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► **To cite this version:**

Dorian Noel, Prosper Bangwayo-Skeete, Justin Robinson, Michael Brei. Sovereign risk spill-overs in the banking sectors of Central America and the Caribbean. *Journal of International Financial Markets, Institutions and Money*, 2021, 73, pp.101379. 10.1016/j.intfin.2021.101379 . hal-03592667

**HAL Id: hal-03592667**

**<https://hal.science/hal-03592667>**

Submitted on 2 Aug 2023

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## Sovereign risk spill-overs in the banking sectors of Central America and the Caribbean

Dorian M. Noel<sup>\*</sup>, Prosper F. Bangwayo-Skeete<sup>\*</sup>, Michael Brei<sup>♦</sup>, and Justin Robinson<sup>▲</sup>

### **Abstract**

This paper examines the relationship between sovereign credit ratings and bank stability in Central America and the Caribbean (CAC). We use data on 177 banks from 24 countries for the period 1999–2014 and find that sovereign rating downgrades precede deterioration in bank stability. The finding highlights the importance of understanding the transmission channels and the amplification of sovereign risk spill-overs. With respect to the former, we found evidence to support both the “balance sheet exposure” and “asset valuation adjustments” arguments found in the literature. Concerning the latter, the sovereign risk spill-overs are more intense in countries with low foreign currency reserves, limited financial transparency and weak central bank independence. Our findings support the argument that banks are vulnerable to the aggravation of sovereign risk concerns and thus, the zero risk weight to sovereigns should be reviewed.

JEL classification: G21; G01; E44.

Keywords: Caribbean; Central America; Bank Stability; Sovereign Risk Spill-over.

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The authors wish to thank two anonymous referees, Anthony Birchwood, Winston Moore, Anthony Wood and the participants at the 50th Annual Monetary Studies Conference in Barbados for their valuable comments. All remaining errors are our own.

## 1. Introduction

Banking regulations (such as, risk-based capital framework and reserve requirements) have had the unintended consequence of incentivizing banks to hold more sovereign debt on their balance sheets than suggested by their strategic motives. Bank stability, therefore, should depend on the creditworthiness of governments. Despite this apparent link, the impact of sovereign credit ratings on bank stability is still an open debate in the literature.

In this paper, we study the relationship between sovereign rating risk and bank stability, measured by banks' asset quality. Bernanke and Gertler (1989) and Bernanke, Gertler, Gilchrist (1999) provide theoretical arguments for studying asset quality in the banking system and its link to macroeconomic stability. The authors argue that the pro-cyclicality of credit markets and existence of information asymmetries in lending markets work to amplify and propagate credit market shocks to the real economy. From a practical viewpoint, the argument is even more compelling if one was to consider that banking regulations, such as risk-based capital framework and reserves requirements, have had the unintended effect of transforming banks into amplifiers of sovereign shocks rather than heat sinks that is, mechanisms to absorb and dissipate shocks.

The recent global financial crisis and the subsequent sovereign debt problems in Europe provide ample evidence of the importance of this line of research. The key message of both crises is that financial stability analysis and sovereign risk assessment need to incorporate macro-financial linkages that is, spill-overs, spillbacks and other contagion channels. In other words, sovereign defaults can cause financial sector fragility just as financial sector fragility can induce sovereign defaults. As a consequence, in recent years, academics and supervisory authorities have shown great interest in macro-financial spill-over models (Das et al., 2012; De Bruyckere et al., 2013; Hesse et al., 2014).

De Bruyckere et al. (2013) study the bank-sovereign nexus in Europe. The authors find that risks spill-over from sovereigns (banks) to banks (sovereigns) and the spill-over intensity is stronger with home bias that is, banks' exposures are predominantly domestic debts. Hesse et al. (2014) provide stress test results for sovereign spill-overs on bank stability and find that the impact is non-linear on banks, in terms of both liquidity and solvency. Their result suggests that the appropriate design of stress scenarios should incorporate macro-financial linkages. Das et al. (2012) advance similar argument, noting that the complexity and entwining of sovereigns and private sector balance sheets requires a more holistic approach to risk analysis and stress testing that ought to recognize linkages and feedback loops inherent in

sovereign risk. Hence, Correa and Sapriza (2014) suggest that breaking the “feedback loop” between the two sectors should be an important policy priority.

Panetta et al. (2011) and Corsetti et al. (2012) study the contagion channels through which sovereign credit risk affects, *inter alia*, the broader economy. They identify three contagion channels from sovereign risk to bank risk: (i) information cascade; (ii) balance sheet exposure; and (iii) asset valuation adjustments. First, in the “information cascade” model, sovereign downgrades cause households and firms to lower their beliefs about future economic conditions and income levels. As a consequence, they make the necessary adjustments by cutting expenditure, which may include under-servicing their loans. Also, investors are likely to demand higher risk premia due to the perceived increased riskiness of banks. Banks’ borrowing costs are likely to increase as a result, unless higher risk premia demands are offset by a more accommodating monetary policy. Second, “balance sheet exposure”, banks’ holding of sovereign debts tend to increase their risk profile when sovereigns are downgraded. This is likely to increase their costs of funds and compresses their interest margins. Banks, in turn, respond by increasing loan rates, which adversely impacts borrowers’ ability to service their loans. Finally, “asset valuation adjustments”, sovereign holdings constitute a significant proportion of banks’ assets in the region studied. Sovereign downgrades, therefore, are likely to have significant negative impact on the profitability of banks due to credit value adjustments. In order to maintain profitability and compensate for asset losses, banks are likely to increase their lending rates. The increase in lending rates adversely affects borrowers’ ability to service their loan obligations and hence, increases the non-performing loans (NPLs) of banks.

Altavilla et al. (2017) examine the impact of sovereign stress on bank behaviour and find that public, bailed-out and poorly capitalized banks were more likely to purchase domestic government debt in response to sovereign stress, in support of the “moral suasion” and “carry trade” hypotheses (see also, Uhlig, 2013; Battistini et al., 2014). They also observe that banks decrease lending when there is increased sovereign stress. Similar results are reported in Gennaioli et al. (2018) who argue that the slowdown in bank lending is due to bank losses on public bonds. Other interesting studies on macro-financial spill-overs are provided by Beaton and Desroches (2011), Kirschenmann et al. (2017), Cai et al. (2018) and Cotter and Suurlaht (2018).

The existing literature on the sovereign-bank nexus focuses primarily on developed banking markets, in particular Europe. Such a narrow focus does not provide adequate coverage of an issue that is of importance to macro-prudential analysis. Our work extends the literature to the Central American

and Caribbean region, which provides a unique setting to study this phenomenon for several reasons. First, banks have high exposure to sovereigns due to the underdeveloped microstructure of the financial system and high banking reserve requirements. Second, these markets are highly vulnerable to shocks stemming from high global trade exposures and natural disasters. And finally, bank credit is the dominant form of financing for the real, government and household sectors.

Few studies examine banking markets we studied in this paper. Tracey and Leon (2011) and Jordan and Tucker (2013) focus on the impact of non-performing loans on loan growth (Trinidad and Tobago and Jamaica) and economic growth (Bahamas), respectively. Related studies to ours are provided by Beaton et al. (2016) and Wood and Skinner (2018). These authors find that the asset quality of banks in the Caribbean is affected by both systematic (macroeconomic) and idiosyncratic (bank-specific) factors. Beaton et al. (2016) investigate macro-financial linkages in the Eastern Caribbean Currency Union and provide evidence of a feedback loop between bank asset quality and the real sector. These studies, however, did not examine whether sovereign rating risks spill-over to banks.

We extend these works making various contributions. First, our paper, to best of our knowledge, is the first to examine sovereign rating risk spill-over to bank stability in the CAC region. Second, the study captures other spill-over channels to bank stability namely, macro-channels (global trade linkages and vulnerability) and behavioral (bank behavior). Third, our empirical model controls for the differences in microstructure of the banking markets studied. And fourth, we empirically examine the possible transmission channels through which sovereign risks may affect individual banks.

