TECHNICAL ASSISTANCE REPORT

BARBADOS

Stress Testing

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Executive Summary

The mission aimed to develop a multi-factor and multiperiod solvency stress testing (ST) framework for the Central Bank of Barbados (CBB) and the Financial Services Commission (FSC). It reviewed the available data and the regulatory framework. It constructed two new tools – one for the CBB to stress test banks and finance companies and one for the FSC to stress test credit unions operating in Barbados. Both tools are tailor-made to fully respect the existing accounting, tax, and regulatory rules for both types of credit institutions. The new framework is based on common explicit macroeconomic scenarios and two newly built credit risk satellite models for non-performing loans (NPL) for banks/finance companies and credit unions. The calibrated macroeconomic scenarios – one baseline and two adverse – enter the NPL satellite models to project NPLs and, ultimately, credit losses. The tools provide scenario-specific macroeconomically consistent projections of institutions' key balance sheets, profit & loss, and capital adequacy items over a period of up to three years.

Illustrative stress tests using March 2023 data for both banks and credit unions were run to demonstrate the use of the new tools. The official CBB macroeconomic projection as of July 2023 was used as the baseline scenario, while the adverse scenarios were calibrated by expert judgment to capture the different severity of economic recessions, with the more severe one assuming a real GDP decline of 8% at the bottom of the cycle. The results suggest that banks and finance companies are generally resilient to economic stress, given their relatively high initial capital adequacy and good pre-provision profitability. Credit unions appear more vulnerable to worsening the economic situation mainly due to lower initial capital buffers.

The mission provided several recommendations to the CBB and FSC. They covered technical aspects of ST, the use of the stress test results and their communication, related operational elements and processes, and data sources and their management. The CBB and FSC staff involved in ST and financial stability monitoring need to become familiar with the newly developed framework and be able to update the tool with new macro-financial and institution-specific data regularly, calibrate the scenarios, and adjust additional assumptions and parameters to reflect potential changes in the economy and regulation.

The new framework should be used for regular internal stress tests at least twice a year – once in the spring and once in the autumn. The CBB would be responsible for preparing the macroeconomic scenarios that would be used jointly in both stress tests of banks and credit unions. The (aggregate) results of the spring exercise should be published in the annual Financial Stability Report (FSR) produced jointly by both institutions and typically published in July/August. The detailed description of the new framework, including all key assumptions, should be provided as a "research note" (the "special topic" article) in the FSR once the results are published for the first time. Moreover, the results should be shared and discussed with the supervision departments in both CBB and FSC and used in supervision and supervisory reviews.

Credit risk modeling as the key part of the new framework should be further improved. The satellite models for credit risk estimated by the mission for banks and credit unions were using aggregate NPL ratios, for which a long time series was available. However, the mission recommends that new sectoral credit risk models be constructed for banks/finance companies, at least for mortgages, personal loans, and corporate loans. The research team in the CBB could also assist the FSC in re-estimate the satellite model for credit unions, exploring the use of a broader set of explanatory variables. Additional satellite models that could be included in the ST framework (e.g., for net interest margin or non-interest income) could also be developed. In addition, the CBB's internal macroeconomic projection framework should be further developed to generate suitable adverse macroeconomically consistent scenarios for ST.

The cooperation between the CBB and the FSC should be further strengthened. A group of experts specialized and trained in ST needs to be established in both institutions, and regular cooperation between those

two teams must be set up. As the CBB has more resources for economic research, it could support the FSC in analytical work and estimate models to provide projections for the credit union sector. Moreover, further synergies should be explored by enhancing internal cooperation among stress test, economic research, statistics, and supervision teams.

The supervisory reporting templates for both banks and credit unions should be revised to include missing information relevant for ST and financial stability monitoring. Given that both types of credit institutions now rely on the IFRS 9 approach to classify loans and create loan loss provisions, segment-specific data on the structure of loans by IFRS 9 stages, stage-specific provision stocks, flows among the stages (including loan cures), and NPL write-offs should be newly collected within the supervisory reporting. Additionally, loan interest rate data collected by the CBB and FSC should be further enhanced to include loan rates on both stocks and flows separately for at least the key types of loans (i.e., mortgages, car loans, other personal loans, and corporate loans).

A bottom-up stress test exercise for banks, and later also for the largest credit unions, could be considered to complement the top-down ST in the medium term. This could help to improve ST tools further and enhance the cooperation between the financial stability/ST and supervision teams. The top-down exercise could be used to set up benchmarks for validation of the bottom-up stress test results. As the bottom-up exercise is more resource-intensive compared to the top-down stress tests, a lower frequency would be envisaged, such as once every two years.

Regarding the data warehouse and credit registers, the FSC and CBB should follow up on the recommendations provided during the CARTAC TA mission in February 2023. A joint data warehouse for both institutions with software and tools to process large data with full flexibility should be set up. This would greatly support general macro-financial analysis, economic modeling, and ST. In addition, well-designed credit registers with loan-specific data would enhance the quality of risk monitoring conducted at the CBB and FSC and help improve satellite models for credit risk.

Table 1. Key Recommendations

Recommendations	Priority	Timeframe[1]
Technical aspects of ST		
1. Become familiar with the new macro ST tool to make regular updates.	High	Near term
2. Improve the underlying satellite models for credit risk, in particular, estimate sectoral credit risk models for mortgages, personal, and corporate loans.	High	Medium term
3. Explore other satellite models that could be included in the ST framework – e.g., net interest margin or non-interest income.	Medium	Medium term
4. Develop further the CBB's ability to generate suitable adverse macrofinancial consistent scenarios for ST.	High	Medium term
Use of the stress test results and communication		

[1]Near term: < 12 months; Medium term: 12 to 24 months.

Recommendations	Priority	Timeframe[1]
5. Conduct regular (at least twice a year) top-down stress test exercises with the new framework, ideally in spring and autumn.	High	Near term
6. Publish the aggregate stress test results of the spring exercise in the annual FSR and include a description of the new stress test framework as a "research note" in the FSR when the results are published for the first time.	High	Near term
7. Share and discuss the stress test results with the supervision departments and use them in the conduct of supervision and supervisory reviews.	High	Near term
Operational aspects and processes		
8. Establish a group of experts (ST team) in the CBB and the FSC to specialize and train in ST.	High	Near term
9. Enhance the cooperation between the CBB and the FSC, with the CBB supporting the FSC in analytical work and economic modeling.	High	Near term
10. Strengthen the cooperation among the ST, economic research, statistics, and supervision teams.	High	Near term
11. Develop a step-by-step user guide covering other key internal steps (besides the user manual prepared for the ST toolkit), such as data preparation or validation, to enable knowledge retention within the institution and business continuity.	High	Medium
12. Consider conducting a bottom-up stress test exercise for banks and, later, the largest credit unions to complement top-down ST.	Medium	Medium term
Data sources and their management		
13. Include important information for ST that is not currently reported in the supervisory reporting templates for both banks and credit unions (e.g., IFRS 9 stages and stage-specific provisions for key loan segments, flow data including new NPLs, and loan cures).	High	Medium term
14. Follow up on the recommendations provided during the CARTAC TA mission in February 2023 to set up a data warehouse and software/tools to process large data. Consider setting up a joint data warehouse for the CBB and the FSC.	High	Medium term

Recommendations	Priority	Timeframe[1]
15. Follow up on the recommendations provided during the CARTAC TA mission in February 2023 to set up credit registers to enhance risk monitoring and satellite models for credit risk.	High	Medium term

Table of Contents

Acronyms and Abbreviations

CAR	Capital Adequacy Ratio
CARICOM	Caribbean Community
CARTAC	Caribbean Regional Technical Assistance Centre
CBB	Central Bank of Barbados
ECL	Expected Credit Loss
FSC	Barbados Financial Services Commission
FSR	Financial Stability Report
GDP	Gross Domestic Product
IFRS	International Financial Reporting Standards
IMF	International Monetary Fund
LGD	Loss given default
NIM	Net interest margin
NPLs	Non-performing loans
PD	Probability of default
RWA	Risk weighted assets
ST	Stress testing

Preface

At the request of the Central Bank of Barbados (CBB) and the Barbados Financial Services Commission (FSC), a CARTAC mission was organized in person from July 31 to August 11, 2023, to assist the authorities in developing a new solvency ST framework.

The mission was conducted by Mr. Petr Jakubik (long-term expert) and Mr. Adam Gersl (short-term expert). The preparation meetings were conducted via Webex.

