TECHNICAL ASSISTANCE REPORT

JAMAICA

Systemic Risk Monitoring

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Executive Summary

The mission aimed to build up capacity to enhance financial stability analyses and assessments in the Bank of Jamaica (BOJ). It reviewed the latest available Financial Stability Report (FSR) and the analytical toolkit. In particular, the mission helped the BOJ to estimate sectoral credit risk models to enhance the forward-looking element of its financial stability assessment.

The estimated credit risk models will allow the BOJ to project the impact of different macroeconomic scenarios on banks' balance sheets. The mission explained the Bayesian Model Averaging (BMA) approach as the suitable methodology for short time series of sectoral non-performing loans. It provided R script with initial estimates for five sectoral credit risk models – mortgages to households, personal loans, corporate loans for tourism, corporate loans for construction, and other corporate loans. The estimated models allow the BOJ to make NPL ratio projections by employing the macroeconomic forecasting framework that is available to the BOJ. Moreover, the mission discussed how to measure financial stability, credit risk, and stress testing, insurance & pension economic balance sheets and corresponding financial stability risks, basic elements of climate risk, interconnectedness, and contagion risk. Special attention was devoted to the macroprudential policy as the BOJ is in the process of setting up macroprudential tools, particularly in the near term, the systemic risk buffer and, in the medium term, borrower-based tools. In this context, the mission explained methodological approaches calibrating loan-to-value ratio (LTV) and countercyclical capital buffer (CCyB).

The mission provided several recommendations to the BOJ. They covered the financial stability report (FSR), methodological work on the BOJ financial stability analytical toolkit, internal and external communication, data sources and their management. Those outcomes reflect on both the structure of the organization in the BOJ considering the financial stability agenda as well as the composition of the financial system in Jamaica that is dominated by commercial banks (40% of the total financial system assets [TFA] in 2023) and securities companies (15% of TFA in 2023). Pension funds (11% of TFA in 2023) and insurance companies (8% of TFA in 2023) assets are lower but still significant.

Financial stability should be seen as equally important as monetary policy and supervision. This needs to be reflected in the BOJ's external communication and internal processes. For the FSR, a project group/coordinator should be established. A detailed production plan that provides a sufficient time frame for internal discussion and analytical work should be prepared. It needs to be complemented by a detailed external communication strategy, including actively promoting financial stability reports via press conferences, social media, seminars with market participants, interviews, etc. The foreword of the report could help communicate the Governor's key messages. Moreover, the background figures/statistics published in the FSR could be provided together with the report on the BOJ website, and the date of the publication should be stated in the report. The report should be streamlined, providing fewer nominal figures to follow the central risk story and using appropriate language understandable not only to supervisors or financial stability experts but also to the public. All additional information should be moved to annexes, including a statistical annex. The current boxes resemble thematic/special feature articles that should be moved after the main part of the FSR. The key arguments/ messages from the boxes must be integrated into the main text/ body of the FSR.

Financial stability analyses spelled out in the FSR, and the corresponding toolkit should be strengthened to be more forward-looking. Credit risk plays a key role in the Jamaican financial system. Therefore, its analysis should be substantially enhanced. In this respect, the newly established models and their initial estimates could help, but other indicators to complement NPL ratios, such as the probability of default, should also be explored. Moreover, as a crucial risk for the insurance and pension sector, market risk should be enhanced based on the economic balance sheets of insurance companies and pension funds to capture underlying risks for the sectors. Besides traditional risks, BOJ should also regularly report on new emerging risks in its FSR, especially climate

and cyber risks, as their surveillance should fall within the scope of the Financial Stability Department. In addition, econometric modeling should be employed to project other key financial institutions' balance sheet items under different adverse scenarios. Given the amount of existing analytical work employed in the FSR, it could be considered to publish a comprehensive methodological document covering the whole financial stability toolkit to have one reference for FSR readers to understand better the results reported.

Financial stability indicators need to be communicated together with the key aspects of the existing regulatory framework. This is the case for all segments of the financial system, not only banks and securities companies but also insurance companies and pension funds, where especially liabilities might not be reported as market-consistent values, therefore not capturing underlining risks. This needs to be reflected in the FSR to focus on identifying key risk drivers and their discussion rather than simply describing the reported indicators. In this context, non-bank analysis should be improved considering the upcoming IFRS17 reporting for the insurance sector.

In the context of twin-peaks regulation, the non-bank analysis should be improved. For the insurance sector, the role of reinsurance needs to be considered to understand the potential implications of any instability in the sector. For the pension sector, defined benefits (DB) and defined contribution (DC) schemes need to be distinguished when making financial stability assessments.

The BOJ should organize all data in one data warehouse and fully utilize them for analytical purposes to support the financial stability analytical toolkit. A copy of the database – mirroring database – should be set up for analytical purposes. The statistical mirroring database needs to support analytical tools to process large data (e.g., R), as data should be processed directly at the server. Any chosen data management solution needs to provide full flexibility to conduct any complex analysis that might not be possible to foresee when setting up the BOJ data management system. Moreover, the BOJ could consider setting up a centralized credit register at the bank as a rich data source to be utilized for analytical purposes to calculate important financial stability indicators such as default rates or average LGDs. In the meantime, any existing data gaps could be covered by different surveys.