We use data on the financial statements of 177 deposit-taking entities from 24 countries in CAC for the period from 1999-2014. We estimate our empirical model using the System General Method of Moment (S-GMM) estimator. Consistent with the literature on the sovereign-bank nexus in Europe, an overriding conclusion of our study is that sovereign rating downgrade adversely impacts bank stability. A novel finding is that the sovereign risk spill-over is particularly intense in countries with low international reserves, reporting transparency and central bank independence. We argue that high reserves provide reassurance to the market that the country is still likely, despite the downgrade, to meet its debt obligations. In turn, banks and markets are less affected and continue to function under normal business conditions. Further, banks and markets are less affected when reporting is made transparently and central banks and governments are not connected. In such environments, banks are less likely to face pressure (moral suasion) from governments to finance their debt and domestic ratings are less

dependent on the sovereign rating ceiling. Finally, we do not find that the spill-over intensities differ across banking markets (Caribbean versus Central America), economic conditions (good as opposed to bad), fiscal space (high versus low), and countries' credit rating level (investment grade compared versus non-investment grade).

Our results also reveal that systematic (macroeconomic), idiosyncratic (bank specific) and microstructure factors influence bank stability. GDP growth tends to improve bank stability, while a country's openness provides a channel for global trade shocks to negatively impact bank stability. Banks in small markets in the Caribbean tend to have more vulnerable banks with higher NPLs. Arguably, the small size of these markets allows shocks to bank stability to be persistent. Concerning bank-specific factors, we find that banks with market power tend to have healthier loan books than their peers. We postulate that market power gives banks informational advantage in lending markets. As a result, they can build better quality loan books by cream-skimming the best creditors in the market. We also find that banks with higher operating costs, managerial talent (proxied by the return on assets), and more traditional banking models (less transaction-based fee income) operate with lower non-performing loans.

Arguably, one of the most important policy implication of our findings is that bank stability in the CAC region can be enhanced by merely improving market transparency and protecting the operational independence of banking regulators. Our results are robust to different definitions of bank stability, measures of sovereign spill-over risk and specifications of the empirical model. Finally, we isolate the transmission channel from sovereign risk to bank stability to "balance sheet exposure" and "asset valuation adjustments". A number of robustness checks are carried-out to substantiate our findings.

The remainder of the paper is organized as follows. Section 2 presents the macroeconomic environment of the banking markets in the CAC region. Section 3 discusses the specification of empirical model and describes the bank data used in the study. Section 4 provides the empirical results and Section 5 examines the possible spill-over transmission channels. Section 6 concludes.

## 2. Sovereign and banking risks in the region

The sovereign credit ratings of countries in the CAC region have been, on average, more volatile than not only those of developed countries but also other emerging market countries. This, no doubt, is due to a combination of several factors. Primarily, the CAC region has a relatively high degree of openness, weak fiscal accounts and poor institutional structures (see Table 1).

In other words, the region has a relatively high-risk exposure to the global trade network with weak support mechanisms to mitigate economic shocks from affecting the creditworthiness of sovereign governments.

Figure 1 (left-hand panel) shows the historical evolution of the sovereign credit rating for the Caribbean and Central America over the period from 1999 to 2014. Prior to the global financial crisis (GFC), the sovereign ratings of the two country groupings were, on average, speculative grade. Since the GFC, however, the sovereign ratings of the two groupings have moved in opposite direction. While sovereign ratings in Central America have generally improved, those in the Caribbean, on average, have worsened. The economic fall-out of the GFC was felt greater in the Caribbean as the decline in external demand for primary products and tourism significantly impacted the fiscal accounts of governments. In fact, five Caribbean governments (Antigua and Barbuda, Belize, Grenada, Jamaica, and Saint Kitts and Nevis) defaulted on their debt obligations in the post-GFC period (IMF, 2012; CTT, 2014; Moody's, 2017). In comparison, none of the Central American governments we studied defaulted on their debts during the sample period.<sup>1</sup> It is important to note that countries in our sample that managed to maintain rating stability post-GFC were able to do so by primarily drawing-down on currency reserves or refinancing debts.

The behaviour of banks' non-performing loans in the Caribbean and Central America shares similar patterns prior to the GFC (see Figure 1, right-hand panel). As one can see, loan defaults continuously declined from high levels in the early 2000s. However, post-crisis the average default rates on bank credit began to diverge and move in opposite direction. While NPLs in the banking sector of the Caribbean increased from a low of roughly 4% to 7% of total lending at end-2014, in Central America they moved from a pre-crisis low of roughly 3.75% to 2% in 2014.

For the period under study, we observe that banks and governments in Central America were more stable relative to those in the Caribbean. From a causal inspection of Figure 1, it appears that banks' non-performing loans and sovereign ratings move in opposite directions but this could be due to other common factors. In the following section, we investigate the relationship in more detail on the bank-level and control for other factors of bank stability.

<sup>1</sup> Due to data limitations, Nicaragua's debt default in 2008 is not covered in this study.

### 3. Empirical methodology

#### 3.1. Data description and analysis

We extract annual bank-level data for the Central American and Caribbean region from BankScope for the period from 1998 to 2014. We assume that banks manage their entire set of banking activities on a consolidated basis. Therefore, we work with the consolidated financial statements of banks. Where it is not possible to obtain consolidated statements for a bank, which is likely the case for subsidiaries of foreign-owned banks, we use the bank's unconsolidated financial statement.

Our study focuses on the stability of deposit-taking entities so we exclude non-bank entities from the sample.<sup>2</sup> We also exclude banks and countries from the study for which we were unable to obtain relevant information to compute our measure of bank stability or other variables to parameterize the empirical model. After applying our filters, the final sample covers 177 deposit-taking entities operating in 24 Central American and Caribbean jurisdictions.<sup>3</sup> Of that total, 100 are domestically owned and the rest (77) are subsidiaries of foreign-owned banks.

Table 2 reports summary information for the countries in our sample. At the end of 2014, total assets of the 177 banks in our study amounted to roughly US\$14.4 billion which amounts to approximately 130 percent of the combined GDP of the countries. As one can see, the banking systems can be very different in terms of lending activity and riskiness. For instance, in Guyana and St. Lucia the lending business appears very risky with non-performing loans averaging over 15 percent of total loans. We also see important variation in sovereign risks across countries. While the governments of Barbados and Belize have seen their ratings plummet over the considered sample period (by -6 and -4 notches, respectively), Guyana and Trinidad's ratings have improved by most (by 5 and 4 notches, respectively).

<sup>2</sup> We cross-reference the list of financial institutions obtained from BankScope with the registry of licensed banking entities reported by the various central banks to distinguish deposit-taking entities from the other types of financial firms (that are classified by BankScope as commercial banks).

<sup>3</sup> Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Costa Rica, Cuba, Dominican Republic, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Panama, Saint Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago.



### 3.2. Empirical model

We study the impact of sovereign rating changes on bank stability. To accomplish this task, we first estimate a baseline model that controls for, inter alia, confounding factors and endogeneity bias. We then explore the possibility that the conditioning economic environment may be a moderating/amplifying factor in the sovereign-bank nexus. Therefore, we extend the baseline model to examine the interaction between sovereign rating change and the conditioning economic environment. We now discuss these models in turn.

We estimate the following baseline model:

$$NPL_{ijt} = \alpha_0 + \alpha_1 NPL_{ijt-1} + \beta \cdot Rating_{jt} + \Phi C_{jt} + \Psi X_{ijt-1} + \vartheta_i + \varepsilon_{ijt} \quad [1]$$

where *NPL* refers to banks' non-performing loans as a percentage of total loans (using the logistic transformation)<sup>4</sup>, *Rating* is the credit rating of the government, *C* and *X* are vectors of systematic and idiosyncratic variables, respectively,  $\vartheta$  controls for time-invariant heterogeneity (bank fixed effects) in our data set and  $\varepsilon$  captures the error term. We index individual banks with *i*, countries where banks are located with *j*, and time with *t*. The variables used in our model are discussed below and their definitions are provided in Table 3.