The mission met with the CBB Governor, Kevin Greenidge; CBB Deputy Governor, Mr. Alwyn Jordan; FSC Chief Executive Officer (CEO), Mr. Warrick Ward; CBB Director of Research & Economic Analysis Department, Mr. Anton Belgrave; CBB Deputy Director of Research & Economic Analysis Department, Mr. Carlon Walkes; FSC Manager – Credit Unions, Mr. Curtis A. Lowe; and other experts from both CBB and FSC involved in ST and financial stability analysis. The mission wishes to thank all CBB and FSC staff for their hospitality, cooperation, and productive discussions.

I. Introduction

1. **The mission followed up on the February 2023 CARTAC technical assistance recommendation to enhance the existing stress test (ST) methodologies.**[2] The February mission discussed the key parameters of the existing ST framework at the CBB and FSC published in the FSR, which is based on the first-generation Cihak-type simple top-down stress tests using a static balance sheet approach.[3] A move towards a dynamic balance sheet approach with explicit macroeconomic scenarios and a longer stress test horizon was recommended.

2. **This mission focused on developing a new multi-factor, multiperiod solvency ST framework for banks and finance companies[4] supervised by the CBB and credit unions supervised by the FSC.** It reviewed the available data, discussed the regulatory framework, and constructed two new ST tools that are tailor-made to fully respect the existing accounting, tax, and regulatory rules for both types of credit institutions. The new framework is based on common explicit macroeconomic scenarios and two newly built credit risk satellite models for NPLs for banks/finance companies and credit unions. The calibrated macroeconomic scenarios – one baseline and two adverse – enter the NPL satellite models to project NPLs and, ultimately, credit losses. The tools provide scenario-specific macroeconomically consistent projections of institutions' key balance sheets, profit & loss, and capital adequacy items over up to three years.

3. **Illustrative stress tests using March 2023 data for both banks and credit unions were run to demonstrate the use of the new ST tools.** The official CBB macroeconomic projection as of July 2023 was used as the baseline scenario, while the adverse scenarios were calibrated by expert judgment to capture the different severity of economic recessions, with the more severe one assuming a real GDP decline of 8% at the bottom of the cycle. The results suggest that banks are, in general, resilient to economic stress, given their relatively high initial capital adequacy and good pre-provision profitability. Credit unions appear somewhat more vulnerable to worsening the economic situation mainly due to lower initial capital buffers.

4. **The CBB and FSC ST teams were trained to use and update the new ST tools.** Both tools are prepared to handle any end-quarter initial data for banks and credit unions' balance sheets and P&L and thus can be updated, and new stress tests run at a quarterly frequency if needed. Apart from the institutions' initial data, macroeconomic time series need to be updated, too, and new macro projections for the scenarios provided. Both authorities were instructed on how to set the various parameters and assumptions, calibrate scenarios, and interpret the results. In addition to the Excel-based tools and EViews files with the credit risk models, a detailed user manual for each tool was delivered, as well as a step-by-step checklist that should be followed when updating the tool and running a new stress test.

5. **The findings and recommendations were discussed in the wrap-up meeting with both teams and at the final meeting with the CBB Governor, CBB Deputy Governor, and FSC Chief Executive Officer.** The recommendations are included in this report and relate to (i) technical aspects of ST, including estimating additional satellite models, (ii) the use of stress test results and their communication, (iii) operational processes, and (iv) data sources. An emphasis was put on enhancing the cooperation among both authorities in ST and financial stability monitoring in general, reflecting the continuing practice of having the stress tests

[2] CARTAC Technical Assistance on the Barbados Financial Stability Report was conducted from 30th January to 3rd February 2023.

[3] See Cihak, M. (2007): Introduction to Applied Stress Testing, IMF Working Paper 07/59.

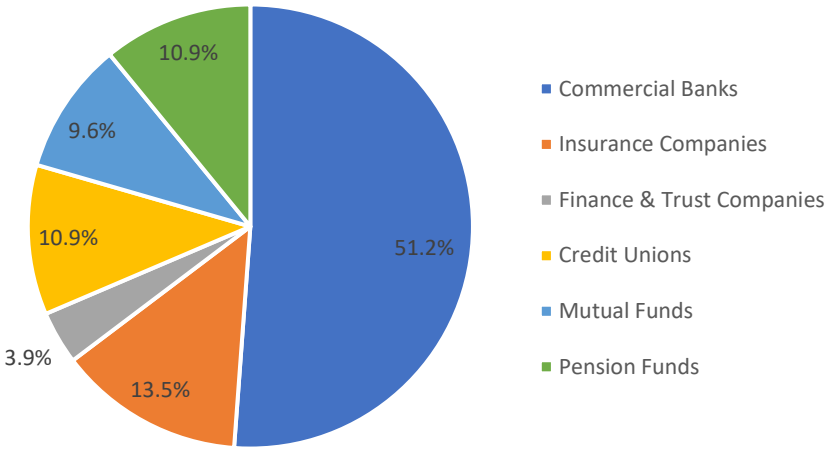
[4] The CBB is responsible for regulating and supervising both banks and finance and trust companies, and the regulation, business model, and reporting are the same for both institutions. When referring to banks in this report, we mean banks and finance companies.

prepared simultaneously by both institutions using the same set of common scenarios developed by the CBB, and results discussed in the Financial Stability Report written jointly by the two authorities.

II. Background Information

6. **The banking sector (together with finance and trust companies) in Barbados is relatively large, amounting to about 135% of GDP, corresponding to about 55% of total financial sector assets** (Figure 1)**.** There are five banks (93% of the sector) and four finance& trust companies (7% of the sector). Towards the end of 2022, a new bank entered the market, but its size was still small, and, given the lack of history for this new institution, it was not yet covered in the stress tests. All banks are universal, focusing on lending to corporations and individuals. Finance and trust companies have similar business models, but two tend to focus mostly on lending to individuals, while the remaining two focus on both sectors. Loans are the main asset item, accounting on average for about 50% of assets (data as of March 2023), with slightly more than half of it reflecting loans to households and the rest loans to corporates and other sectors. The remaining assets are composed of claims on the central bank (22% of assets, primarily compulsory reserve requirements), debt securities (17% of assets, dominated by domestic government securities, although foreign government bonds and local private bonds are there, too), claims on banks (8% of assets, including claims on banks abroad which are either parent banks or correspondent banks), and other assets (3%, including fixed assets).

Figure 1: Distribution of Financial Sector Assets



Source: Central Bank of Barbados and Barbados Financial Services Commission.

7. **All banks and finance & trust companies are subject to the same capital regulation based on the Basel II standardized approach.** The minimum capital adequacy is set at 8% (4% for Tier 1 capital ratio); Pillar 2 capital add-ons or regulatory capital buffers, as we know from Basel III, still need to be used. The risk weighting scheme is relatively simple, with the highest 100% risk weight assigned to the majority of lending to the private sector (corporate loans, loans to households not secured by real property, private bonds, etc.) as well as to fixed assets and investments (equities held). Fully secured residential mortgages attract a preferential risk weight of 50%, while claims on banks would typically be weighted by 20% risk weight. Claims on the central bank, domestic government, and other approved governments (including advanced countries bonds such as US treasuries and bonds issued by CARICOM governments) are assigned a 0% risk weight. There are capital requirements for operational and market risk, additional regulation on reserve requirements at the CBB, required liquidity (in terms of liquid assets ratio), and large exposures, which are in line with best practices.

8. **Loan classification and regulatory provisioning rules are in place, but banks and finance & trust companies create loan loss provisions based on the IFRS 9 Expected Credit Loss (ECL)**. As is the case in most emerging markets, an existing regulation valid since 1998 requires the institutions to classify all loans into five credit quality classes (good/pass, special mention, substandard, doubtful, and loss), with criteria largely in line with other countries (special mention loans being past due 30 – 90 days, substandard more than 90 days, etc.). The regulation specifies the minimum regulatory provisioning ratios that are applied on gross amounts (without taking into account the value of collateral) but are relatively low in international comparison, especially for the first three classes (0% for pass loans, 0% for special mention, substandard 10%, doubtful 50%, and loss 100%). In addition, loans in the substandard class that are collateralized by financial collateral or government guarantees and residential mortgages classified as substandard are further exempted from provisioning (0% provisioning coefficient). This leads to relatively low required regulatory provisions. Banks typically report more than two times the required amount of provisions using the IFRS 9 provisioning in which both good loans (Stage 1), problem loans (Stage 2, roughly equivalent to special mention), and non-performing loans (Stage 3) – even those covered by collateral such as mortgages – might require some provisioning.