Recommendations	Priority	Timeframe[1]
Financial Stability Report and methodological work on financial stability toolkit		
1. Financial stability analyses spelled out in the FSR and corresponding toolkit should be strengthened to be more forward-looking.	High	Medium-term
a. The FSR should be streamlined to follow the central risk story, using appropriate language that is understandable not only to supervisors or financial stability experts but also to the public. All additional information should be moved to annexes, including a statistical annex.	High	Near-term
b. Credit risk and market risk analysis should be improved.	High	Medium-term

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

Recommendations	Priority	Timeframe[1]
c. Econometric modeling should be employed to project key financial stability variables, and the initial estimates of sectoral credit risk models developed during the mission should be further improved.	High	Medium-term
d. Non-bank analysis in the context of the new regulatory regime (twin-peaks) should be improved.	High	Medium-term
2. Financial stability indicators need to be communicated together with the key aspects of the existing regulatory framework for different segments of the financial system.	High	Near-term
3. New emerging risks, such as cyber and climate risks and their surveillance, should fall within the scope of the Financial Stability Department and should be consistently covered in the FSR.	High	Near-term
4. Given the amount of work already done, BOJ could consider publishing a comprehensive methodological document covering the whole financial stability analytical toolkit.	Medium	Medium-term
Internal processes and external communication		
5. A detailed FSR production plan providing a sufficient time frame for internal discussion and analytical work should be prepared.	High	Near-term
6. The external communication strategy related to financial stability should be further developed.	High	Near-term
7. The background figures/statistics could be provided together with the FSR on the BOJ website.	Medium	Near-term
8. The foreword in the FSR should be used to communicate the Governor's key messages.	Medium	Near-term
9. FSR publication date should be stated in the report.	Medium	Near-term
Data and their management		
10. The BOJ should organize all data in one data warehouse and fully utilize them for analytical purposes to support the financial stability analytical toolkit.	High	Medium-term

Recommendations	Priority	Timeframe[1]
11. The BOJ could consider setting up a centralized credit register at the bank.	High	Medium-term
12. Any existing data gaps could be covered by different surveys with financial institutions/market participants.	Medium	Medium-term

Table of Contents

Acronyms and Abbreviations

AFSI	Aggregate Financial Stability Index
AST	Aggregate Stress Test
BOJ	Bank of Jamaica
BSI	Bank Stability Index
CARTAC	Caribbean Regional Technical Assistance Centre
CAR	Capital Adequacy Ratio
CCA	Contingent Claims Approach
CCyB	Countercyclical Capital Buffer
CISS	Composite Indicator of Systemic Stress
CoVaR	Conditional Value-at Risk
DB	Defined contribution
DC	Defined benefit
EWS	Early Warning System
FDI	Financial Development Index
FSC	Financial Services Commission
FSI	Financial Soundness Index
FSR	Financial Stability Report
FVI	Financial Vulnerability Index
GDP	Gross Domestic Product
HP	Hodrick–Prescott
IFRS	International Financial Reporting Standards
IMF	International Monetary Fund
JSE	Jamaica Stock Exchange
LGD	Loss given default

LTV	Loan-to-value ratio
MaFi	Macro-financial index
MiPi	Micro-prudential index
NPL	Non-performing loan
PD	Probability of default
PL	Performing loan
RAI	Risk Appetite Index
VAR	Value at risk
WECI	World Economic Climate Index

Preface

At the request of the Bank of Jamaica (BOJ), a CARTAC mission was organized in person from October 19 to October 28, 2023, to assist the authorities in enhancing its systemic risk monitoring.

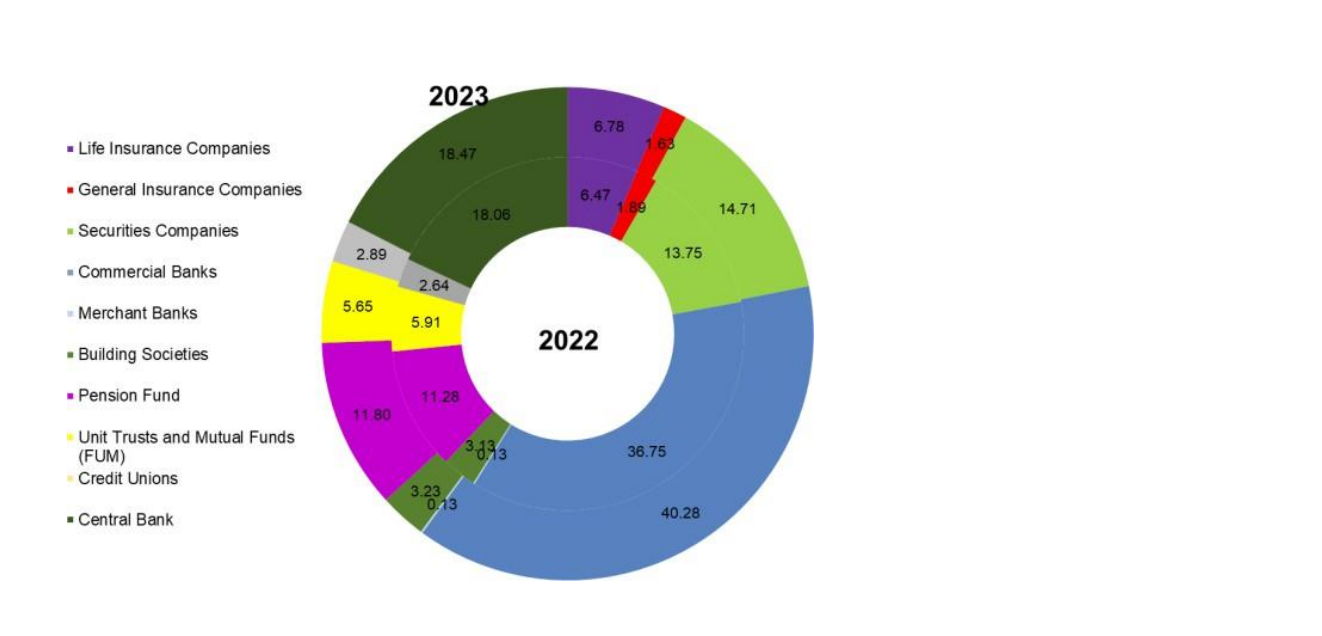
The mission was conducted by Mr. Petr Jakubik. It met with the BOJ Deputy Governor, Financial Stability and Research and Economic Programming, Mr. Robert Stennett, BOJ Head of the Financial Stability Department, Ms. Sherene Bailey, BOJ Head of Financial Risk Management Oversight, Ms. Lisa-Kaye Wallace, BOJ Head of Macroprudential Surveillance & Policy Ms. Andrene Senior, and the staff of the Financial Stability Department. The mission wishes to thank all BOJ staff for their cooperation and productive discussions.