The sovereign credit rating ("Rating") is the rating on the central government's long-term foreign currency debt. We transformed the rating scale of two major agencies (Moody's, Standard and Poor's) into a numerical equivalent, where a higher number indicates a better rating. It ranges from 1 for a rating of C to 21 for a triple-A rating.<sup>5</sup> We introduce the sovereign credit rating variable into our model as a cumulative change to capture the dynamic effects of changes in sovereign ratings on bank stability. Our main coefficient

<sup>4</sup> Given that the NPL ratio is bounded between zero and one, the logit-transformed value,  $\ln\left(\frac{NPL/L}{1-NPL/L}\right)$ , is used to create an unrestricted variable in the regressions. As a consequence, we have to transform the regression coefficients, when inferring the economic impact on the non-performing loan ratio according to  $\partial y/\partial x = \beta/(1/y + 1/(1-y))$ , where *y* is the non-performing loan ratio, *x* an independent variable, and  $\beta$  the estimated coefficient. Evaluated at the mean of the non-performing loan ratio (0.051), this implies that the coefficients have to be multiplied by a factor of 0.048.

<sup>5</sup> For Anguilla, Antigua and Barbuda, Guyana, Haiti, St. Kitts and Nevis, and St. Lucia, a rating was not available and we inferred it from an auxiliary regression in which we regressed sovereign ratings on a constant and the ratio of government debt to GDP for the other countries with available information. We then used the implied rating for missing countries, i.e. the fitted values of the regression using the public debt ratios observed in the countries without a rating.

of interest is  $\beta$  and it measures the impact of changes in sovereign credit ratings on banks' NPLs, controlling for the macroeconomic and bank-specific factors.

As mentioned previously, our objective is to examine the impact of sovereign credit rating shocks on bank stability. In order to do so, we control for the influence of confounding factors. We consider both systematic (macroeconomic) and idiosyncratic (bank-specific) factors. The systematic factors we include in vector  $C$  are: real GDP growth; inflation; lending rate; trade openness; and indicator variables for the global financial crisis, government debt default, hurricane strike and island jurisdictions. We expect that banks operating in small islands and states that are vulnerable to natural disasters are more likely to be riskier than other banks.

With respect to idiosyncratic (bank-specific) factors, vector  $X$  includes bank market power, net interest margin, non-interest income, operating cost, capitalization, liquidity and ROA.<sup>6</sup> These factors are likely to determine the ability of banks to effectively manage their loan books. For instance, banks with market power might have better performing loan books because their dominant market position allows them to reduce the costs of adverse selection in lending markets. Moreover, market power affords banks the opportunity to cream-skim the best creditors in markets. Other important determinants are bank capitalization and bank profitability. One might argue that these banks' franchise values are higher and thus they have less incentives to take on risks.

The regressions are estimated with the dynamic System Generalized Method of Moments (S-GMM) panel methodology, which is a consistent estimator in our setting (small time, large cross-sectional dimension). For the estimator to be valid, it has to pass the misspecification tests on the validity of instruments and the absence of second-order autocorrelation in the residuals. We use the two-step system GMM estimator to improve estimation efficiency by adding a second equation to the differenced version of the estimator and use the Windmeijer (2005) finite-sample correction to reduce the possibility of spurious precision. Finally, we use a parsimonious set of instruments across all specifications (number of instruments < number of cross-sections) to reduce the possibility of instrument proliferation (Roodman, 2009). We also cross-check our results with the fixed effects estimator. This estimator does not use instruments but suffers from the Nickel bias in our dynamic panel setting (large N and small T dimension).

<sup>6</sup> Market power is proxied by the Lerner index and we follow the approach of Birchwood et al. (2017) to estimate the index. Table 3 provides details on the exact definitions.

It is possible that our model suffers from an identification problem due to endogeneity in that high levels of NPLs in the banking sector may affect sovereign credit ratings. While this may be true at the macro-level, we argue that endogeneity is less likely a problem at the micro-level because an individual bank's loan book is unlikely to be considerable so as to affect sovereign ratings. A number of robustness checks are done to validate this argument. Further, we address the potential endogeneity problem in our model by using the dynamic System Generalized Method of Moments (S-GMM) estimator, which can accommodate both endogeneity bias and heterogeneity in the data caused by unobservable factors affecting individual banks.

We extend the baseline model to capture the possibility that sovereign rating shocks may not have a symmetric impact on bank stability across different environments in our sample. For instance, the spill-over intensity might be magnified in countries where governments have little fiscal space or during recessions. Spill-overs might also be amplified in countries with weaker market microstructures. We account for impact asymmetries by interacting *Rating* with a variable that captures the conditioning environment in our sampled countries. We estimate the following extended model:

$$NPL_{ijt} = \alpha_0 + \alpha_1 NPL_{ijt-1} + (\beta + \beta^* \cdot D_{jt}) Rating_{jt} + \Phi C_{jt} + \Psi X_{ijt-1} + \vartheta_i + \varepsilon_{ijt} \quad [2]$$

where  $D$  is an indicator variable that takes a value of one if a country is experiencing a specific type of environment and zero otherwise. All other mathematical notations are as previously defined.

We consider seven different types of environment and estimate a separate model for each one. These are: (i) fiscal space (Heritage Foundation's government spending index is below the 25<sup>th</sup> percentile of the distribution); (ii) sovereign rating is non-investment grade (Moody's rating below Baa3); (iii) region (dummy variable with a value of one for banks in Central America and zero otherwise); (iv) recessions (real GDP growth is negative); (v) low levels of international reserves (import cover is below the 25<sup>th</sup> percentile); (vi) central bank independence (supervisory independence index of Barth et al. (2013) is below the 25<sup>th</sup> percentile); and (vii) low market transparency (transparency index of Barth et al. (2013) is below the 25<sup>th</sup> percentile).

The coefficient  $\beta^*$  in our extended models indicates whether the impact of rating changes is different depending on whether a country's environment is subject to the above-mentioned conditions. More specifically, the impact of sovereign rating changes on NPLs is equal to the  $\beta$  for countries not subject to the above-mentioned conditions ( $D = 0$ ). For those that are subject to

these conditions ( $D = 1$ ), the aggregate effect of a sovereign rating change on bank stability is the sum of the estimated coefficients  $\beta$  and  $\beta^*$ .

#### 4. Empirical results and discussion

Table 4 reports the estimation results for the baseline and extended models. The results for the baseline model are reported in column (1), while the remaining columns contain the results for the extended models. We refer readers to Table 3 for the information on the definitions and summary statistics for the variables used in our empirical models.

We start discussing the baseline specification and subsequently the augmented regressions. The misspecification tests on the absence of second order autocorrelation and the validity of instruments support our regressions. There is also evidence of significant persistence in non-performing loans, which confirms our dynamic specification. This is not surprising because bad loans are more than likely a consequence of accumulated bad loans over time. It means that once loans are non-performing, they are likely to remain in that state in subsequent periods before they are written off.

The estimation results for the baseline model support our main argument of a spill-over of sovereign rating changes to bank stability. The main coefficient of interest,  $\beta$ , is significantly negative: an improvement (deterioration) in sovereign ratings is associated with a decrease (increase) in banks' non-performing loans. More specifically, we find that a sovereign downgrade of one notch tends to increase NPLs of banks by 0.25 percentage points (p.p.) in the short-run ( $-0.051 \times 0.048 = 0.0025$ ). Relative to an average NPL ratio of 5.1 percent of total loans, this is also economically significant. Taking into account the persistence in NPLs, the impact is more than double in the long-term. Our main finding on the link between sovereign ratings and bank risks is also confirmed when using the fixed effects estimator, as shown in Table 1, column (1\*). Note that we excluded in this specification the lagged dependent variable to avoid the Nickel bias and the indicator variable on islands, which is colinear with the fixed effects. The significance of our findings is robust to model specifications that is, both the baseline and extended models confirm the existence of spill-overs from sovereign rating changes to bank stability. However, as will be discussed below, the economic and microstructural background of countries matters.

