, causing inflation to fall and the exchange rate to stabilize.
Guyana	1987-1998	Under heavy state control, the economic growth started slowing in 1982 as a result of sharp contractions in the bauxite sector and the erosion of its export sector. External debt and arrears grew to unsustainable levels as foreign reserves dwindled due to large current account deficits, and domestic inflation shot up.	The informal, parallel exchange market became so large that by 1987, as an element of a multi-year economic restructuring program, the exchange rate was discretionally devalued by 56 percent to return external transactions to the formal markets.
Haiti	2003	Between 2000 and 2003, economic growth was near zero, reflecting a difficult political situation, low private sector confidence and investment, sizeable fiscal expenditure overruns and revenue shortfalls, and shrinking external assistance. Due to a sharp rise in inflation, accompanied by falling international reserves, the gourde depreciated by over 60 percent.	A transition government restored macroeconomic stability by March 2004 and eliminated the liquidity surplus by halting central bank lending to the government. Inflation eventually declined, the exchange stabilized, and the rate of dollarization slowed.
Jamaica	1983	In the early 1980s, falling commodity prices weakened terms of trade, world tourism slumped, and high global interest rates put pressure on debt services. Signs of exchange rate misalignment appeared as the balance of payments deficit lasted for many years. Credit to government reached to 400 percent of the monetary base. In 1982, the government removed sanctions on parallel foreign currency transactions, but pressure in the exchange system continued.	In November 1983, the official rate was allowed to devalue by 43 percent. The authorities introduced an exchange rate auction to replace the peg.
Jamaica	1991	After a series of devaluations, the auction was suspended. Further devaluations and failure to contain inflation diminished the government's credibility.	The exchange rate determination by the Central Bank was abandoned. The exchange rate subsequently fell by 300 percent in 1991.
Papua New Guinea	1995	An increase in credit to the government led to a depletion of reserves which undermined the stability of the kina. A shift to a market determined exchange rate in late 1994 caused a sharp devaluation that continued into 1995 and inflation rose quickly.	A screen-based foreign exchange trading system was introduced later that year and tighter monetary policy quelled inflation pressure.
Seychelles	2008	Seychelles had a balance of payments and public debt crisis after a period of expansionary fiscal and monetary policies, compounded by the global financial crisis. However, reforms to liberalize the economy were insufficient to address longstanding imbalances, which were exacerbated by fuel and food price shocks. This resulted in foreign exchange shortages, a rapid rise in inflation, current account deficits, and a nominal depreciation of 37.5 percent.	In November 2008, a liberalization of the exchange regime towards a float resulted in the elimination of restrictions on international transactions, after which the rupee stabilized and appreciated significantly.
Suriname	1990-1995	Central bank financing of the fiscal deficit increased, but inflation only rose gradually, as prices were controlled for 80 percent of all goods and services. After the military government was replaced in free elections, the price controls were abandoned, and inflation soared to near hyperinflation. Fearing an outright devaluation as the parallel market rate diverged from the official one, the authorities implemented a multiple exchange system in 1992	The authorities unified official and parallel foreign exchange markets in 1994. This slowed the depreciation in the parallel exchange rate. The Central Bank stepped up to absorb liquidity, which eventually helped stop exchange rate depreciation.