I. Introduction

1. **The mission aimed to build up capacity to enhance financial stability analyses and assessments in the BOJ.** The mission provided a workshop on key aspects of the financial stability agenda covering financial stability and macroprudential policy, financial stability indices, credit risk, stress testing, insurance & pension balance sheets and corresponding financial stability risks, essential elements of climate risk and interconnectedness, and contagion risk. In addition, the mission reviewed the latest FSR together with other provided relevant documents to identify existing gaps. Moreover, the mission also extensively discussed existing and potential new data sources to be utilized for purposes of financial stability. It further focused on data management in terms of the current practices and optimal solutions. In particular, the mission helped the BOJ to estimate sectoral credit risk models to enhance the forward-looking element of its financial stability assessment. The Financial Stability Department primarily received the TA.

2. **The financial system of Jamaica is dominated by banks and securities companies, but pension funds and insurance companies are also significant.** This composition set up the priorities and requisite effort. The total financial assets correspond to 221.4% of GDP at the end of 2023. The financial sector is dominated by commercial banks (40% of TFA in 2023) and securities companies (15% of TFA in 2023). Pension funds (11% of TFA in 2023) and insurance companies (8% of TFA in 2023) assets are lower but still significant.

FIGURE 1. Distribution of financial system assets



Source: Bank of Jamaica.

3. **The key financial stability challenges are rising interest rates and consequent credit and market risk increases, financial groups' interconnectedness, climate, and cyber risk.** This is in line with the risks in other Caribbean countries. However, Jamaica has some specificities compared to other countries in the region. First, Jamaica is a large country in the Caribbean context with a developed security market, but that is not the case for others. Therefore, the impact of market risk is much more substantial. Moreover, the role of security dealers is significant. Security markets contain developed equity markets with the participation of

large institutional investors. Considering credit risk, while personal loans have typically fixed interest rates, mortgage interest rates are somewhat variable.

4. **The mission considered the organizational structure of the BOJ.** The bank is headed by the Governor and supported by five deputy governors and one senior deputy governor. The financial stability role is allocated to the Financial Stability Department, with the head reporting to the Deputy Governor for Research & Economic Programming Division and Financial Stability (the Deputy Governor is also responsible for monetary policy). The department is split into two units – (1) Financial Risk Management Oversight and (2) Macroprudential Surveillance.

5. **The mission's main aim was to enhance financial stability analyses and assessments in the BOJ.** It conducted a review of the financial stability analysis toolkit, identified potential gaps and issues to be addressed by future TAs, and built BOJ's capacity to strengthen the financial stability assessment. The mission used the latest release of the BOJ Financial Stability Report (FSR) available at the time (FSR 2021) and other relevant materials that the BOJ shared during the mission. The focus of capacity building was mainly devoted to credit risk.

6. **The review of the FSR ahead of the mission formed the basis for the targeted workshop and meetings.** The workshop on the findings of the FSR review and best practices in financial stability analyses and assessments was complemented by targeted sessions with the relevant experts. The findings were discussed with the Head of the Financial Stability Department at the end of the mission. The final wrap-up meeting with the Deputy Governor responsible for financial stability was conducted online a week after the mission.

II. Key Elements of Financial Stability Reports

7. **The key elements of good financial stability reports based on the best international practices were highlighted at the beginning of the mission.**[2] As the FSR is the key communication tool for systemic risk monitoring, the mission started with the most important aspects and the gaps of the current FSR. In this respect, the following elements were covered: aims, objectives, and reasons; overall assessments; coverage of issues; data, assumptions, and tools; structure and other features.

8. **FSRs should explicitly state their objectives.** The reports should inform the public and encourage a constructive debate about financial sector developments and policies, holding public authorities accountable for their surveillance of the financial system. The information provided should facilitate a proper assessment of risks by investors active in the market.

9. **FSRs should be clear about what financial stability means.** The definition should include a dynamic perspective: a financial system is stable not only when it is carrying out its essential functions and services but when it is also capable of withstanding the shocks and strains that can be reasonably expected to affect it in the short and medium term. It is important that the report clarify the operational benchmarks used to assess whether the system is stable, explaining what data, indicators, and types of information would be monitored for this purpose.

10. **The executive summary should be brief and easy to read.** A well-articulated executive summary is critical to inform and guide public opinion. A reader should not have to sift through the entire report to distill the main conclusions of the analysis and should be able to understand the key messages of the report even if the reader is not financially sophisticated. More advanced and technical material should be covered in the analytical chapters, preferably in boxes or annexes. The function of the executive summary is to bring together the various strands of analysis developed in the rest of the report, presenting a panoramic and honest view of risks and vulnerabilities, including politically sensitive risks. The executive summary should also discuss how these risks have evolved since the previous issue of the report and provide a summary of the key recommendations.

11. **FSRs should integrate macroeconomic and financial analysis.** This analysis should flow in both directions, assessing the key macroeconomic trends that can have an impact on the stability of the financial sector as well as the key financial sector developments that can, in turn, have an impact on the real economy. The report should identify the main transmission channels that link the financial and real economy and assess in quantitative terms how shocks in one area could reverberate in other areas.

12. **FSRs should not only explain but also properly justify the assumptions used.** This is especially relevant in the case of stress tests, whose meaning and interpretation depend critically on the assumptions made regarding the severity of the shocks, the speed and scale of the impact of shocks on default probabilities, the hurdle rates on capital and liquidity, dividend distribution, and other parameters of the test. Ideally, stress tests should be computed within a general equilibrium framework with the support of satellite econometric models that link macroeconomic and financial conditions. Simpler, partial-equilibrium or even ad hoc tests can also be appropriate. They could be the inevitable consequence of capacity or data constraints, but any limitations of this choice should be described and explained.