Our findings support the argument that bank stability oversight ought to incorporate macro-financial linkages and spill-over channels (see Bernanke 1989, Gertler and Gilchrist 1998, Panetta et al. 2011, Corsetti et al. 2012, De Bruyckere et al. 2012, Angeloni and Wolff 2012, Das et al. 2012, Louzis et al. 2012, Hesse et al. 2014). The contagion is likely to work through a number of

channels that can reinforce each other depending on the initial conditions in the countries studied in this paper. According to the “information cascade” channel, sovereign downgrades cause households and firms to cut down expenditures due to lower expectations about future incomes. As a result, they may adjust expenditure by underservicing their outstanding loans, increasing loan defaults in the process. The “balance sheet exposure” channel postulates that banks’ holding of sovereign debts increases their risk profile and funding costs when sovereigns are downgraded. This compresses interest margins to which banks respond by increasing loan rates, adversely affecting borrowers’ ability to service loans. Third, the “asset valuation adjustment” channel stipulates that sovereign downgrades entail a weakening of bank balance sheets through losses on holdings of sovereign debt. As before, to maintain profitability and compensate for asset losses, banks increase loan rates with adverse consequences on borrowers’ repayment capacity.

Another contagion channel is based on the idea that sovereign ratings tend to impose a “sovereign ceiling” on the rating of domestic firms and banks, particularly in small and opaque markets. A negative outlook about sovereigns can hereby lead to a general deterioration of domestic credit ratings and reinforce the initial shock. In environments where public debt is high and central bank independence is low, economic agents may anticipate that the government will force banks to buy their bonds by, inter alia, raising bank reserve requirements. Such a situation would give rise to the “moral suasion” hypothesis (Uhlig, 2013; Battistini et al., 2014; Altavilla et al, 2017) and households and firms may refrain from depositing money into banks adversely affecting their funding liquidity (Reinhart and Rogoff, 2011). Banks may be forced to ration credits (reduce lending) by raising lending rates, which ultimately negatively impacts debtors’ ability to service their debts.

Concerning our macroeconomic control variables, we find a positive relationship between real GDP growth and bank stability (low NPLs). This procyclicality of bank stability justifies banking regulations on countercyclical capital buffers. Other important macro-variables that influence bank stability are country exposure to the global trade network (“openness”) and geographical size (“island dummy”). The global trade network is yet another potential spill-over channel to bank stability. Moreover, economic shocks in one country are likely to cascade and propagate to other countries through the trade network. Our findings support this argument in that banks in countries with large exposure to global trade partners tend to have more unstable banks (higher NPLs). The finding supports the global coordinated approach to macro-prudential supervision and oversight.

We find that loan books of banks operating in small island states in the Caribbean are riskier than those in Central America. We surmise that the small

market size of these countries causes economic shocks to be persistent and hence, tend to have a prolonged negative impact on the loan books of banks. Interestingly, we find that hurricane strikes ("hurricane") do not affect bank stability in CAC region which is similar to the findings reported by Brei et al. (2019) for the Eastern Caribbean Currency Union. As they show, hurricanes have not been followed by deterioration in loan quality and capital but rather by deposit withdrawals used by households and firms to finance the recovery. Thus, an explanation of our result is that the region has a long history in dealing with natural disasters and as such, these events are ingrained in the psyche of the people – a part of life.

Our findings also reveal that market microstructure ("market power") and bank-specific factors ("non-interest expense", "ROA" and "non-interest income") influence bank stability. We confirm our a priori expectation that banks with market power, operating in more concentrated markets, have less risky loan books. Arguably, market power provides banks with an informational advantage, which reduces the adverse selection costs they incur in lending markets. As a result, they can build better high-quality loan books than their peers in less concentrated markets. Banks can also obtain informational advantage by investing in information gathering. An indication of this could be our finding that banks with higher non-interest expenses are banks who invest in such activity and thus have lower non-performing loans. Moreover, we find that more profitable banks (high ROA) have lower NPLs which could be an indication for better managed banks being more prudent at managing and taking risks (Stakic, 2014; Godlewski, 2005).

Another interesting finding is that banks with higher levels of income from transaction-based fee business (measured by non-interest income to total assets) have riskier loan books. We argue that the shift to transaction-based banking reduces banks' incentive or regulatory requirement to monitor the performance of their loan books. This gives rise to two important issues that are of concern to regulators. First, banks have lower informational advantage in the lending market, which contributes to low quality loan books. Second, the process of financial disintermediation increases. In both instances, the banking system becomes less stable and credit provision more volatile. Bolton et al. (2016) and Hardie and Howarth (2013) provide supporting evidence.

The spill-over effects can arguably vary and depend on, inter alia, the economic conditions existing at the time of sovereign downgrade or the degree of investor confidence. We explore this line of research by interacting the sovereign rating variable ("Rating") with a number of measures on differences in the conditioning environment in the countries studied. The results are shown in Table 4, Columns 2-10.

In the first two experiments, we test whether the spill-over effects depend on government fundamentals. For this we include interactions for countries with (i) fiscal space and (ii) sovereign ratings below non-investment grade. Against our expectation, the spill-over intensity of sovereigns to banks is not affected by these two factors (the coefficient  $\beta^*$  is insignificant). Next, we test whether the impact of sovereign risk spill-over differs across Caribbean and Central American countries, but we do not find a significant difference. In the next column, we test whether sovereign rating downgrades have a stronger impact on banks' NPLs during recessions. Again, we do not find significant differences in the spill-over intensity across good and bad economic conditions. Thus, so far, our experiments suggest that the impact of sovereign risk on banks is similar across countries with different fiscal, geographic and economic conditions.

Next, we investigate whether external country vulnerability (measured by the import cover ratio) amplifies the spill-over intensity. Interestingly, we find that banks in countries with low foreign currency reserves to imports are affected more by the sovereign rating risk than banks in high reserve countries. We postulate that a country having high reserves at a time of a downgrade softens adverse effects of the downgrade. In other words, high reserves provide a buffer to the market that the country is likely, despite the downgrade, to meet its debt commitment. As a result, the sovereign downgrade has little or no material impact on banks and their loan pricing. This leaves borrowers' ability to service their debt less affected.

With respect to the microstructure of the banking market, two variables are of statistical significance: reporting transparency and central bank independence. Only in markets with low levels of transparency or central bank independence, banks tend to experience higher rates of NPLs when sovereign ratings deteriorate. Intuitively, one would expect the quality of banks' loan books being lower in less transparent markets where information asymmetries are relatively high. In such markets, the discipline exercised by bank outsiders is low and banks may have incentives to underreport bad loans or 'extend and pretend' loans. The argument is analogous to the information-based pricing models in the market microstructure literature where dealers' pay-offs are directly related to market transparency (see O'hara, 1995). Further, investor sentiments might be more prone to bad news about governments when markets are opaque and little is known about the financial records of governments and banks (Kladakis et al., 2020).

It is not obvious why low central bank independence exacerbates the adverse effects of sovereign spill-over to bank stability. We argue that central bank independence is likely to be low in markets where the financial regulation process is characterized by regulators whose decisions are influenced by

external stakeholders (such as, governments, politicians and influential market players). In such a setting, it is possible that the spill-over is made worse by special interests who prevent the normal market adjustments to sovereign downgrades to occur. If central bank independence is low, regulators are likely to accede to governments' preference for banks holding more sovereign debts at the expense of financial stability. Our argument is consistent with the literature on the political economy of financial regulation (see Avgouleas and Donald, 2019). Our finding is also consistent with the "moral suasion" hypothesis in which governments exercise pressure on banks to buy their bonds by, perhaps, forcing central banks to raise bank reserve requirements (Uhlig, 2013; Battistini et al., 2014; and Altavilla et al, 2017).

In the last two experiments, we consider adverse shocks to US policy and the exchange rate given that the region is highly dependent on the US economy and external debt is mainly denominated in foreign currency. Concerning the policy shock, we add an interaction term with a dummy variable that is equal to one when the Economic Policy Uncertainty (EPU) index is above the 90th percentile of its distribution. The results indicate that EPU does not amplify the impact of changes in sovereign ratings on bank stability. We find that the coefficient value on EPU is negative with a p-value of 15.8% which exceeds acceptable significance levels (see column 9 of Table 4).