9. **Banks and finance & trust companies appear well-capitalized and profitable.** The aggregate capital adequacy ratio was 18.6% (18.0% Tier 1 ratio) in March 2023, ranging between 13% and 35% across the institutions, with a sufficient buffer above the required minimum. The profitability is good, with an average (before-tax) return on assets (RoA) of 1.6% and (after-tax) return on equity (RoE) of 11.4% in the last four quarters ending with March 2023. Apart from a relatively low 5% corporate income tax, banks and finance & trust companies also pay a special bank tax of 0.35% of financial assets, which brings the final RoE down compared with the relatively high RoA. The profits are mainly driven by net interest income, with an interest margin of about 4% (defined as net interest income in a year over average interest-bearing assets). This reflects the interest-setting behavior of banks and finance companies, with rather a low remuneration on deposits and loan rates hovering around 5-6% over the past three years. The non-interest income (fees, commissions, etc.) is about half of the net interest income and thus also represents an important source of income that serves as a first line of defense against possible shocks such as larger-than-expected credit losses. At the same time, however, the institutions show quite a large cost-to-income ratio (non-interest expense to the net interest and non-interest income) of 65%. Impairments were negative over the past two years, reflecting a release of precautionary provisions created during the uncertain COVID-19 times and contributing to good profitability.

10. **The NPL ratio in the banking sector has been declining over the past two years.** Without finance & trust companies, the banks' aggregate NPL ratio declined from its COVID-19 peak in June 2021 of 10.6% to 7.3% as of March 2023. This reflects mostly reclassifications of loans (loan cures), where many loans that have been classified as substandard or doubtful due to a drop in clients' revenues during the pandemic have reversed back to standard or watch status after the economy and tourist arrivals rebounded. Some roles (albeit relatively small ones) have also been played by NPL write-offs (which are obligatory if an NPL is in the loss class). An important driver of the decline in the NPL ratio has also been a pick-up in credit growth. The March 2023 NPL ratio level for banks and finance companies was 5.6%.

11. **Credit unions represent a comparatively smaller sector, about 28% of GDP.** There are 28 credit unions in Barbados, with the largest five representing about 90% and the largest eight representing about 95% of the market. Even if there are many small institutions, the largest credit unions are larger than all the finance & trust companies, and one is even larger than the smallest bank. Like other countries, they are based on membership (members being both the shareholders, depositors, and borrowers), with a strong social function supporting local developments. They lend only to individuals for various purposes (mortgages for house and land purchases, car loans, other personal loans, loans to small entrepreneurs, etc.), with mortgages representing more than 50% of their loans. Even if the sector is small, credit unions' lending to individuals accounts for about 1/3 of the total loans to individuals in the market.

12. **Credit unions' assets are dominated by loans, reflecting their business model.** Using data for the largest eight institutions as of March 2023, the share of lending to total assets was 63%, while holdings of bonds (mostly local government bonds) accounted for 6% and placements (deposits) at domestic banks for 8% of assets. The rest includes other assets, mostly fixed assets. There are no reserves at the Central Bank and almost no exposure to banks, governments, and corporates abroad. This reflects their business model, which is primarily aimed at lending locally, with liquidity managed by keeping cash, deposits at local banks, and government bills and bonds.

13. **The regulation of credit unions differs from that of banks.** The legislation allows the FSC to use the capital ratio (capital to total assets) to monitor the capital position of credit unions. The FSC can launch supervisory actions such as suspension of certain operations or dividend payouts should the capital ratio be "declining fast", with a risk of approaching zero.[5] But the legislation does not define any minimum capital ratio – instead, it proposes a maximum capital ratio of 10% (which is however not followed by the institutions as many show capital ratios above that level).[6] Also, there is no regulation on loan classification and provisioning, although the FSC collects data for the largest institutions on loans classified into buckets by days past due, which are similar to the ones used by banks. Thus, the FSC can monitor credit quality developments and the evolution of the NPLs. Credit unions use IFRS 9 ECL provisioning for their loan portfolios, and the total amount of provisions is reported to the FSC. Still, not much is known about the underlying credit risk parameters.

14. **Credit unions appear to be less capitalized than banks and less profitable.** As credit unions still need to (yet) use risk-weighted capital ratios, it is tricky to compare the level of capitalization. The aggregate capital-to-assets ratio for the largest eight credit unions was 11.1%, while the same measure for banks (using Tier 1 ratio to total assets) was at a similar level of 11.2%. However, a large part of credit unions' assets are loans, riskier than other assets, such as claims on CBB, government bonds, and interbank deposits, representing a larger part of the banks' assets. If we used a simplified risk weighting scheme for credit unions (mortgages 50%, other loans 100%, deposits at banks 20%, government bonds 0%, fixed and other assets 100%) and added a similar share of operational risk capital requirement, the capital adequacy ratio for the largest credit unions would be around 12%-14%, lower than the banks' Tier 1 ratio of 18%. Also, the profitability of credit unions is much smaller, with RoA at 0.5% and RoE at 4.6% (even though credit unions do not pay any taxes). Deposit rates are higher at credit unions than at banks, especially for savings deposits, which attract new funding sources and support the expansion of balance sheets, with higher credit growth than in banks. Deposits at credit unions are not insured, with the FSC only now preparing the deposit insurance scheme that would need to pass the legislation process. The net interest margin is larger (6% compared to 4% in banks), driven by higher loan interest rates. However, non-interest income is small (only about 20% of the net interest income level), and operating costs are high (cost to income of around 85%).

15. **NPLs in the credit union sector are higher than in the banking sector.** The March 2023 figure for the largest eight institutions was 12% (compared to 5.6% of banks and finance companies). While the pre-COVID level of the NPL ratio was around 9.5% and comparable to banks, it rapidly increased during the COVID-19 pandemic, reaching a maximum of 14.1% in June 2021. Since then, the ratio has slowly declined, but at a slow pace, reflecting low write-offs (there is no obligation to write off bad loans as is the case in banks) and slow cures and recoveries, reflecting the fact that most of the loans are to individuals who could only recently benefit from the improvement in the labor market amid the renewal of tourist inflows.

16. **Credit risk is the key risk for all credit institutions in Barbados**. The economy is highly concentrated in tourism despite government efforts to diversify towards new sectors such as renewable energy or logistics,

[5] , This is a general guidance without a numerical benchmark, left for expert judgment by the FSC.

[6] This regulation aims to incentivize credit unions to extend new lending and distribute rather than retain any accumulated earnings to perform their "social" function. The FSC plans to improve capital regulation by introducing a risk-weighted measure of capital adequacy similar to banks, defining credit-union-specific minima based on the credit union size (higher minima for the more important institutions), and removing the maximum capital ratio requirement.

trying to become a hub for the shipment overseas of agricultural products from the whole region. Loan repayments are thus dependent mostly on tourist arrivals (hotels, restaurants) and accompanying services, which was visible, especially during the COVID-19 period, where NPLs increased despite a loan repayment forbearance program that was introduced during the pandemic. While banks currently maintain relatively strict credit standards and rely on centralized risk management by the parent companies, mostly banks in advanced countries, they also report problems with foreclosing real estate collateral for defaulted mortgages due to slow legal processes. Credit unions' risk management practices are weaker than those of banks.

17. **Market risk does not represent a significant risk for credit institutions in Barbados, but given the experience of the 2018 government default, sovereign risk needs continuous monitoring.** FX risk is muted due to a long-standing peg of the Barbados dollar to USD (2:1), with FX reserves kept at a sufficient level supported by capital controls and IMF programs. Even if credit institutions hold bonds, they do not typically mark them to market and hold them until maturity, so there is almost no bond repricing in the institutions' portfolios. Also, using derivatives or performing active trading in financial markets is not common. The only risk in this area remains a possible sovereign risk, as Barbados has already experienced it during 2018, with an impact on credit losses for banks and credit unions due to the restructuring of government debt. This risk needs to be continuously monitored and included in ST.

III. Building the ST Tools

18. **The mission developed two Excel-based macro-ST tools – one for banks/finance & trust companies and one for credit unions.** The new framework explicitly projects the key balance sheet items (such as performing and non-performing loans across the main loan segments, loan loss provisions, total and risk-weighted assets, and capital) and P&L items (net interest income, other income and expenses, and credit losses) over a horizon of up to three years. The loan segments are set differently for the two sectors – for banks, the tool works with 11 segments (can be increased up to 15 if needed), including the public sector, financial institutions, manufacturing, agriculture, hotels and restaurants, mortgages to individuals, and other household loans, while for credit unions, only two loan segments are used – mortgages and other personal loans. The tools can be run on any end-quarter data and generate results using the evolution and contribution charts to visualize better the key drivers of changes in capital adequacy for banks and capital ratio for credit unions. The tools also include a detailed step-by-step guide in the form of a checklist to follow at every new round of ST. Detailed user manuals were prepared for each tool and shared with the authorities.