[2] See Lim, Ch. H., Klemm, A. D., Ogawa, S., Pani, M. and Visconti, C. (2017) Financial Stability Reports in Latin America and the Caribbean, IMF Working Paper, 17/73.

13. **FSRs should indicate the data and methodology used and make them readily available.** The sources and cutoff date of the data should be indicated clearly and in an easily identifiable place. The data displayed in the reports should also be made available to the public on the internet, on the same website where the reports are published. The methodology used for projections, sensitivity analyses, and stress tests should be explained in clear and simple terms in the text, with more technical details provided in special boxes or annexes. In analyzing the data, the report should consider not only aggregate and average measures but also distributional indicators and, where appropriate, extreme or individual values (with proper safeguards to preserve confidentiality), highlighting, for instance, the position of the weakest or most vulnerable institutions or asset classes.

14. **The reports should follow a logical and integrated structure with unifying themes centered on the key risks.** The structure should enable the reader to identify which parts of the report contain specific information about different topics while also facilitating the discussion of cross-cutting topics. The structure should be consistent over time to allow the reader to compare the assessments and should contain boxes or appendices dedicated to issues that either evolve slowly over time or reflect passing concerns. The reports should have an executive summary, several chapters devoted to external and domestic developments that affect the financial sector and changes in the financial infrastructure, including the regulatory and supervisory framework, and should preferably include a table of acronyms, a glossary of technical terms, a methodological annex, and a statistical annex.

15. **The publication of the reports should be supported by a well-designed communication strategy.** The current and past issues of the reports should be made available on the internet on a dedicated webpage that is easy to navigate and easy to find on the home page of the publishing authority; this page should also contain a database containing the data used as well as links to other relevant publications and to other agencies and sources of information. The launch of the report should be supported by an outreach campaign aimed at disseminating the main messages and recommendations through audiovisual broadcasts, press releases, public presentations, and press conferences. The format and medium of the communication should be adapted depending on the intended audience. The publication of the report should follow a timely, regular, and predictable schedule. As financial sector conditions can change very rapidly, reports should be published within three months of the cutoff date for the data, preferably at least two times a year. The publication date should be announced in advance so that the readers know when to expect the next issue, and it should not change frequently. The past publication dates should also be clearly indicated on the website to enable the readers to know what information was available to the public at different times.

III. Financial Stability Analyses and Assessments and the Corresponding Toolkit

16. **The FSR is regularly published to communicate the key financial stability risks based on the financial stability analyses and assessments that have been conducted.** The report has been published on an annual basis since 2015. It provides clear messages on key vulnerabilities, risks, and policy initiatives containing a macro-financial narrative. The scope covers the macroeconomic environment, deposit-taking institutions, pension funds, collective investment schemes, securities dealers, and life and general (non-life) insurance companies. The report also includes the Foreword with financial stability aims and objectives and uses mission/theme statements to navigate readers throughout the text. Overall, it is better quality compared to FSRs published by most of the other Caribbean authorities.

17. **The BOJ has worked on developing its financial stability toolkit.** It comprises value at risk (VAR) calculation, the macro model for NPL projection based on real GDP development, and macroprudential indices. In addition, the BOJ also regularly conducts stress testing involving interest rates, foreign exchange rates, funding, credit, and contagion risks. The macroprudential indices cover the early warning system (EWS) for the banking crisis, aggregate financial stability index (AFSI), Amihud index of market debt, banking stability index (BSI), composite indicator of systemic stress (CISS), contingent claims approach (CCA), conditional value-at-risk (COVAR), risk appetite index (RAI), Z-score index, financial stability-cobweb, credit-to-GDP gap, TRE spread, network topology indicators, absorption ratio and residential real estate price index. However, a few of the frameworks are not currently operational due to staff loss in some instances. This includes the VaR, Co-VaR, CCA, BSI, and absorption ratio.

18. **The BOJ VAR framework provides a comprehensive assessment of the investment portfolios of Jamaican financial institutions.** It uses historical simulation, variance-covariance, and the Monte-Carlo simulation method. As compared to other Caribbean countries, Jamaican investment portfolios are more material. Therefore, it is important to follow up on the related market risk.

19. **The BOJ uses the estimated macro model to project aggregate NPL development based on real GDP growth.** This allows the BOJ to estimate total credit risk under adverse scenarios, assuming significant drops in GDP. In this way, the BOJ could anticipate the migration of past due and performing loans to NPLs based on historical relationships between those variables and GDP.

20. **The EWS framework monitors the health of the banking sector.** It examines the latest values of an indicator relative to its tranquil period that is composed of the micro-prudential index (MiPi) involving the monitoring of a set of banking sector indicators and the macro-financial index (MaFi) constructed to reflect the influences of the financial sector, the real sector, the private sector, the public sector, and the external sector on bank soundness. The signals from the MiPi and the MaFi are based on EWS scores for each indicator, computed based on the number of standard deviations of each indicator from its 'tranquil period' mean.

21. **The AFSI represents a single quantitative measure of financial stability comprising microeconomic, macroeconomic, and international factors indicative of banking sector performance.** These indicators reflect different aspects of financial stability, including financial development, financial vulnerability, financial soundness, as well as the world's economic climate. Sub-indexes capture those different dimensions of financial stability, specifically, the financial soundness index (FSI), the financial vulnerability index (FVI), the world economic climate index (WECI), and the financial development index (FDI).

22. **The Amihud Index of market depth can be interpreted as the daily price response associated with one dollar of trading volume and serves as a rough measure of price impact.** The index covers both foreign exchange (FX) and stock exchange markets, and it is measured by the absolute daily change in asset prices divided by the absolute daily level of trading volumes (turnover). For markets with lower depth, the impact of volumes traded on the price of an asset will be more significant. Reductions in the index suggest that daily volumes traded have a minimal impact on asset prices and suggest more significant depth.