With respect to the currency shock, we add an interaction term with a dummy variable that represents a shock to currency depreciation in countries where the exchange rate is flexible, and low levels of import cover in countries with fixed exchange rates. To identify the first, we calculate percent deviations of the exchange rate from a moving average of the past 12 monthly exchange rates. The currency shock dummy is then equal to one if there was at least one month in a given year during which the percent deviation is above the 90th percentile of the distribution. For countries with fixed exchange rates, the dummy is equal to one when the import cover is below the 10th percentile of its distribution. The results shown in column 10 of Table 4 indicate that such shocks do not have a significant impact on the sovereign spill-over transmission to bank stability.

We also perform a number of robustness tests to verify whether our results are sensitive to the different measures of bank and sovereign risk, different samples and the inclusion of other control variables. Table 5 reports these estimation results. For comparison purposes, column 1 of Table 5 also reports the estimation results for the baseline model [1] previously reported in Table 4. Across all robustness tests, the main result of the study is confirmed that is, better sovereign ratings are associated with lower bank risks. These different robustness tests are discussed in turn below.



First, we examine whether our results are driven by large banks in the sample. One reason for this analysis is that there might be reverse causality to the extent that the stability of banks might drive government ratings. This concern would be particularly important in the case of large banks. The results shown in Table 5, column 2 are robust to the exclusion of large banks defined as those with total assets representing more than 20 percent of their country's GDP.<sup>7</sup> Overall, this confirms our view about the region in which governments represent a large part of the economy and fiscal stance is an important determinant of macroeconomic conditions. It is not the banking sector, as it might be in the advanced economies, that has been the driver of macroeconomic uncertainty and bank stability.

Next, we replace the dependent variable with the Z-Score or distance to default. We calculate bank-specific Z-Scores over 5-year windows as follows:

$$Z = \frac{\overline{ROA} + E/TA}{\sigma_{ROA}}$$

where  $\overline{ROA}$  is the mean of the return on assets,  $\sigma_{ROA}$  its standard deviation, and  $E/TA$  is the equity ratio (De Young and Torna, 2013). The higher the Z-Score, safer is the bank. The advantage of this measure of bank risk is that it takes account of other risk factors outside the loan book. The drawback of the measure, however, is that the mean and standard deviation have to be estimated with few observations. The results shown in column 3 suggest that improvements in sovereign ratings are associated with lower bank risks (higher Z-Scores), which confirms our previous results.

The next robustness check involves replacing the cumulative change in sovereign ratings with different lags of annual rating changes. Our results shown in column 4 suggest that it takes two years, on average, for sovereign rating changes to impact banks' loan books. We then exclude from the estimation sample: (i) banks from large offshore financial centers (Bahamas, Bermuda and Cayman Islands); and (ii) banks from the interventionist economy of Cuba. These estimation sample restrictions did not alter our previous findings (see columns 5 and 6).

In the following two robustness tests, we modify the set of our control variables in our empirical model. First, we replace the Lerner index with the Herfindhal-Hirschman index and second, we include bank loan growth. As shown in columns 7 and 8 of Table 5, these modifications have no statistical

<sup>7</sup> We also performed a Placebo test and regressed our rating change variable on country-year averages of non-performing loan ratios, country- and time-fixed effects and did not find any significant relationship. The results not shown here can be obtained from the authors upon request.

impact on our main conclusion that is, sovereign rating change adversely impact bank stability.

In the final robustness checks, we replace our sovereign risk measure with a market-based risk measure in the form of government bond spreads.<sup>8</sup> We estimate two specifications, one with only bank-specific control variables and another that includes in addition macroeconomic control variables. The results reveal a positive and significant relation between sovereign bond spreads and non-performing loans when only bank-specific controls are included (Table 5, column 9). Once the other macroeconomic control variables are included, sovereign bond spreads are no longer significant (Table 5, column 10). This seems to suggest that the market information contained in the bond spreads reflects forward-looking information about macroeconomic conditions, which is also confirmed by correlations. More specifically, the strongest correlation of -0.56 is observed between the lagged spread and GDP growth.

## 5. Exploring the spill-over mechanism

Our findings confirm a statistically significant link between sovereign rating changes and bank stability in the CAC region. These findings, interesting in and by themselves, are of regulatory importance especially in light of the current market debate on the appropriateness of 0% risk weights to sovereign exposures. Also of considerable regulatory importance is determining the spill-over transmission channel at play. In this section, therefore, our main objective is to shed some light on the transmission channels from sovereign risk to bank stability.

As previously mentioned, the main channels identified in the literature are: (i) "information cascade"; (ii) "balance sheet exposure"; and (iii) "asset valuation adjustments. We discuss the mechanics of these transmission channels in Section 1.

The "information cascade" transmission channel is rather difficult to empirically examine because it requires, *inter alia*, a model of market expectations, which is near impossible to construct.<sup>9</sup> We, therefore, concern ourselves with testing for the other channels that is, "balance sheet exposure" and "asset valuation adjustments". For this purpose, we restrict our sample to

<sup>8</sup> Due to data limitations, we use information on EMBI spreads for four large countries (Jamaica, Trinidad and Tobago, Panama and Dominican Republic) and a long-term government bond spread for Barbados.

<sup>9</sup> While not empirically examined in our work, it should be noted that the "information cascade" channel is likely to be an important contagion channel for sovereign risk to spill-over to bank stability in the CAC's banking markets, because of the low degree of market transparency and disclosure. As a result, any news release on sovereign credit rating is more than likely to come as a surprise to the board cross section of the market and hence, will have a material impact on the economic behaviour of households.

141 banks for which we have information on sovereign holdings. Further, we use several regression models of the form:

$$y_{ijt} = \alpha_0 + \beta_0 Rating_{jt} + \beta_1 (Rating_{jt} * gov.exposure_{ijt}) + \vartheta_{jt} + \epsilon_{ijt}$$

where  $y_{ijt}$  are the following dependent variables: (i) non-performing loans (as before); (ii) funding rate; (iii) loan rate; (iv) return on equity; (v) total deposits; and (vi) total loans.<sup>10</sup> The main variable of interest is our rating variable (cumulative change) and its interaction with banks' exposure to sovereign debts (measured as government securities as a percentage of total bank assets). The impact of rating changes on the various dependent variables is given by the sum of  $\beta_0$  and the term  $\beta_1 * gov.exposure$ . For instance, if we find that the two coefficients are significant and positive, then the impact of rating changes is amplified at banks with higher government exposure. We also include country-year fixed effects,  $\vartheta_{jt}$ , to absorb any other variations at the macro-level.

The estimation results are shown in Table 6. The first column of the table confirms our previous result that is, non-performing loans (bank stability) increase (decreases) when sovereign ratings deteriorate. However, the effect is not materially larger when banks hold more sovereign debts on their balance sheets. We find that funding rates of banks increase with sovereign downgrades and the impact is greater at banks with higher levels of sovereign exposures (see column 2). Similarly, banks' loan rates also increase with sovereign downgrades and, as we expect, the size of the increase is disproportionately larger in banks with higher exposure (see column 3). These findings are consistent with the "balance sheet" transmission channel. Our findings also support the "asset valuation adjustments" transmission channel. Moreover, we find that bank profitability (proxied by ROE) is negatively affected by sovereign downgrades. However, the impact does not increase with sovereign exposure (see column 4).

Our findings support both the "balance sheet" and "asset valuation adjustments" channels. Academically, one will want to know which one of two channels is dominant in the CAC region. From a regulatory perspective, we argue that knowing whether one or another channel dominates is merely of academic interest because the policy description is likely to be the same in both cases. Appropriate policy response to the sovereign risk spill-over is either credit concentration limit, risk weighting of sovereign exposures, monetary policy accommodation or a combination of these policy options.