19. **Both tools are tailored to the existing accounting, tax, and regulatory rules for both types of credit institutions.** In particular, the projected loan loss provisions for both sectors are based on the IFRS 9 Expected Credit Loss concept (in a simplified way, using proxies and additional assumptions), as this is the approach that both institutions use in practice. The provisioning rates for various credit quality classes of loans are thus time-varying, increasing in bad times and decreasing in good times, creating an additional channel through which adverse economic conditions impact credit institutions. The definition of regulatory capital for banks, including the limits on the inclusion of selected Tier 2 items (such as general provisions), is respected, together with different minimum capital adequacy ratio levels for Tier 1 and total regulatory capital. For credit unions, the risk-unweighted capital ratio (using total assets as the denominator) is implemented, with the possibility of setting any hurdle rate as no regulatory limit is currently applied. In addition, the ST tool for credit unions already includes the possibility of using risk-weighting of assets and calculating the stress test results in terms of capital adequacy, as risk weighting is planned to be introduced in the sector in the near future. Finally, the tool for banks includes corporate income tax and the newly introduced tax on assets, while the tool for credit unions respects that these institutions do not pay taxes.

20. **The new framework is based on common explicit macroeconomic scenarios**. It is expected that both authorities would run the stress tests at the same time, typically twice a year, and the CBB would, for each round of stress tests, prepare common macroeconomic scenarios used for both sectors. The baseline scenario would reflect the most recent official CBB macroeconomic forecast. In contrast, two adverse scenarios (titled “moderate” and “severe”) would be calibrated to capture different intensities of an economic recession. The macroeconomic projection framework at the CBB that is used for the baseline scenario can also be used for the adverse scenarios, as it includes various interlinkages among key macroeconomic variables and economic sectors to safeguard consistency and can project variables in quarterly frequency for the next three years. The key macroeconomic variable that would always be projected for all three scenarios and that would typically drive the stress test results via its impact on credit risk is the real GDP growth; other variables include inflation, the unemployment rate, and eventually, some additional indicators from the monetary side (interest rates), external side (current account) or fiscal side (fiscal balance and debt). Given that credit unions are more exposed to households while banks are to corporates, the key drivers and corresponding macroeconomic variables impacting credit risk most prominently might differ. Since the macro scenario will be common for both types of institutions, the scenario’s design could consider this and either accordingly, calibrate two different adverse scenarios or switch focus between the rounds. The macro projections also provide the credit forecast to the private sector, which is used as input to calibrate loan portfolio growth for banks and credit unions and leads to a dynamic feature of the stress test in which the institutions’ balance sheet size changes over time.

21. **The scenario-specific macroeconomic projections are used to predict non-performing loans (NPLs) with two newly constructed credit risk satellite models for banks and credit unions, respectively.** The CBB and the FSC had no credit risk model in place before the mission. For both sectors, the NPLs were available as a relatively long time series (since the 1990s for banks and since the 2000s for credit unions), and macroeconomic variables such as real GDP growth, unemployment, interest rates, and inflation were also available for a sufficiently long period, all in quarterly frequency. Given that flow-based credit risk indicators such as default rates, new NPLs, probabilities of default (PDs), or migration matrices were not available, the mission estimated the credit risk models using the aggregate NPL ratio as the dependent variable. The mission explored various options, such as (i) two aggregate models – one for banks and one for credit unions - where the NPLs would be the aggregate across all loan segments, (ii) separate models for three main borrower segments (such as corporate loans, mortgages, and other personal loans), either jointly for banks and credit unions (three models) or separately for banks (three models) and credit unions (two models, as there is no corporate lending), (iii) separate models for more granular borrower segments, such as the different economic sectors and industries (i.e. having more models for corporate NPLs). Given the length of available time series, structural breaks in reporting, and the need to have as many business cycles captured by the data as possible (preferably including also the 2008 global financial crisis), option (i) was chosen, and two NPL models – one for banks and one for credit unions – were estimated. Option (ii) and option (iii) are left to the CBB and the FSC to explore further and possibly include in the framework if the estimation results are satisfactory.

22. **The final specifications of both NPL models were prepared in EViews and shared with the authorities.** After testing various options, both final models are the same in terms of the explanatory variables, although the estimated coefficients differ. They both use the four-quarter moving average of the year-on-year real GDP growth rate and an autoregressive term (lagged dependent variable) controlling for the strong persistence of the NPL ratio (see the precise specifications and model diagnostic statistics in the Annex). The dependent variable is expressed in the logistic transformation to prevent possible model-based projections that could lie outside of the 0%-100% range. The models are relatively simple but perform well in and out of the sample. They are sufficiently “sensitive” in producing reasonable NPL increases in case of adverse economic developments. More complex models can be constructed in the future and integrated into the ST tools by the authorities.

23. **For each institution, the absolute change in the projected aggregate NPL ratio is applied to each loan segment's starting NPL ratio level.** Using absolute rather than relative changes ensures that even institutions with a 0% starting level of the NPL ratio in some loan segments are hit by new NPLs in times of adverse economic developments. Additionally, it is possible to provide additional expert-based adjustments of the projected NPL ratio and combine the NPL model projections with explicit segment-specific NPL ratio add-ons, enabling the ST of selected industries beyond the average impact of economic recession on NPLs.

24. **In addition to the NPL ratio, the ST tools project the special-mention-to-performing loans ratio for each institution and segment.** Both credit institutions now use IFRS 9 to create provisions, and provisioning rules are different for the three IFRS 9 credit quality "stages". As the breakdown by IFRS 9 stages is not collected by the authorities, the tools approximate them with the credit quality classes reported to the CBB by banks (good/pass loans represent Stage 1, special mention loans represent Stage 2, and non-performing loans represent Stage 3) and classes of loans by days past due reported to the FSC by credit unions (loans not past due or up to 30 days Stage 1, loans past due 30-90 days Stage 2, and loans past due more than 90 days Stage 3). In adverse economic conditions, the proportion of special mention (Stage 2) loans in performing loans typically increases, along with the NPL ratio. Instead of estimating a separate model, the projection for the special-mention-to-performing loans ratio is linked to the projection of the NPL ratio, using an elasticity specified as a parameter that is set by expert judgment and can be changed if needed. The loan growth projection calibrated as part of the scenario and, for simplicity, applied equally across all loan segments and institutions, would then jointly with the credit risk projections (NPL ratio, special-mention-to-performing loans ratio) determine the paths of the good, special mention and non-performing loan exposures.

25. **The projection of loan loss provisions is based on the assumptions about the provisioning rates for the three credit risk classes, approximating the IFRS 9 Expected Credit Loss.** The NPL provisioning levels are institution- and segment-specific, constructed for each year of the horizon as the starting NPL provisioning rate of the institution in that segment plus an assumed increase of around 10-20 ppts (cumulative) in both adverse scenarios (typically no change from the starting level for the baseline scenario). This shock can be set separately for each scenario and year and reflects a worsened recovery of bad loans, for example, due to a decrease in collateral value. This change in the NPL provisioning level is then used as a proxy for a change in the Loss Given Default (LGD), which is needed to approximate the changes in provisioning for S1 (one-year ECL) and S2 (lifetime ECL) loans. The other key credit risk parameter required by the ECL is the PD, which is – as a proxy – derived from the NPL ratio projections, assuming a certain level of NPL write-offs. The changes in PD and LGD are then used jointly to project changes from the initial provisioning rates for S1 and S2 loans, with an additional expert adjustment using a pre-defined (and changeable) passthrough elasticity to safeguard relatively smooth changes over time. In the case of banks, provisions created for good loans are considered general provisions and qualify as Tier 2 regulatory capital up to 1.25% of credit risk-weighted assets, which is in line with Basel standards, which is reflected in the tool.

26. **Final loan loss provisions impacting the P&L are derived from the projected stocks, considering scenario- and year-specific NPL write-offs.** These are calibrated by expert judgment using the information about past write-offs in banks, which are available at the CBB. Even if the model projects unchanged NPL stocks, new provisions might still need to be created, accounting for the NPL inflows that are needed to keep NPLs stable amid NPL write-offs. The information about loan write-offs is not collected for credit unions, so the parameter was set to be the same as for banks but can be changed once the FSC gets this data.

27. **Projections of additional financial assets, other than loans, such as debt securities, exposure to the CBB (in the case of banks), and claims on banks, can be specified.** The calibration of these growth rates can follow the assumptions for loan growth but can also be done by expert judgment depending on observed developments and the scenario considered. The evolution of such asset items is needed because they have an impact on total (and some also on risk-weighted) assets, and some also form a part of interest-bearing assets along the loans, so their growth would ceteris paribus also increase the projection of the net interest income.

28. **No market risk impact is assumed.** This reflects the common practice of banks and credit institutions in Barbados to not mark to market the securities held in their balance sheets to account for market interest rate developments. Banks and credit unions hold government securities, which are an important source of interest income but they are not revalued. For the FX risk, the long-standing peg of the Barbadian dollar to the USD virtually removed the exchange rate risk in the institutions' balance sheets and was thus not considered an item to be stressed.