23. **The BSI is an aggregate financial stability indicator for the banking sector, which combines partial indicators of soundness, asset quality, profitability, liquidity, IRR, and foreign exchange risk.** The index assesses each partial indicator in terms of standard deviations from its historical average. The averages are computed for a 10-year period or the available data if only a shorter period is available.

24. **The CISS measures the joint impact of activity in the money, equity, bond, and foreign exchange markets.** An increase in the CISS indicates a high degree of correlation between markets, which aggravates systemic risk. When the correlation between markets is low, the risk is reduced. Activity in the money market is measured using an interest rate spread as well as changes in the money market rate. Measures of bond market activity involve changes in the yields on short-term bonds. In contrast, activity in the equity market is measured by the maximum cumulated loss over a one-year moving window, and equity returns are computed using the Main JSE Index. As it relates to the foreign exchange market, activity is measured by the bid-ask spread and changes in the foreign exchange rate. A sub-index is computed for each market segment to compute the CISS. The stress indicators for each sub-index provide complementary information about the stress level in the specific market segment.

25. **The BOJ uses CCA to compute a probability of default measure using Black-Scholes-Merton's option pricing theory.** It is an equity-based assessment of default risk. The model assesses the likelihood that the market value of an entity (or a sovereign) will fall below the value of its liabilities and assumes that if the value of the firm's assets is less than its total liabilities, then the firm simultaneously defaults, declares bankruptcy and without cost turns control over to the bondholders. Notably, financial firms can have problems meeting even their short-term liabilities and may become insolvent if liquidity is unavailable to meet these obligations.

26. **The BOJ calculates CoVaR by capturing a financial institution's contribution to overall systemic risk based on market data and the value-at-risk (VaR) methodology.** It looks at the impact on the system's VaR when an institution is under financial stress. The calculation uses weekly institutional data (assets and liabilities book value, market value of equity, leverage ratio, and market value of assets) and weekly macro data (interest rate spread, main stock index returns, and their volatility, nominal GDP, inflation, and 180-day T-Bill).

27. **The BOJ calculates RAI to measure changes in risk aversion based on the rank correlation between assets' riskiness and their excess returns.** This index is calculated for Jamaica's Stock Market, Money Market, and Foreign Exchange Market.

28. **The BOJ uses the Z-score index to measure the risk of insolvency based on the interaction of an institution's leverage, profitability, and potential magnitude of return shocks.** It represents the probability that an individual bank's losses exceed its shareholder equity. In other words, the Z-score is used to capture the likelihood of a bank's earnings each year becoming low enough to eliminate the bank's capital base and, thus, the likelihood of the bank becoming insolvent. In addition, the BOJ employs a return on risk-adjusted capital (RORAC) instead of the ROA to obtain a more robust measure of the probability of insolvency. A higher Z-score implies a lower probability of insolvency.

29. **The BOJ also uses a cobweb diagram to assess broad risks to financial stability covering credit markets, the economy, market or funding liquidity, and leverage.** The cobweb diagram distinguishes

vulnerabilities across five different dimensions. Three dimensions are designed to identify the systemic shocks that would trigger major difficulties for financial institutions. These are propagated through the domestic macroeconomic environment, financial market conditions, and the global environment. The remaining two dimensions reflect the capacity of financial institutions to absorb a shock to either side of their balance sheets, measured through their capital and profitability as well as their funding and liquidity.

30. **The BOJ employs credit-to-GDP gaps to capture credit risk accumulation in the financial system and the pro-cyclicality of systemic risk.** It is measured by deviations from the long-term trends derived from the one-sided Hodrick-Prescott filter. In particular, the BOJ uses three definitions – (1) private sector credit[3], (2) total credit (private and public sector credit), and (3) total credit plus investments in public sector bonds. The gaps could be used to calibrate countercyclical buffer (CCyB) once needed.

31. **The TRE spread is another index the BOJ uses to measure the premium price in the repo rate for default risk.** It captures both counterparty risk and liquidity risk in the money market. It is calculated as the difference between the 30-day repo rate and the 30-day T-bill rate.

32. **The exposure-at-default framework captures the vulnerability of financial institutions to large but plausible changes in the macroeconomic (and global) environment, which impact the debt-deficit dynamics of the sovereign.** Financial institutions with significantly large exposures to sovereign debt on their balance sheets are more vulnerable to sovereign debt crises.

33. **The BOJ network topology examines the structure of inter-linkages and bilateral exposures of financial institutions within the network, identifies central institutions in the system, and detects potential shock transmission channels.** A network consists of a collection of nodes (financial institutions) and connections between them (which can be directed or undirected links). Nodes are also referred to as vertices, while links are also referred to as edges. The links represent credit exposures/funding relationships between nodes in the interbank system.

34. **The BOJ absorption ratio measures the co-movement of bank returns, represented by return on assets (ROA) and net interest margin (NIM).** The covariance matrix of bank returns is used to calculate each quarter's absorption ratio using a principal components analysis. Significant upward shifts in absorption ratio indicate possible market fragility as returns across institutions are behaving in a more unified manner.

35. **The BOJ constructed the residential real estate price index as one of the key financial stability indicators.** Econometric estimates of the relationship between the price of residential properties in Jamaica and the characteristics of these properties are produced using market transaction and valuation data on housing units provided by the National Housing Trust. The evolution of the constructed residential real estate price index has yet to signal an excessive build-up of risk in the housing market.

36. **All mentioned elements of the BOJ financial stability toolkit are well documented.** The VAR calculation and macroprudential indices are described in the internal manual, covering all employed data, definitions of all variables, and applied methodologies. The description of a macro model for NPL projection based on real GDP is provided in the FSR.

[3] Private sector credit represents loans and advances extended by commercial banks, FIAs, and building societies, excluding loans to overseas residents plus corporate securities.