<sup>10</sup> The funding rate is measured by total interest expense divided by total funding, the loan rate is interest income divided by total loans, return on equity is net income divided by total equity, total deposits are divided by total assets, and total loans are divided by total assets.

We examine other sovereign risk spill-over effect to banks in particular, deposits and credit provision. We find that sovereign rating downgrades are associated with lower deposit ratios but, interestingly, the impact is less pronounced in banks with higher government exposure (see column 5). We could only surmise that the low degree of market transparency and disclosure make it rather difficult for outsiders to assess the size of sovereign exposure of banks. Finally, we observe that bank lending shrinks when sovereigns are downgraded (see column 6). However, the decline in credit provision is statistically similar across high and low sovereign-exposed banks.

## 6. Conclusions

We extend the literature on macro-financial linkages by empirically examining sovereign risk spill-over to bank stability in the CAC region. Our empirical results reveal that sovereign rating downgrades adversely impact bank stability and the spill-over is exacerbated in countries where market transparency, central bank independence and foreign currency reserves are low. This represents an important policy insight from our work: even though the banking systems in CAC countries are inherently vulnerable to spill-overs from sovereign and trade network exposures, bank stability can be enhanced by improving market transparency and strengthening central bank independence.

Further, we find that bank stability is influenced by bank-specific and systematic factors. More profitable banks and those with informational advantage in lending markets were found to have healthier banking books, whereas those with higher transaction-based fee business have riskier books. On the macro-level, we find evidence of procyclicality of bank stability and that a country's degree of exposure to the global trade network negatively impacts bank stability. The latter finding provides support for a coordinated, cross jurisdiction approach to macro-prudential regulation and oversight.

We empirically examine the spill-over transmission channel and find evidence to support both the "balance sheet exposure" and "asset valuation adjustments" arguments in the literature. This finding supports the Basel Committee on Banking Supervisory initiation of a review of 0% risk weights for sovereign exposures.

Finally, the main findings are robust to different model specifications, definitions of bank stability and measures of sovereign exposure risk.

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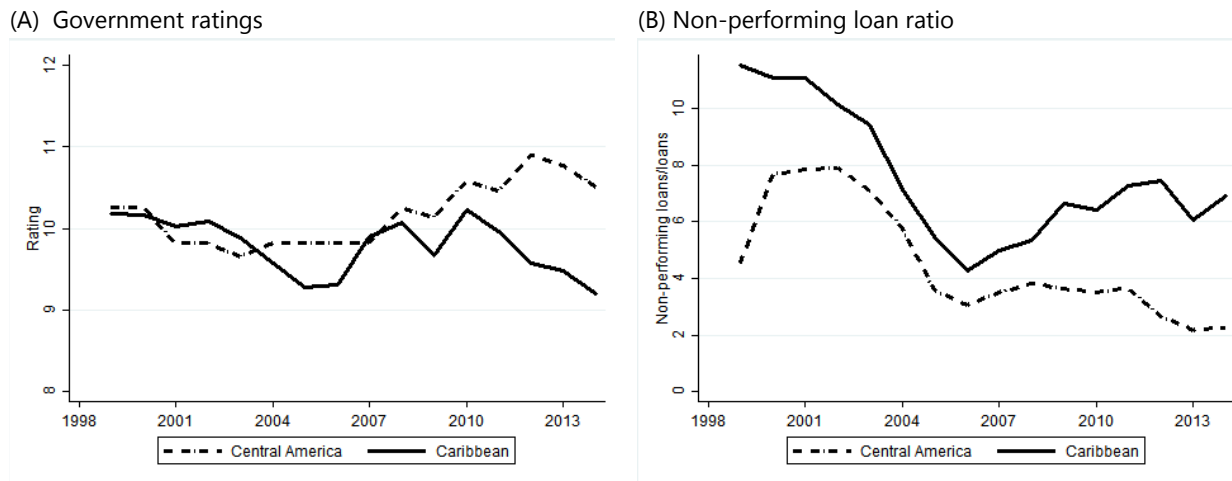
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## Figures and tables

Figure 1: Bank credit risks and government ratings



Note: The vertical axis shows government ratings and the non-performing loan ratio for Central America and the Caribbean over the period 1999-2014. Government ratings refers to the long-term foreign-currency rating converted into integers (1=lowest rating, ..., 21=highest rating). For details on the included countries, see Table 2. Medians across country groups and years are shown.

Source: BankScope; Standard and Poor's; Moody's. Authors' calculations.

Table 1: Economic and market structure for selected region

	<b>Govern- ment debt</b>	<b>Trade openness</b>	<b>Bank credit</b>	<b>Financial markets</b>	<b>Central bank independ.</b>	<b>Trans- parency</b>
Africa	31.7	80.2	23.2	59.5	1.9	5.2
Asia	48.0	102.4	57.3	98.5	1.9	5.3
Caribbean Islands	66.2	105.4	50.4	39.2	1.3	4.7
Central America	36.9	93.8	44.7	22.1	1.3	4.1
Europe	58.8	116.6	84.0	50.7	2.4	5.2
North America	92.7	46.1	50.1	121.3	2.5	6.0
South America	48.3	56.3	36.4	53.5	1.3	5.3
<b>World average</b>	<b>54.7</b>	<b>85.8</b>	<b>49.4</b>	<b>63.5</b>	<b>1.8</b>	<b>5.1</b>

Note: "Government debt" is central government debt over GDP, "Trade openness" the sum of exports and imports over GDP, "Bank credit" credit provided by banks to the private sector over GDP, "Financial markets" is stock market capitalization over GDP, "Central bank independence" is an index on a scale of 0-3 (higher value means higher independence), and "Transparency" is an index on a scale of 0-6 (higher value indicates higher level of reporting transparency). The sample includes 175 countries. All values for the reported regions are unweighted averages across countries over the years 1999-2014.

Sources: WDI; Barth et al. (2013). Authors' calculations.

Table 2: Characteristics of the database (1999–2014)

	No. of banks	Total assets, end-2014		Total loans	NPLs	ROA	Sovereign rating in year		
		Billion USD	% of GDP	% of assets	% of loans	% of assets	2000	2014	Δ
Anguilla	2	0.6	368.1	58.6	11.2	1.1	11	11	0
Antigua & B.	1	0.4	29.6	64.1	6.7	1.4	8	8	0
Aruba	2	1.4	57.8	67.6	9.5	1.8	13	13	0
Bahamas	5	8.5	102.9	69.5	7.6	1.3	15	13	-2
Barbados	3	13.1	306.8	61.4	6.3	1.7	15	9	-6
Belize	1	0.5	43.4	72.1	3.9	6.4	10	6	-4
Bermuda	3	22.6	403.1	23.5	11.6	1.0	20	19	-1
Cayman Islands	5	11.7	363.6	33.5	2.1	1.6	18	18	0
Costa Rica	17	36.9	79.2	63.1	5.1	1.3	10	10	0
Cuba	4	7.5	12.4	35.1	12.8	1.4	5	5	0
Dom. Republic	13	24.8	42.2	57.0	2.3	1.9	6	8	2
El Salvador	9	11.9	59.5	60.0	4.8	1.0	11	11	0
Grenada	3	0.7	88.2	61.9	6.3	0.9	4	5	1
Guatemala	20	33.0	62.0	54.6	4.3	1.4	10	10	0
Guyana	3	1.4	43.1	36.1	17.7	1.4	5	10	5
Haiti	5	3.5	42.4	34.2	2.7	1.3	11	12	1
Honduras	18	14.7	80.1	61.4	4.7	1.2	8	8	0
Jamaica	10	12.3	84.7	35.8	6.6	1.5	7	6	-1
Panama	38	113.6	267.0	62.6	2.6	1.4	12	13	1
St Kitts & Nevis	2	1.3	167.2	39.3	8.4	1.6	4	7	3
St Lucia	5	2.6	224.3	60.2	18.3	1.0	10	10	0
St Vincent	1	0.3	44.6	69.8	2.4	1.5	8	8	0
Suriname	1	0.3	9.9	52.4	2.0	-1.0	6	8	2
Trinidad	6	23.0	99.8	50.1	3.5	2.2	12	16	4
Average/sum*	177*	14.4	128.4	53.5	6.8	1.5	10.0	10.2	0.2

Note: Unweighted averages across banks per country. "Average/sum\*" indicates unweighted averages or sums (\*) over countries. "Sovereign rating" refers to the long-term foreign-currency rating converted into integers (1=lowest rating, ..., 21=highest rating). For Anguilla, Antigua and Barbuda, Guyana, Haiti, St. Kitts and Nevis, and St. Lucia, the rating was inferred from an auxiliary regression (see footnote 6).