### Currency crises

Country	Crisis period	Nature/Cause of Crisis	End of Crisis/Reforms
Suriname	2000-2003	Economic activity weakened in 1999. By 2000, the fiscal position deteriorated due to an increase in election related expenses. Widened external and fiscal imbalances led to the removal of exchange rate bands and large currency devaluation (about 90 percent). Weakened macroeconomic policies following the stabilization effort resulted in further depreciations and higher inflation.	Government borrowing from the Central Bank was terminated, petroleum subsidies were eliminated, and electricity and water tariffs were increased. Eventually tighter fiscal and monetary policies helped stabilize exchange rate and inflation pressures in 2003.
Suriname	2016	In 2015-16, the fall in gold and oil prices, and closure of the bauxite plant resulted in large GDP contraction, fiscal and current account deficits, and an uptick in unemployment. In an ambitious adjustment plan to cut deficits, build foreign reserves and curb monetary financing, authorities changed the de jure monetary regime to reserve money targeting in March 2016. But progress on numerous key policy items stalled, and with limited action to raise interest rates, bouts of exchange rate depreciation occurred. This resulted in a sharp rise in inflation and capital flight occurred.	Eventually, commodity prices rebounded, and large segments of the economy became dollarized.
Trinidad and Tobago	1985-1986	The fall in oil production and prices starting in 1982 led to sustained GDP contraction. Initially, the government tried to reduce imports via exchange controls and licensing but was offset by fiscal expansion. Disequilibrium in the currency market was evident through the wide current account deficit, significant drawdowns in international reserves, the sharp rise in lending to the government, and capital flight. This all led to the emergence of a parallel foreign exchange market. The exchange rate was devalued by 50 percent in December 1995.	The authorities launched a stabilization and structural adjustment program in 1988 and moved to a flexible exchange rate regime.

Source: IMF Article IV, IMF Selected Issues.

## Appendix I. Small States Selected Indicators

	2018 GDP per capita 1/ (US\$)	Population (thousands)	FX Regime (as of 2018)	Banking Crisis (starting year)	Currency Crisis (starting year)
<b>Caribbean</b>					
Antigua and Barbuda	16,861	95	Currency Board		
Bahamas, The	34,584	377	Pegged		
Barbados	17,758	286	Pegged		
Belize	4,813	398	Pegged		
Dominica	7,081	75	Currency Board		
Grenada	10,486	111	Currency Board		
Guyana	6,121	782	Pegged	1993	1987
Jamaica	5,730	2,731	Free float and flexible	1996	1978, 1983, 1991
St. Lucia	11,557	179	Currency Board		
St. Kitts and Nevis	19,270	56	Currency Board		
St. Vincent and the Grenadines	7,354	110	Currency Board		
Suriname	5,871	590	Pegged		1990, 1995, 2001, 2016
Trinidad and Tobago	17,038	1,390	Pegged		1986
<b>Middle East</b>					
Bahrain	25,051	1,503	Pegged		
Djibouti	2,872	1,049	Currency Board	1991	
Qatar	66,422	2,760	Pegged		
<b>Europe</b>					
Cyprus	29,300	864	Free float and flexible	2011	
Estonia	23,181	1,322	Free float and flexible	1992	1992
Iceland	75,260	348	Free float and flexible	2008	1975, 1981, 1989, 2008
Malta	31,282	476	Free float and flexible		
Montenegro	8,855	6	No separate legal tender		
<b>Asia Pacific</b>					
Bhutan	3,281	735	Pegged		
Brunei	30,668	442	Currency Board		
Maldives	14,477	366	Pegged		1975
Samoa	4,198	199	Pegged		
Solomon Islands	2,497	627	Pegged		
Timor-Leste	1,230	1,2	No separate legal tender		
Tonga	4,836	100	Pegged		
Vanuatu	3,256	285	Pegged		
<b>Sub-Saharan Africa</b>					
Botswana	8,290	2,251	Pegged		1984
Cabo Verde	3,616	544	Pegged	1993	
Comoros	1,386	851	Pegged		1994
Equatorial Guinea	10,106	1,314	Pegged	1983	1980, 1994
Gabon	8,221	2,053	Pegged		1994
Gambia, The	729	2,280	Pegged		1985, 2003
Guinea-Bissau	866	1,738	Pegged	1995, 2014	1980, 1994
Lesotho	1,141	2,034	Pegged		1985, 2015
Mauritius	11,206	1,266	Free float and flexible		
Namibia	5,664	2,414	Pegged		1984, 2015
São Tomé and Príncipe	1,989	209	Pegged	1992	1987, 1992, 1997
Seychelles	16,143	95	Free float and flexible		2008

Sources: IMF WEO; Luc Laeven and Fabian Valencia (2018).

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