29. **Concentration and sovereign risk can be stress tested.** The exposure to one or more of the largest five (for credit unions, the largest 25) borrowers can be stressed, assuming an LGD calibrated at any level between 0% and 100%. This is a traditional concentration risk stress test that is typically applied as a sensitivity test and additional shock within one of the adverse scenarios. Also, given the recent experience with the sovereign default in 2018, sovereign risk can be directly tested as an extended specification of a selected scenario via applying a haircut to domestic government bond holdings, reflecting a loss due to a possible government debt restructuring. This should ideally be done regularly, both for internal and external purposes.

30. **Pre-provision income is projected as a sum of net interest and non-interest income minus non-interest expenses, serving as the first defense against credit losses.** Net interest income is a product of the institution-specific net interest margin (defined as the initial ratio of net interest income to interest-bearing assets adjusted for a possible haircut in adverse scenarios) and scenario-specific interest-bearing assets, which typically decline in adverse scenarios amid the migration of performing loans into NPLs. Thus, even if the net interest margin remains constant, the net interest income would drop with the underlying pool of interest-bearing assets. A decrease in net interest margin could be assumed in case of increased funding costs caused by possible funding liquidity pressure, which can be driven, for example, by concerns about the

financial sector's stability in times of bad economic developments. This could become a real threat in the credit union sector, where deposits are not insured. Non-interest income and expenses are projected to be a product of the institution-specific starting point and a haircut set by expert judgment.

31. **Capital is projected consistently with the existing regulatory framework, changing over the horizon as a function of net income.** Negative net income – accounting loss – decreases capital. In contrast, positive net income is first subject to the distribution decision so that only the retained part (after the dividend payouts) is topping up the capital. The assumptions about dividend payouts are institution-specific, reflecting their typical dividend payout behavior. Banks do not typically pay dividends, so this parameter would usually be set to zero, while credit unions pay small amounts (5-10% of profit) to their members.

32. **Total assets are projected as the sum of time-varying net loans and other financial assets, while credit risk-weighted assets (RWAs) are projected as a function of net exposures and the initial average risk weight.** This is implemented in both tools, even if credit unions still need to start using a risk-weighting scheme for assets. RWAs for market and operational risk are kept constant. Total assets and RWAs will thus be driven by credit growth, the evolution of the NPL ratio, and provisioning, and both would typically decline in adverse scenarios amid very low or negative gross credit growth, migration of a large part of loans to NPLs, and higher average NPL provisioning, bringing the net value of loans down. This typically helps the capital ratios somewhat, but the effect is small compared to the effect of economic recessions on capital, especially if the credit institutions run large accounting losses.

33. **The tools report the key results based on capital ratios.** Apart from the scenario-specific evolution of the capital adequacy ratio for banks (and capital ratio for credit unions), the tools show the factors that contribute to the changes in the capital (adequacy) ratio such as net interest income (+), other income/expenses (+/-), credit losses (-), dividend payouts and taxes (-), and the change in the denominator of the ratio, i.e. (risk-weighted) asses (+/-). Also, a number of institutions in each year and scenario that are below a specified hurdle rate for the total capital (adequacy) ratio (and Tier 1 ratio for banks) and their share in the sector's assets is reported, together with capital injections (expressed as a % of GDP) that are needed to bring all institutions to at least the minimum capital (adequacy) ratio.

34. **Table 2 summarizes the key components of the developed stress testing methodology for banks and credit unions.** Where appropriate, the differences between the approach applied to banks and credit unions are shown.

Table 2. Overview of the Key Components of the Stress Testing Methodology

Component	Banks[7]	Credit Unions
Institutional perimeter	All institutions (5 banks, 4 finance & trust companies)	8 largest (but the tool can accommodate up to 30 credit unions)
Key variables in which macroeconomic scenarios are calibrated	Real GDP growth, y-o-y % Inflation, y-o-y % Unemployment rate, % Private sector credit growth, y-o-y%	

[7] Banks also include the "trust and finance companies".

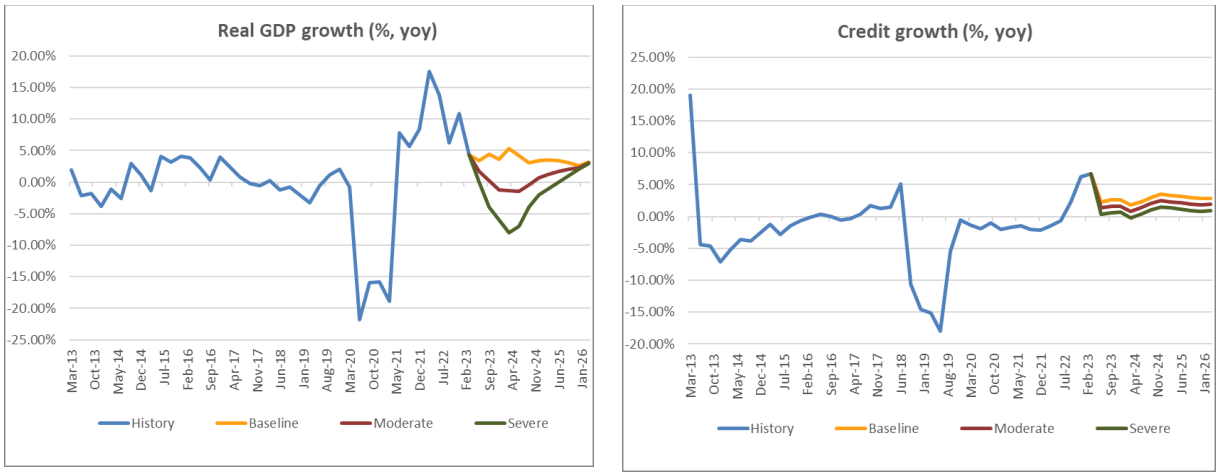
Component	Banks[7]	Credit Unions
Credit risk satellite model	Dependent variable: logistic transformation of NPL ratio Explanatory variables: autoregressive term, GDP growth, constant logNPLr = -0.115 + 0.944 * logNPLr(-1) – 2.710 * MOVAV(GDP growth, 4 quarters)	Dependent variable: logistic transformation of NPL ratio Explanatory variables: autoregressive term, GDP growth logNPLr = 0.995 * logNPLr(-1) – 0.765 * MOVAV(GDP growth, 4 quarters)
Additional credit risk assumptions that need to be set	Assumed (annual) NPL write-off rate, % Change in NPL provisioning from initial level, ppts	
Assumptions for the development of balance sheet items	Annual growth, %, for: - Claims on CBB domestic currency - Claims on CBB FX currency - Debt securities with zero risk weight - Debt securities with a positive risk weight - Claims on banks	Annual growth, %, for: - Debt securities - Claims on banks
Concentration risk	Need to specify - which out of 5 largest borrowers fail - In which year of the horizon - loss given default in %	Need to specify - which out of 25 largest borrowers fail - In which year of the horizon - loss given default in %
Sovereign risk	Need to specify: - In which year of the horizon sovereign default happens - Haircut in %	
Assumptions for pre-provision income	Scenario-specific change in net interest margin applied on institution-specific initial level, ppts Scenario-specific change in non-interest income applied on institution-specific initial annual volume, % Scenario-specific change in non-interest expense applied on institution-specific initial annual volume, %	
Additional assumptions	Dividend payout rate Minimum total regulatory capital ratio Minimum Tier 1 regulatory capital ratio	Dividend payout rate Minimum capital ratio

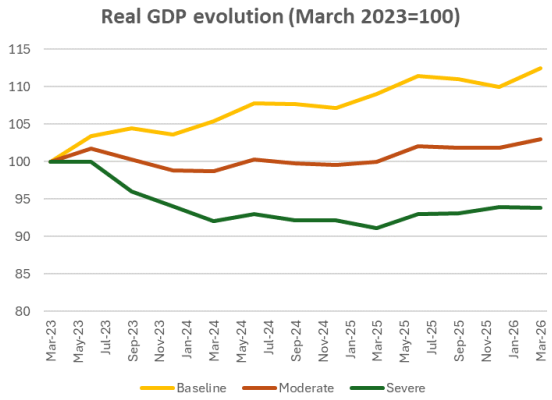
IV. Results of Illustrative Stress Tests

35. **The mission prepared a set of illustrative STs for banks and credit unions using March 2023 data.** Five banks, four finance companies, and the eight largest credit unions were covered by the STs. The macroeconomic scenarios were calibrated by the mission in cooperation with the CBB and the FSC. The baseline scenario captures the official CBB forecast as of July 2023. The Severe scenario was calibrated to reflect a 2-standard deviation shock to the GDP growth, assuming a real GDP decline by 8% at the bottom of the cycle. The Moderate scenario captures a milder recession, with GDP growth values set as averages of the baseline and the Severe scenarios values (Figure 2). Both adverse scenarios reflect a possible deterioration in tourism revenues and a resulting economic recession hitting the economy, similar to the 2009-2011 post-Global Financial Crisis period or the recent 2020-2021 COVID-19 recession.