Sources: BankScope; WDI; Standard and Poor's; Moody's; IMF-IFS; Central bank reports. Authors' calculations.

Table 3: Variable definitions and summary statistics

<b>Variable</b>	<b>Definition</b>	<b>Obs.</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
Non-performing loans	Ln(NPL ratio/(1-NPL ratio))	1388	-3.52	1.22	-6.93	-0.12
Sovereign rating	Cumulative change in long-term foreign-currency ratings	1388	0.15	1.43	-6.00	5.00
Market power	Lerner Index	1388	0.25	0.13	0.00	0.78
Net interest margin	Net interest income/total assets	1388	1.56	1.33	-1.75	17.68
Non-interest income	Non-interest income/total assets	1388	5.46	4.13	-2.35	24.84
Non-interest expense	Non-interest expense/(net interest income + non-interest income)	1388	64.24	20.78	1.42	210.36
Capital ratio	Total equity/total assets	1388	12.23	6.12	0.77	58.22
Liquid assets	(Cash and due from banks + loans and advances to banks)/total assets	1388	18.06	10.79	0.00	99.53
ROA	Net income/total assets	1388	1.43	1.55	-9.33	13.89
GFC dummy	= 1 if 2009-12	1388	0.33	0.47	0.00	1.00
Island dummy	= 1 if island	1388	0.34	0.47	0.00	1.00
Default dummy	= 1 if government default	1388	0.01	0.12	0.00	1.00
Hurricane dummy	= 1 if hurricane strike	1388	0.03	0.17	0.00	1.00
GDP growth	IMF-IFS	1388	3.81	3.65	-18.41	20.28
Inflation	IMF-IFS	1388	5.80	3.70	-1.67	39.28
Lending rate	IMF-IFS	1388	13.12	6.33	-4.44	48.00
Openness	Trade/GDP	1388	99.71	32.45	16.66	205.22

Note: The sample goes from 1999 to 2014.

Sources: BankScope; WDI; Standard and Poor's; Moody's; IMF-IFS; Central bank reports. Authors' calculations.

Table 4: Regression results for non-performing loans

Y = NPL	(1)	(1*)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Baseline, S-GMM	Baseline, FE	Fiscal space	Non- investment grade	Central America	Recession	Import cover	Central bank independ- ence	Trans- parency	US policy uncertainty	Currency shocks
NPL, t-1	<b>0.571***</b> (0.064)		<b>0.572***</b> (0.064)	<b>0.577***</b> (0.064)	<b>0.569***</b> (0.064)	<b>0.572***</b> (0.064)	<b>0.581***</b> (0.067)	<b>0.574***</b> (0.064)	<b>0.562***</b> (0.067)	<b>0.571***</b> (0.065)	<b>0.575***</b> (0.065)
Sovereign rating	<b>-0.051**</b> (0.022)	<b>-0.076*</b> (0.039)	<b>-0.070**</b> (0.029)	<b>-0.072**</b> (0.029)	<b>-0.064***</b> (0.025)	<b>-0.052**</b> (0.023)	-0.025 (0.023)	-0.020 (0.022)	-0.022 (0.024)	<b>-0.046**</b> (0.021)	<b>-0.054**</b> (0.023)
Sov. rating*D			0.048 (0.048)	0.049 (0.032)	0.054 (0.047)	0.003 (0.026)	<b>-0.105**</b> (0.050)	<b>-0.086**</b> (0.042)	<b>-0.097*</b> (0.056)	-0.023 (0.016)	0.091 (0.073)
Market power	<b>-2.274**</b> (0.939)	-0.636 (0.864)	<b>-2.307**</b> (0.934)	<b>-2.152**</b> (0.913)	<b>-2.293**</b> (0.944)	<b>-2.293**</b> (0.952)	<b>-2.038**</b> (0.893)	<b>-2.226**</b> (0.912)	<b>-2.428**</b> (0.980)	<b>-2.274**</b> (0.953)	<b>-2.179**</b> (0.990)
Net int. margin	-0.017 (0.049)	-0.025 (0.032)	-0.016 (0.049)	-0.020 (0.048)	-0.015 (0.048)	-0.017 (0.049)	-0.024 (0.049)	-0.020 (0.050)	-0.013 (0.050)	-0.016 (0.049)	-0.021 (0.049)
Non-int. income	<b>0.032***</b> (0.011)	<b>0.101**</b> (0.046)	<b>0.032***</b> (0.012)	<b>0.032***</b> (0.011)	<b>0.032***</b> (0.012)	<b>0.033***</b> (0.012)	<b>0.032***</b> (0.011)	<b>0.033***</b> (0.012)	<b>0.033***</b> (0.012)	<b>0.033***</b> (0.011)	<b>0.032***</b> (0.011)
Non-int. expense	<b>-0.017**</b> (0.007)	<b>-0.008*</b> (0.005)	<b>-0.018**</b> (0.007)	<b>-0.016**</b> (0.007)	<b>-0.017**</b> (0.007)	<b>-0.017**</b> (0.007)	<b>-0.016**</b> (0.007)	<b>-0.017**</b> (0.007)	<b>-0.018**</b> (0.008)	<b>-0.017**</b> (0.007)	<b>-0.016**</b> (0.007)
Capital ratio	0.008 (0.007)	0.004 (0.011)	0.009 (0.007)	0.008 (0.007)	0.009 (0.007)	0.008 (0.007)	0.007 (0.007)	0.008 (0.007)	0.008 (0.00)	0.008 (0.007)	0.008 (0.007)
Liquid assets	0.008 (0.007)	0.010 (0.007)	0.008 (0.007)	0.007 (0.006)	0.007 (0.007)	0.008 (0.007)	0.008 (0.006)	0.008 (0.006)	0.009 (0.007)	0.008 (0.007)	0.007 (0.007)
ROA	<b>-0.077**</b> (0.032)	<b>-0.230***</b> (0.046)	<b>-0.079**</b> (0.033)	<b>-0.076**</b> (0.032)	<b>-0.074**</b> (0.032)	<b>-0.077**</b> (0.032)	<b>-0.083**</b> (0.032)	<b>-0.080**</b> (0.034)	<b>-0.079**</b> (0.034)	<b>-0.076**</b> (0.033)	<b>-0.078**</b> (0.032)
GFC dummy	0.043 (0.046)	0.016 (0.072)	0.047 (0.045)	0.039 (0.046)	0.034 (0.046)	0.046 (0.046)	0.059 (0.046)	0.062 (0.048)	0.045 (0.048)	0.050 (0.046)	0.040 (0.046)
Island dummy	<b>0.303***</b> (0.109)		<b>0.316***</b> (0.110)	<b>0.315***</b> (0.108)	<b>0.319***</b> (0.110)	<b>0.302***</b> (0.108)	<b>0.292***</b> (0.107)	<b>0.285***</b> (0.110)	<b>0.294***</b> (0.110)	<b>0.296***</b> (0.109)	<b>0.307***</b> (0.111)
Default dummy	0.158 (0.140)	0.213 (0.146)	0.157 (0.141)	0.155 (0.137)	0.145 (0.141)	0.158 (0.138)	0.143 (0.137)	0.161 (0.136)	0.206 (0.148)	0.161 (0.147)	0.155 (0.136)
Hurricane dummy	0.065 (0.107)	<b>-0.323**</b> (0.125)	0.056 (0.109)	0.053 (0.108)	0.070 (0.106)	0.069 (0.109)	0.049 (0.110)	0.061 (0.108)	0.076 (0.108)	0.066 (0.107)	0.055 (0.108)
GDP growth	<b>-0.031***</b> (0.008)	<b>-0.033***</b> (0.009)	<b>-0.031***</b> (0.008)	<b>-0.031***</b> (0.008)	<b>-0.031***</b> (0.008)	<b>-0.031***</b> (0.008)	<b>-0.030***</b> (0.008)	<b>-0.029***</b> (0.008)	<b>-0.031***</b> (0.008)	<b>-0.031***</b> (0.008)	<b>-0.032***</b> (0.008)
Inflation	-0.004 (0.008)	<b>-0.017*</b> (0.010)	-0.003 (0.008)	-0.005 (0.008)	-0.005 (0.008)	-0.004 (0.008)	-0.005 (0.008)	-0.005 (0.008)	-0.005 (0.008)	-0.004 (0.008)	-0.004 (0.008)
Lending rate	-0.001 (0.008)	<b>0.035***</b> (0.012)	-0.001 (0.008)	0.000 (0.008)	0.001 (0.008)	-0.000 (0.008)	0.001 (0.008)	0.001 (0.008)	0.002 (0.008)	-0.001 (0.008)	-0.000 (0.008)
Openness	<b>0.003**</b> (0.001)	<b>0.009***</b> (0.002)	<b>0.003**</b> (0.001)	<b>0.003**</b> (0.001)	<b>0.003*</b> (0.001)	<b>0.003**</b> (0.001)	<b>0.003**</b> (0.001)	<b>0.003**</b> (0.001)	<b>0.002*</b> (0.001)	<b>0.003**</b> (0.001)	<b>0.003**</b> (0.001)
Constant	-0.408 (0.729)	<b>-4.339***</b> (0.632)	-0.384 (0.735)	-0.465 (0.718)	-0.416 (0.719)	-0.395 (0.739)	-0.565 (0.716)	-0.497 (0.725)	-0.424 (0.741)	-0.416 (0.747)	-0.466 (0.741)
Observations	1388	1388	1388	1388	1388	1388	1388	1388	1388	1388	1388
Banks	177	177	177	177	177	177	177	177	177	177	177
Hansen/R <sup>2*</sup>	0.484	0.083*	0.490	0.510	0.458	0.501	0.521	0.491	0.438	0.474	0.502
AR2	0.420		0.421	0.414	0.421	0.421	0.412	0.413	0.425	0.420	0.417
No. instruments	108		109	109	109	109	109	109	109	109	109