BOJ Stress Testing Framework

37. **The stress test framework is based on a simple static methodology covering interest rate, foreign exchange rate, funding, credit, and contagion risks.**[4] The exercise covers deposit-taking institutions and security dealers. It calculates stresses for those mentioned risks separately and combines several stresses – the Aggregate Stress Test (AST). The AST assumes the simultaneous impact of increases in interest rates, currency depreciation, credit quality deterioration, and deposit outflow. In most instances, the specific shocks are calibrated based on the known period of stress in the Jamaican financial system during the early 2000s.

38. **The interest rate stress test assesses the impact of a range of changes in domestic and foreign interest rates on financial institutions' capital adequacy ratio (CAR).** This exercise considers (i) the fair value impact resulting from changes in the prices of securities because of interest rate changes and (ii) the net interest income impact resulting from maturity mismatch between rate-sensitive assets and liabilities. These losses are finally reflected in the impact on the capital buffers of institutions, and any losses more than the buffer reduce the capital base.

39. **The foreign exchange stress test assesses the impact of changes in the foreign exchange rate on financial institutions' CAR.** This exercise evaluates (i) the direct solvency risk impact resulting from changes in financial institution's foreign currency assets and liabilities positions and (ii) the indirect solvency risk impact resulting from an assumed increase in loan loss provisions on foreign currency loans. These losses are finally reflected in the impact on the capital buffers of institutions, and any losses more than the buffer reduce the capital base.

40. **The funding risk stress test calculates the change in financial institutions' liquid assets and CAR resulting from hypothetical runs on banks.** This exercise models a liquidity drain that simultaneously affects all financial institutions in the system. This BOJ exercise allows the BOJ to have varying assumptions on the percentage of deposits that get withdrawn.

41. **The BOJ credit risk stress tests evaluate the impact of shocks to non-performing loans (NPLs) and performing loans (PLs) on the CAR of the banking system.** The impact of increased NPLs and past-due loans (PDLs) leads to increased provisioning, which reduces statutory capital. Increased provisions also improve the risk profile of the portfolio. The exercise employs sectoral loan data and sectoral profile of past due loans (for the sectoral stress test), balance sheet data on total loans, PLs, total assets, NPLs, and provisions of all institutions. The aggregate estimated BOJ model explaining NPLs by real GDP growth could be used to calibrate shocks to NPLs. The exercise also considers the loss in interest income due to additional NPLs.

42. **The yield curve stress test assesses hypothetical changes to the yield curve to portfolio holdings of securities by financial institutions to determine the potential impact on net earnings and capital adequacy.** The methodology for constructing the domestic government Jamaica zero-coupon yield curve relies on the Svensson functional form estimating a zero-coupon curve given information on the current market yields of existing bond issues. The implied forward rate curve exemplifies the expected short-term future interest rate for a specific point along the term structure.

[4] Cihak, M. (2007): Introduction to Applied Stress Testing, IMF WP 07/59.

43. **The BOJ stress testing framework is well documented.** The internal manual describes all essential elements of the methodology, covering data, definition of all variables, and applied methodologies. The manual also describes all steps that need to be taken to proceed with the calculations.

Potential Improvements and Recommendations

44. **The FSR could be further streamlined and more forward-looking.** The current FSR uses descriptive statistics rather than a forward-looking modeling framework to support the key messages. The team should further develop a modeling framework to enhance the forward-looking dimension of the report. The FSR provides too many nominal figures that could be replaced/complemented by relative indicators or moved to annexes. The report could be streamlined, focusing on key risk drivers and providing fewer nominal figures. Moreover, the Foreword could be used to communicate the Governor's key messages, while financial stability objectives could be moved to the Preface. Furthermore, some explanation on the Financial Policy vs. Financial System Stability Committee whose composition is reported could be added, and the cut-off date for different data sources employed and the publication date should be clearly stated. Finally, as the themes presented in the boxes are extensive, it could be considered to change them into specific thematic articles moved at the end of the report.

45. **Financial stability indicators need to be communicated together with the key aspects of the existing regulatory framework, allowing the interpretation of the numbers.** This is the case for all segments of the financial system, not only banks but also insurance companies and pension funds, where for the solvency assessment, it is essential to understand whether not only assets but also liabilities are reported as fully market-consistent. Hence, this information needs to be added to the FSR. Moreover, the upcoming move to IFRS17 reporting for the insurance sector should be discussed.

46. **The FSR and the corresponding toolkit should be strengthened to be more forward-looking.** Credit risk and market risk analysis should be improved. This needs to capture average PD or LGD trends for different segments/ sectors. If data on PD are not available, the implied default rate could be calculated based on the information about write-offs and cured loans. Granular banking data should be used to monitor credit risk models for different segments of loans, such as mortgages, consumer loans, or loans to industry-specific sectors. In this respect, it is also important to monitor lending interest rates, especially for mortgages, where its fixation could mitigate the effect of increased interest rates on credit risk. Similarly, for market risk, analyses of the impact of interest rate risk should be elaborated. This is crucial for insurance companies and pension funds.

47. **In terms of market risk assessment, the key information on duration should be included in the regular reporting.** For insurance and pension funds, this needs to cover not only assets but also liabilities. While banks typically have positive duration mismatches negatively affecting market risk with increased yields, balance sheets of pension funds and life insurers with usual negative duration mismatch are negatively affected by market risk with decreased yields.

48. **The financial stability analytical toolkit should be strengthened.** The BOJ should work on econometric models to project key financial stability variables such as expected nonperforming loans, credit growth, and net interest rate income for banks. In this context, the mission explained the Bayesian Model Averaging (BMA) approach as the suitable methodology for short time series that can be challenging for traditional methods due to limited observations. BMA's flexibility in considering multiple models helps handle uncertainty in predictions and parameter estimates. It addresses issues like variable selection and dynamic relationships, making it a valuable approach for making informed inferences with limited data. The mission provided R script with an initial estimate for five sectoral credit risk models – mortgages to households, personal loans to households, corporate loans – tourism, corporate loans – construction, and other corporate loans.