36. **Currently, the two key macro-financial variables from the CBB macroeconomic projection framework that are used are real GDP growth and (nominal) credit growth.** While the NPL models require real GDP growth, the tools need the credit growth assumption to project the evolution of loan exposures over time. The credit growth assumption for the baseline scenario is based on the official forecast. At the same time, it was calibrated by expert judgment to be somewhat lower (but not extremely low) for the adverse scenarios. Calibration of macroeconomic variables other than real GDP growth and credit growth (e.g., unemployment rate, inflation, interest rates) were discussed, but the trajectories were not prepared for the illustrative STs. However, going forward, the CBB should calibrate the scenarios and include all other relevant variables to support the narrative. Also, they may be needed if some of the satellite models for NPLs or other variables are re-estimated in the future with an alternative set of explanatory variables.

Figure 2. Macroeconomic Scenarios Used for the Stress Test

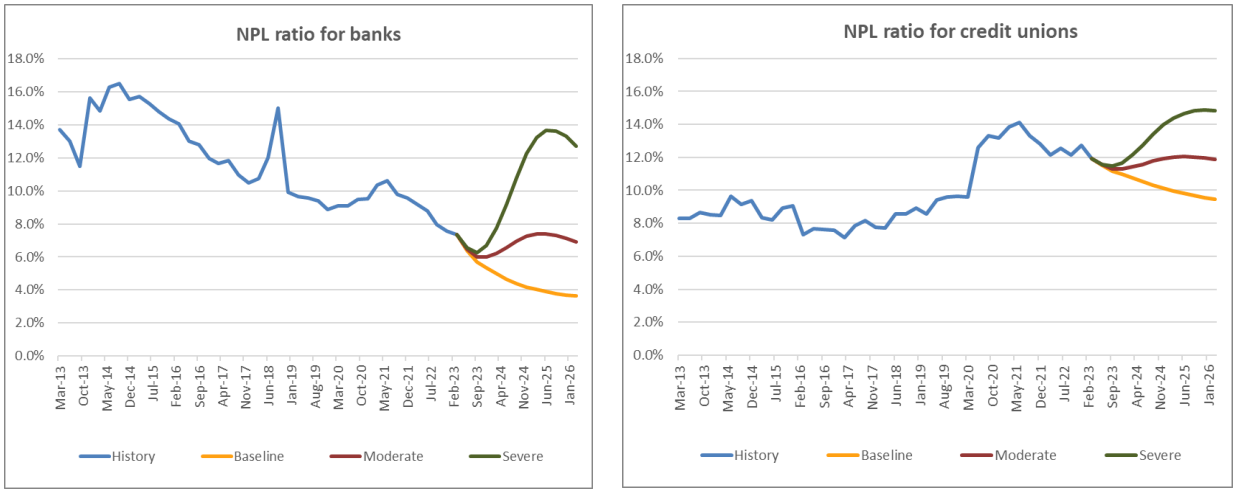




Source: Central Bank of Barbados, mission team calculations

37. **The NPL models project the NPL ratios in banks and credit unions.** In both sectors, the baseline scenario assumes a continuous decline in NPLs amid a relatively good projection of economic growth in this scenario (Figure 3). For the Severe scenario, in the case of credit unions, there is an increase in the NPL ratio to the high levels experienced in the COVID-19 times, where most clients could not use the loan forbearance programs as these were only targeting borrowers with a drop in income (mostly businesses) rather than a loss of income (mostly individuals losing a job). For banks, the projected increase in the NPL ratio is somewhat lower than the post- Global Financial Crisis peak in 2014 or the 2018 sovereign restructuring peak (driven by the classification of loans to the government as NPLs in that year) but higher than the COVID times peak in 2021. For the Moderate scenario, NPLs are projected to increase only slightly. No sector-specific shocks or failures of the largest borrowers are assumed.

Figure 3. NPL Ratios in the Stress Test



Source: Central Bank of Barbados, Financial Services Commission, mission team calculations

38. **Additional assumptions of the stress tests that significantly impact the projected loan losses are related to NPL provisioning and NPL write-offs.** For both banks and credit unions, a shock to the NPL provisioning rate (a proxy for LGD) of 10 ppts in the Moderate scenario and of 20 ppts in the Severe scenario was assumed and applied in the first period of the horizon (the increased NPL provisioning rate was kept for the next two years). On average, the starting NPL provisioning was 43% for banks and 22% for credit unions, so for the Severe scenario, these rates would increase to about 63% and 42%, respectively. The NPL write-

off rate was set to equal 10% for the baseline, 15% for the Moderate, and 20% for the Severe. The increase in the NPL write-off rate with the severity of the economic recession reflects the regulation that asks banks to write off loans that are in the loss category (i.e., more than 360 days past due). The same assumptions were kept for credit unions, even if no such regulation on write-offs existed.

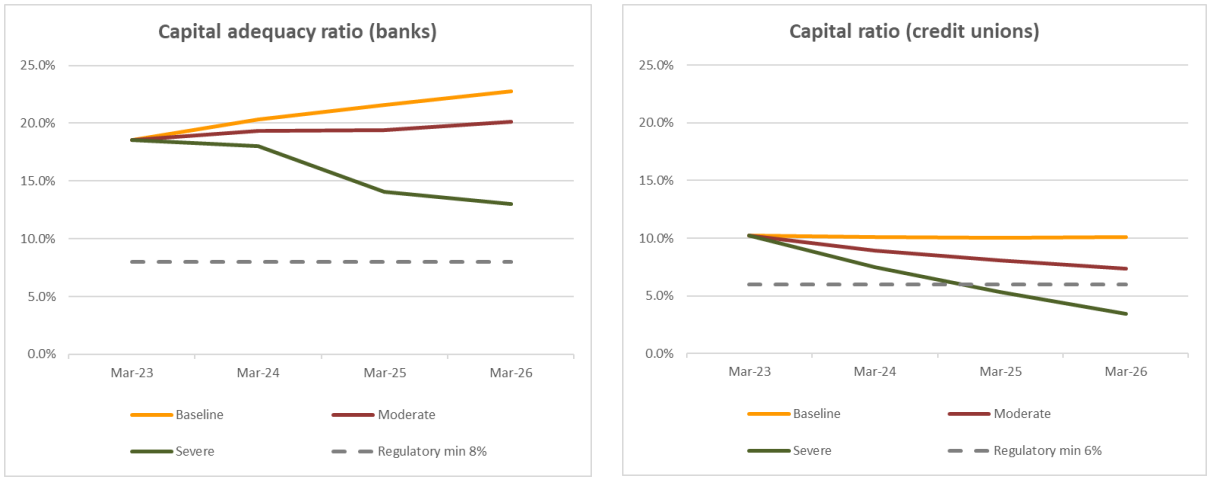
39. **Loan losses in both sectors would be relatively small in the baseline scenario but increase dramatically in the Severe scenario.** In this adverse scenario, the implied PD proxy would increase more than three times for banks and roughly two times for credit unions, which, together with the LGD increase, would also increase the S1 and S2 provisioning rates by a factor of between two (credit unions) and three (banks). For banks, the stock of loan loss provisions would increase about three times over the 3-year horizon, with large new provisioning of around 4.5% per year on average (credit loss rate defined as new provisioning booked in the P&L over the initial stock of net loans). This contrasts with the baseline scenario's credit loss rate which hovers around 0.1% per year. For credit unions, the loan loss provisions would more than double over the next three years, and the credit loss rate would also reach levels around 4.5% per year (compared to around 1% in the baseline).

40. **Pre-provision income would continue to serve as a first line of defense against credit losses but would be lower in the adverse scenarios.** The net interest margin was assumed to remain at the initial institution-specific levels, but the underlying interest-bearing assets are, in general, lower in the adverse scenarios, leading to a lower net interest income. This is driven mainly by the evolution of performing loans (which decline given their move to the NPL category), as the additional asset items that might bring interest income, such as debt securities, reserves at the CBB (for banks), and claims on banks were assumed to remain at the initial level in this illustrative stress tests, for simplicity. The non-interest income was assumed to remain at last year's baseline level and drop by 5% and 10% in the Moderate and the Severe, respectively. Non-interest expenses are assumed to remain stable in all scenarios.