Note: The sample period goes from 1999 to 2014. All estimations are based on the Arellano and Bover (1995) system GMM estimator, except for column (1\*) which is estimated by the fixed effects estimator (excluding the lagged dependent variable). Robust standard errors are reported in brackets. The interaction variable  $D$  in columns (2)-(10) is a dummy for (2) fiscal space (government spending index (Heritage Foundation) < 25th percentile of the distribution); (3) sovereign rating is non-investment grade (Moody's rating < Baa3); (4) Central America; (5) recessions (real GDP growth < 0); (6) low levels of international reserves (import cover < 25th percentile); (7) central bank independence (supervisory independence index (Barth et al., 2013) < 25th percentile); (8) low market transparency (transparency index (Barth et al., 2013) < 25th percentile); (9) adverse US policy uncertainty shock (EPU index > 90th percentile); and (10) currency shock (currency deviation from 12-month moving average > 90th percentile, or import cover < 10<sup>th</sup> percentile). The null hypothesis of the Hansen test is that the instruments are valid (column 2 reports instead the overall R<sup>2</sup>). The null hypothesis of the AR2 test is that errors in the first-difference regression exhibit no second-order serial correlation. P-values are shown for these tests. No. instruments indicates the number of instruments used in the regressions. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level, respectively.

Table 5: Robustness checks

	(1) Baseline	(2) Exclude large banks	(3) Z-Score	(4) Rating change	(5) Exclude OFCs	(6) Exclude Cuba	(7) HHI	(8) Loan growth	(9) EMBI spread	(10) EMBI spread
$Y, t-1$	<b>0.571***</b> (0.064)	<b>0.494***</b> (0.072)	<b>0.606***</b> (0.073)	<b>0.566***</b> (0.073)	<b>0.538***</b> (0.071)	<b>0.564***</b> (0.072)	<b>0.518***</b> (0.079)	<b>0.590***</b> (0.065)	<b>0.746***</b> (0.121)	<b>0.749***</b> (0.147)
Sovereign rating	<b>-0.051**</b> (0.022)	<b>-0.049*</b> (0.027)	<b>1.782***</b> (0.675)		<b>-0.044*</b> (0.023)	<b>-0.054**</b> (0.022)	<b>-0.050**</b> (0.024)	<b>-0.046**</b> (0.023)	<b>0.031**</b> (0.013)	<b>0.011</b> (0.014)
$\Delta$ Sovereign rating <sub>t-1</sub>				-0.042 (0.031)						
$\Delta$ Sovereign rating <sub>t-2</sub>				<b>-0.083***</b> (0.029)						
HHI							<b>0.834**</b> (0.332)			
Loan growth								0.000 (0.001)		
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Observations	1388	1226	1185	1284	1308	1372	1388	1388	385	385
Banks	177	166	166	177	164	173	177	177	69	69
Hansen	0.484	0.433	0.115	0.395	0.507	0.364	0.443	0.399	0.669	0.455
AR2	0.420	0.405	0.831	0.424	0.400	0.425	0.409	0.422	0.357	0.337

Note: The sample period goes from 2000 to 2014. All the control variables shown in Table 4 are included in the regressions but not reported to save space. Column (1) shows the baseline specification of Table 4. Column (2) excludes banks with a total asset to GDP ratio of larger than 20%. Column (3) uses the Z-Score as a dependent variable instead of the NPL ratio. Column (4) uses the change in ratings one and two years ahead instead of the cumulative change. Column (5) excludes large international financial centers (Bahamas, Bermuda, Cayman Islands). Column (6) excludes Cuba. Column (7) uses the HHI index instead of the Lerner index to control for the market structure. Column (8) includes in addition to the other control variables the growth rate of lending. Columns (9) and (10) use sovereign bond EMBI spreads, lagged by one year, instead of the cumulative change in ratings as a measure of sovereign risk. All estimations are based on the Arellano and Bover (1995) system GMM estimator. Robust standard errors are reported in brackets. The null hypothesis of the AR2 test is that errors in the first-difference regression exhibit no second-order serial correlation. The null hypothesis of the Hansen test is that the instruments are valid. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level, respectively.

Table 6: Exploring the transmission channel

	(1) NPLs	(2) Funding rate	(3) Loan rate	(4) ROE	(5) Deposits	(6) Loans
Sovereign rating	<b>-0.303***</b> (0.054)	<b>-0.179**</b> (0.091)	0.712 (0.800)	0.019*** (0.004)	<b>-4.041***</b> (1.049)	<b>4.111***</b> (1.041)
Sovereign rating*gov. exposure	-0.000 (0.003)	<b>-0.015***</b> (0.006)	<b>-0.115**</b> (0.054)	-0.0004 (0.0002)	<b>0.163***</b> (0.052)	-0.006 (0.053)
Country-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	904	904	904	904	904	904
Banks	141	141	141	141	141	141
R <sup>2</sup>	0.530	0.581	0.472	0.430	0.442	0.537
R <sup>2</sup> , adjusted	0.384	0.450	0.308	0.253	0.267	0.393

Note: The estimations are based on OLS. The regressions include for each country year fixed effects. Robust standard errors are reported in brackets. The dependent variables in the columns are (1) non-performing loans (ratio, log-transformed), (2) implicit funding rate (interest expenses divided by total funding), (3) implicit loan rate (interest income divided by total loans), (4) return on equity (net income divided by total equity), (5) total deposits divided by total assets, and (6) total loans divided by total assets. 'R<sup>2</sup>' denotes the coefficient of variation and 'R<sup>2</sup>, adjusted' shows the adjusted coefficient of variation. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% level, respectively.