49. **The BOJ should become familiar with the provided R script for the sectoral credit risk models and further work on improvements to the initial estimates.** NPL ratio was used as a proxy for credit risk modeling for all five mentioned sectors and transformed with logit transformation for modeling purposes.[5] The available potential explanatory variables considered were real GDP growth, unemployment, inflation, foreign exchange rate, T-bill 180-day yield, and BOJ policy rate. All mentioned time series and sectoral NPL ratios were available quarterly. The estimated model for household mortgages for Jamaica suggests that the NPL ratio rises with higher T-bill 180-day yield and depreciation of the local currency. The role of inflation was rather positive (decreasing NPLs), probably related to increased house prices and the corresponding decline of LGDs. For the personal loans, the role of inflation was the opposite, so higher inflation increased NPLs. For tourism and other corporate loans, inflation increases NPLs together with exchange rate depreciation. For the construction sector, the impact of inflation was the same as for the mortgages to households, which could be explained by the increased value of collaterals with higher inflation.

50. **In the context of twin-peaks regulation, the non-bank analyses that were conducted should be improved.** The BOJ has a macroprudential mandate, but the supervision of the non-banking sector lies with the Financial Services Commission (FSC). This put some restrictions on the financial stability work of the BOJ, having access to only aggregate data submitted by the FSC. Moreover, the BOJ has less experience, especially in the insurance and pension sectors, compared to the banking sector. In this context, the foreseen twin-peek model should help to improve the conducted financial stability work for the insurance and pension sectors.

51. **Key risks for the insurance sector should be analyzed and discussed in the FSR.** The report currently covers only a few descriptive statistics. It describes the development of assets and their distribution, premiums, profit, solvency, and retention ratios. It should further discuss the impact of changing yields, inflation, climate risk, and other relevant risk factors. It needs to elaborate on life insurance guarantees in the context of interest rate risk, and the role of reinsurance needs to be considered to assess the potential implications of any instability in the sector. Overall, the FSR needs to discuss key risks rather than a set of descriptive statistics and indicators without clear link and assessment of risks.

52. **Financial stability risks related to the pension funds should be assessed.** The FSR provides only the total assets and investment split. As the pension fund sector is a significant part of the overall financial system, it is essential to follow up on the sector's solvency position. In this context, defined benefits (DB) and defined contribution (DC) schemes must be distinguished when assessing financial stability. While the funds with DB schemes are exposed to insolvency risk, pension funds with DC schemes transfer the risks to policyholders. To assess the solvency of DB schemes, the funds need to report the consistent market value of both assets and liabilities. The sector is exposed to interest rate risk and other market risks, especially equity risk.

53. **The BOJ should implement a multi-factor, multiperiod solvency stress testing tool for deposit-taking institutions.** Although the CBCS has a stress testing framework, it is based on a simple static methodology that cannot project the impact of different macroeconomic scenarios on institutions' balance sheets over time. In this context, the framework could be further elaborated towards a dynamic balance sheet approach. This could be facilitated via the foreseen CARTAC technical assistance mission on stress testing, which aims to develop a multi-factor, multiperiod solvency stress testing tool. Moreover, the financial stability team should closely cooperate with the macroeconomic modeling team to set up the process to generate different macroeconomic adverse scenarios reflecting the relevant financial stability risks.

54. **The BOJ needs to cover and communicate the development of new emerging risks.** As such, climate and cyber risks need to be included in the regular work of the financial stability department. While this is the

[5] Instead of NPL ratio, ln(NPL ratio/(1-NPL ratio)) was used as a dependent variable for the regressions.

case of climate risk, cyber risk is not much covered and is not communicated in the FSR. Hence, this needs to be changed, and cyber risks must be followed more closely. In terms of climate risk, the BOJ needs to work to build up a comprehensive climate risk analysis. As a precondition, the BOJ must collect appropriate climate data, cooperate with regional climate scientists to estimate climate damage and implement multi-factor, multi-period stress testing models for deposit-taking institutions. A CARTAC technical assistance mission could help to implement climate risk analysis for the financial sector.

IV. Organizational and Operational Setup of the Financial Stability Work

55. **Financial stability should be seen as equally important as monetary policy and supervision.** This needs to be reflected in the BOJ's external communication and internal processes. Financial stability is one of the core activities of the BOJ. It is primarily the responsibility of the Financial Stability Department. Still, it also needs to rely on contributions from the supervision division, research and economic programming division, market operations department, and payment system department. However, it needs to be kept in mind that the financial stability function must be independent of monetary policy and supervision despite the necessary interaction and coordination between those functions. For example, the Research and Economic Programming Division provides macroeconomic data and projections that are primarily used for monetary policy. Still, the angle and targets for financial stability focusing on tail risk rather than central scenarios are different.

56. **The BOJ should enhance internal communication and processes.** A project group/coordinator should be established for the FSR. A detailed production plan with sufficient time for internal discussion and analytical work should be prepared. As the publication date is fixed to the end of May every year, it should be possible to stick to a detailed production plan that needs to include all internal deadlines on different chapters, boxes, and thematic articles for the first draft and subsequent reviews clearly stating the responsible person of each step. Furthermore, it needs to contain the deadlines for different data submissions and their availability for further work to process. It must include all contributions from other departments with the responsible contact person. Such a production plan should be discussed internally with all relevant experts and their managers. The final version needs to be approved by the senior management/Governor to be binding for all departments/divisions involved.

57. **The internal interaction related to the FSR among relevant departments/divisions in the BOJ could be further enhanced.** A structural cross-departmental discussion(s) before starting the report drafting and during the drafting process could be further enhanced. Despite the report being drafted primarily by the Financial Stability Department, it might be better to have more extensive structural interaction with other departments, especially supervision.