41. **While banks would, on average, become loss-making only in the Severe scenario, credit unions would experience negative profitability already in the Moderate scenario.** Given large non-interest expenses, credit unions are operating with a thinner profit margin, so a small drop in pre-provision income and larger credit losses may quickly lead to accounting losses. On the other hand, banks have a larger pre-provision buffer and can withstand the shocks better despite paying the asset-based tax of 0.35% of assets and, if profitable, the 5% corporate income tax. For banks, zero dividend payouts were assumed, while for credit unions, a 10% dividend payout rate was applied for all tested institutions (applicable only if they were profitable).

42. **The results suggest that banks are generally resilient to economic stress, given their relatively high initial capital adequacy and good pre-provision profitability.** In aggregate, the sector's capital adequacy ratio (CAR) would grow both in the baseline and the Moderate scenario due to continuing profitability, with all the earnings retained given no dividend payouts (Figure 4). In the Moderate scenario, two institutions with a small share of the sector's total assets would get below the 8% CAR limit, which would require capital injections of 0.3% of GDP. Only in the Severe scenario would the sector's CAR drop significantly but remain above the limit, with three institutions below the minimum and capital injections of 1% of GDP. The contribution of the individual factors in the Severe scenario over a 3-year horizon is shown in Figure 5.

Figure 4. Capital Ratios in the Stress Test



Source: Central Bank of Barbados, Financial Services Commission, mission team calculations

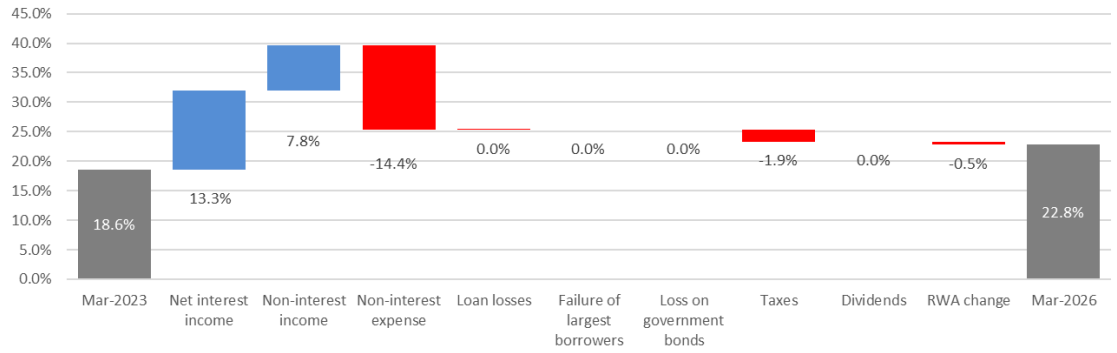
43. **Credit unions appear somewhat more vulnerable to worsening the economic situation mainly due to lower initial capital buffers.** In aggregate, the capital ratio of the credit unions' sector would slightly decline (by 0.1 pp) in the baseline even when most institutions remain profitable as the sector, compared to banks, is much less profitable and low profits (the only source of regulatory capital in the illustrative scenarios) do not keep up with the growth of assets due to the assumed credit growth. Also, there are dividend payouts decreasing the additions to retained earnings (Figure 4), while in the banking sector, the dividend payout ratio was assumed to be zero.[8] In the Moderate and Severe scenarios, the drop in capital is driven by negative net income, bringing the capital ratio to low levels. As there is no official regulatory limit for the capital ratio, after the discussion with the FSC, an illustrative minimum of 6% was used to assess the stability and resilience of this sector. Using this hurdle rate, one credit union in the Moderate scenario and three credit unions in the Severe scenario would be below the limit, requiring a capital injection of 0.1% and 0.9% of GDP, respectively. The contributions of the individual factors in the Severe scenario over a 3-year horizon are shown in Figure 6.

44. **Under these illustrative scenarios, simulated capital shortfalls in the Severe scenario can point to potential systemic losses and pockets of vulnerabilities in the sector.** Hence, the stress testing exercise can help guide the authorities in formulating suitable policies to safeguard financial stability in Barbados.

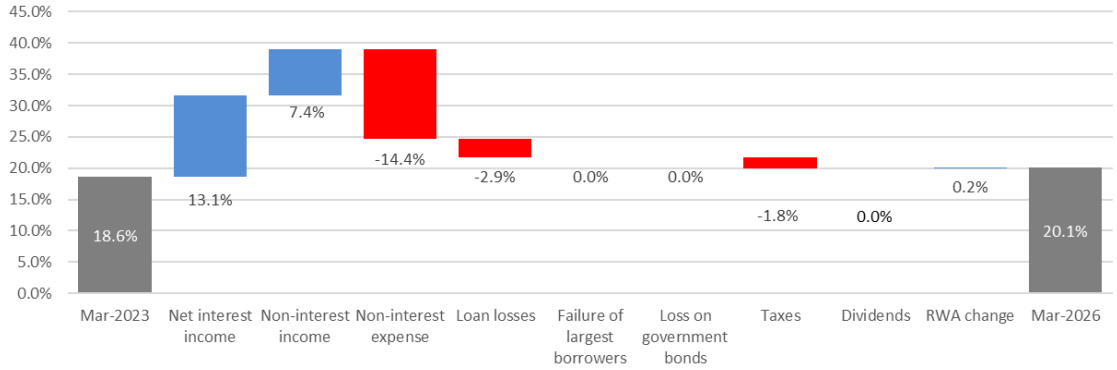
[8] The fact that in the baseline, the NPLs in the credit union sector slightly declined, but the institutions still report some credit losses because we assume positive and relatively large (about 10% annually) NPL write-offs. Thus, even if the stock of NPLs declines, there are NPL inflows (new NPLs leading to new provisions created), but these are smaller than NPL outflows (NPL write-offs and potential cures).

Figure 5. Contribution chart – changes in the bank's aggregate capital adequacy

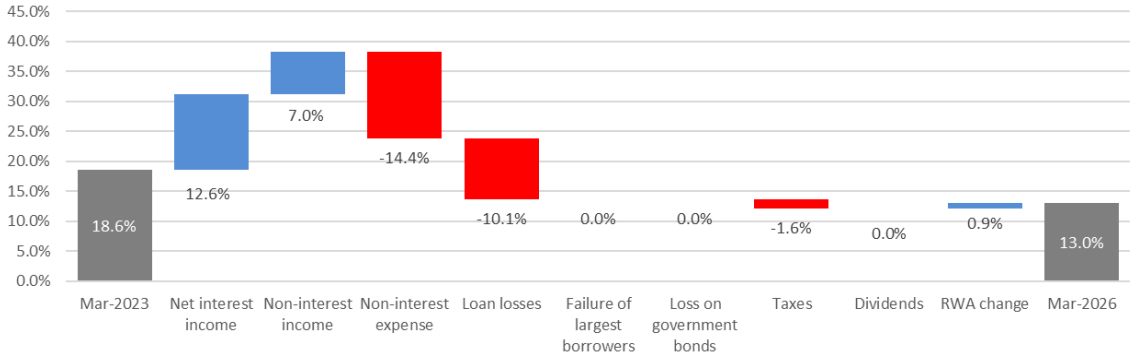
Baseline scenario



Moderate scenario



Severe scenario



Source: Central Bank of Barbados, mission team calculations

Figure 6. Contribution chart – changes in the credit unions' aggregate capital ratio

Source: Financial Services Commission, Central Bank of Barbados, mission team calculations

45. **While the illustrative stress tests demonstrate well how the new ST framework works, additional analysis and some fine-tuning of the scenario calibration are needed before using it for regular ST.** The scenarios need to be prepared in a consistent way for more variables using the official CBB macroeconomic projection framework, with additional variables included to support a better narrative of the

scenarios. The calibration of several parameters, such as the NPL write-offs or the passthrough coefficient, to capture the impact of the changes in PD and LGD on provisioning rates might need to be based on additional analysis and data. The credit growth assumptions, especially for the adverse scenarios, should be based on the existing CBB credit growth model.

V. Recommendations

Area 1: Technical Aspects of ST

46. **The ST teams from the CBB and FSC should become familiar with the new framework to make regular updates.** The staff must be able to update the tool with new macro-financial and institution-specific data regularly, calibrate the scenarios, and adjust additional assumptions and parameters to reflect potential changes in the economy and regulation. The new framework should be used for regular internal stress tests at least twice a year – once in the spring and once in the autumn.

47. **Credit risk modeling as the key part of the new framework should be further improved.** The satellite models for credit risk for banks and credit unions estimated during the TA mission were using aggregate NPL ratios, for which a long time series was available. However, new sectoral credit risk models, at least for mortgages, personal loans, and corporate loans, should be estimated as they could better capture different risk drivers for those segments. The research team in the CBB could also assist the FSC in re-estimate the satellite model for credit unions, exploring the use of a broader set of explanatory variables.

48. **Apart from credit risk, other satellite models can be constructed and included in the ST framework.** The CBB and the FSC should explore the possibility of further improving the framework by estimating other econometric models for selected items that are currently based only on simple assumptions (averages or last year's values, adjusted by expert judgment). In particular, a model-based projection of net interest margin/income and non-interest income would be good examples of such potential improvements.

49. **Finally, the CBB should further develop its ability to generate suitable adverse macrofinancial-consistent scenarios for ST.** The CBB's internal macroeconomic projection framework is in place, but the calibration of macroeconomic variables other than the real GDP growth and credit growth (e.g., unemployment rate, inflation, interest rates) for adverse scenarios might be needed in the near future both to support the narrative of the scenarios and as additional explanatory variables for the improved and new satellite models for both banks and credit unions.

Area 2: Use of Stress Test Results and Communication

50. **The CBB and the FSC should regularly conduct top-down stress test exercises with the new framework at least twice a year.** Since the results of the stress tests are included in the FSR, which is published every summer, one exercise should be carried out in spring to ensure that the report contains the most up-to-date data. A second run of the exercise could be conducted in the fall for internal purposes to monitor any emerging risks and resilience of the tested institutions.

51. **The aggregate stress test results of the spring exercise should be published in the annual FSR.** Given that stress test results are a regular part of the FSR, it is important that the readers fully understand the differences between the results in the old and new frameworks. In this respect, a detailed description of the new framework, including all key assumptions, should be provided as a "research note" in the FSR once the results are published for the first time.

52. **Stress test results should be shared and discussed with the Supervision Departments in both the CBB and the FSC.** Stress tests are useful not only from a macroprudential but also from a microprudential point of view. Hence, the results should be used in the conduct of supervision and supervisory reviews of individual banks and credit unions. This would also trigger some synergies between the financial stability and supervision teams, helping to improve the calibration of the ST framework further or reflect on any changes

in the banking and credit unions' sectors. Also, given the important share of government bonds with zero risk weights in banks' portfolios and the experience of the 2018 sovereign default, stress test results not only in terms of regulatory capital ratios but also risk-unweighted capital ratios for banks should be monitored.

Area 3: Operational Aspects and Processes

53. **The CBB and the FSC should establish a group of experts specializing in ST.** It should involve at least two experts in each authority to ensure business continuity. These experts should continuously develop relevant skills and be trained in ST. Sufficient seniority of at least one team member should be ensured for both the CBB and FSC teams.

54. **The CBB and the FSC should further enhance their cooperation.** The two authorities have already cooperated on several issues relating to financial stability, particularly when preparing the joint FSR. To fully implement the newly developed TS framework, the teams of both authorities should work closely together, discuss the calibration of the scenarios and additional assumptions and parameters, and, over time, focus on improving the satellite models. The CBB, which has more resources and knowledge in this area, should support the FSC in analytical work and estimating models to provide projections for the credit union sector.

55. **Additionally, collaboration between the ST, economic research, statistics, and supervision teams within both authorities should be enhanced.** Financial stability topics are complex and require understanding economics, finance, statistics, supervision, and regulation. To thoroughly identify, monitor, and assess emerging risks that have the potential to become systemic, it is crucial that all teams working in the areas mentioned above coordinate their efforts and explore mutual synergies. To take advantage of the pooled expertise accessible in both authorities, the teams should collaborate more closely and avoid working in silos.

56. **In the medium term, conducting a bottom-up stress test exercise for banks and, later, for the biggest credit unions can be considered.** This would strengthen the risk analysis of both sectors and foster better cooperation between the teams in charge of financial stability/ST on the one hand and supervision on the other. The results of the bottom-up stress tests might be validated using the top-down exercise, which could be used to set up proper benchmarks. Simultaneously, the bottom-up exercise would provide additional insights and a more detailed calculation of the impact of selected shocks, such as on the level of loan loss provisions that are difficult to estimate precisely in the top-down stress tests. Given that the bottom-up exercise requires more resources than the top-down stress tests, a lower frequency for initial rounds, such as every two years, would be expected.

Area 4: Data Sources and Their Management

57. **Missing information pertinent to ST and financial stability monitoring, in general, should be added to the supervisory reporting templates for both banks and credit unions.** Given that both types of credit institutions now classify loans using the IFRS 9 approach and create loan loss provisions based on the ECL, new data should be collected within the supervisory reporting such as (i) segment-specific structure of loans by IFRS 9 stages, (ii) segment- and stage-specific provision stocks, (iii) flows between the three IFRS 9 stages (including loan cures), and (iv) NPL (Stage 3 loans) write-offs. Furthermore, loan interest rate information gathered by the CBB and FSC must be further enhanced to include loan rates for both stocks and flows separately for at least the key loan types (i.e., mortgages, car loans, other personal loans, and corporate loans).

58. **The recommendations made during the CARTAC TA mission in February 2023 to establish a data warehouse and software/tools to process large data should be followed up on by the CBB and the FSC.** One of the main obstacles to financial stability work, including ST, is the need for a data warehouse. Any data manipulation in this situation is inherently inefficient, resulting in additional costs due to labor-intensive data processing. In this context, it is necessary to set up a fully flexible data processing solution with

an analytical mirrored database of the live database. A joint data warehouse should be set up for both authorities, ensuring confidentiality by setting up different access rights. This would greatly support general macro-financial analysis, economic modeling, and ultimately ST.

59. **In addition, a well-designed credit register with loan-specific data would enhance the quality of risk monitoring conducted at the CBB and the FSC and help improve satellite models for credit risk.** This aligns with the recommendations provided during the February 2023 CARTAC TA mission. A joint credit register for banks and credit unions is highly recommended, ensuring confidentiality by setting up different access rights. Similar to the data warehouse, a fully flexible solution for data processing using an analytical mirrored database needs to be set up. Moreover, the system should allow combining data from the credit register and the data warehouse for analytical purposes.

VI. Conclusions

60. **The mission developed two multi-factor and multiperiod solvency ST tools - one for the CBB to stress test banks and one for the FSC to stress credit unions.** Both tools were tailor-made to fully respect the existing accounting, tax, and regulatory rules for both types of credit institutions. They are based on common macroeconomic scenarios and two newly estimated credit risk satellite models for NPLs for banks and credit unions. The tools provide scenario-specific macroeconomically consistent projections of institutions' key balance sheets, profit and loss, and capital adequacy items over a period of up to three years.

61. **Two illustrative stress tests using March 2023 data for both banks and credit unions were run.** The baseline scenario was based on the official CBB macroeconomic projection as of July 2023, and the adverse scenarios were calibrated by expert judgment covering the different severity of economic recessions. The results reveal that banks are, in general, well resilient due to their relatively high initial capital adequacy and good pre-provision profitability. On the contrary, credit unions appear somewhat more vulnerable to a worsening economic situation mainly because of lower initial capital buffers.

62. **The mission provided several recommendations to the CBB and FSC in four areas.** They covered technical aspects of ST, the use of the ST results and their communication, related operational aspects and processes, data sources and their management.

Annex: Credit risk models

Credit risk model for banks

Dependent Variable: LOGIT_NPLR
Method: Least Squares
Date: 06/02/24 Time: 19:47
Sample: 2007Q1 2020Q1
Included observations: 53

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGIT_NPLR(-1)	0.944892	0.029261	32.29134	0.0000
@MOVAV(GDPG,4)	-2.710876	0.648926	-4.177480	0.0001
C	-0.115635	0.069535	-1.662965	0.1026

R-squared	0.956051	Mean dependent var	-2.281685
Adjusted R-squared	0.954293	S.D. dependent var	0.600393
S.E. of regression	0.128360	Akaike info criterion	-1.213023
Sum squared resid	0.823810	Schwarz criterion	-1.101497
Log likelihood	35.14510	Hannan-Quinn criter.	-1.170135
F-statistic	543.8366	Durbin-Watson stat	1.976177
Prob(F-statistic)	0.000000		

Credit risk model for credit unions

Dependent Variable: LOGIT_NPLR
Method: Least Squares
Date: 08/10/23 Time: 06:56
Sample: 2007Q1 2020Q1
Included observations: 53

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGIT_NPLR(-1)	0.995430	0.005723	173.9419	0.0000
@MOVAV(GDPG,4)	-0.765416	0.533910	-1.433606	0.1578

R-squared	0.780396	Mean dependent var	-2.525431
Adjusted R-squared	0.776090	S.D. dependent var	0.223863
S.E. of regression	0.105930	Akaike info criterion	-1.615066
Sum squared resid	0.572282	Schwarz criterion	-1.540715
Log likelihood	44.79925	Hannan-Quinn criter.	-1.586474
Durbin-Watson stat	2.830430		