58. **The prepared detailed communication strategy should complement the internal FSR production plan by promoting the report as the key communication tool for financial stability.** The FSR should have the highest priority as a flagship publication of the bank. The report is published at the end of March. There is currently no press conference on the FSR. It is published on the website, followed by a press release. The BOJ prepared the monetary policy and communication strategy in November 2018. This is a good start, but the strategy should be developed further as the existing document is focused more on monetary policy. Moreover, every year, there needs to be a detailed list of concrete dates for each step regarding all planned outreaches. Hence, the BOJ should further elaborate this document to set up a comprehensive, detailed communication strategy for every FSR release, including active promotion of the FSR via press conferences, social media, seminars with market participants, interviews with key media, and/or YouTube videos with the management and experts, etc. This could be done in two phases, starting with the workshop with market participants and then followed by interviews and more extensive communication on social media. The existing communication platform should be fully utilized. Given that the report is regularly published at the end of March, the subsequent promotional activities should be scheduled between April and May. All those activities must be planned in detail before the report is published. Moreover, the foreword of the report could help communicate the Governor's key messages. Furthermore, to provide more extensive service to the media, all

background figures/statistics displayed in the report in the form of charts or tables should be provided together with the report on the BOJ website, and the publication date should be stated in the report.

59. **The communication could be further elaborated beyond the FSR.** The BOJ prepared protocols surrounding the communication of exceptional stress test results. These protocols outline a communication process and action plan involving the relevant committees and institutional stakeholders without publishing details of the relevant stress tests and the institutional results so that confidence in the financial system is not undermined. A press release, if warranted, can also be issued to the public.

60. **The group of people communicating financial stability topics could be broadened.** The existing document covering the communication strategy defines spokespersons on financial stability as the governor, senior deputy governor, and deputy governor in charge of financial stability. This list could be further enriched with the BOJ spokesperson, Head of the Department, or even experts to communicate on some specific topics for specific audiences. For example, for YouTube communication with the younger generation, some experts closer to the average age of the target group could be selected. Similarly, the Head of the Department could lead the discussion with the experts and be supported by selected financial stability experts according to the topics discussed and related expertise.

IV. Data Sources and their Management

61. **The BOJ has a data warehouse containing prudential data.** The BOJ data warehouse supports SQL and contains analytical tools such as Tablo and Power BI. The prudential data for deposit-taking institutions are stored in the data warehouse, and nonbanking data are in the process of being included. It covers data on remittances, financial market data, national accounts, tourist data, and data from the FSC. The data might sometimes be resubmitted with some corrections. Other data sources are the Central Database Management System (CDMS), which contains monetary statistics; the Jamaica Financial Institutions Reporting Management System, which includes supervisory data; and Bloomberg.

62. **The BOJ should organize all data in one data warehouse and fully utilize them for analytical purposes to support the financial stability analytical toolkit.** A copy of the database (mirroring database) should be set up for analytical purposes. The statistical mirroring database must support analytical tools to process large data (e.g., Power BI, R), as data should be processed directly at the server. Any chosen data management solution needs to provide complete flexibility to conduct any complex analysis that might be impossible to foresee when setting up the BOJ data management system.

63. **Moreover, the BOJ could consider setting up a centralized credit register as a rich data source for analytical purposes.** Currently, two data registers covering 98% of the market operated by private companies - CRIFF and Creditinfo- are in Jamaica. However, the BOJ does not have access to those registers and obtains only some aggregate reports that do not allow the full utilization of this information for financial stability purposes. Hence, the BOJ could consider setting up its register, given that credit institutions already report the information to the private registers, and it would not increase any reporting requirements for them. Like the data warehouse, a fully flexible solution for data processing using an analytical mirrored database must be set up. This solution would allow the calculation of crucial credit risk parameters such as default rates and average LGDs for different segments of credit portfolios (e.g., mortgages, consumer loans, etc.). In this respect, it needs to be set up so that a complex analytical work could be conducted. Moreover, the system should allow combining data from the credit register and the data warehouse for analytical purposes.

64. **In the meantime, the BOJ could cover existing data gaps through different industry surveys.** The BOJ could initiate a survey with the industry to help overcome those gaps. Such surveys could especially cover information related to credit risk, given its prominent role in the financial system, and cyber risk, which is a new emerging risk that has yet to be monitored. Credit risk could be covered, for example, by a bank-lending survey.

65. **Such surveys should collect all crucial missing information related to the key financial stability risks, especially credit risk.** This also partially addresses the current need to use credit register(s). The surveys could cover especially the following information:
    - Average PD/default rate for corporate loans, consumer loans, and mortgages;
    - Average loss given default for corporate loans, consumer loans, and mortgages;
    - Average lending rates for corporate loans, consumer loans, and mortgages;
    - Information for corporates could potentially be further break down to SME, and large corporates;
    - Information on type of collateral – real estate, other assets, etc.
    - Average deposit rates.

66. **Another potential survey could address the lack of information on cyber risk.** It could cover, for example the following information:
    - Number of cyber incidents with the impact exceeding the defined threshold,
    - Total losses related to cyber incidents,

- The information could be potentially broken down by type of cyber incidents, e.g., malware attack, phishing attack, insider threat, etc.

67. **Any other information/survey that would address the existing data gap based on the risk identified should be further considered.** This could reflect any potential new emerging risks or any existing data gaps beyond the mentioned examples.

V. Conclusions

68. **The CARTAC technical assistance mission aimed at strengthening the capacity of the BOJ to analyze and assess financial stability.** It addressed the structure, communication, organizational and operational setup, and the FSR's content, which included data sources and an analytical toolbox. It sought to offer suggestions on every topic that could impact the report, both directly and indirectly, by enhancing the quality of the FSR through improved analysis and risk assessments.

69. **Financial stability should be viewed as equally important as monetary policy and supervision.** The BOJ should enhance internal communication and processes covering interaction among relevant departments/divisions. The prepared communication strategy should complement the internal FSR production plan by promoting the report as the key communication tool for financial stability.

70. **The FSR could be further streamlined and more forward-looking.** This could be facilitated by focusing on key risk drivers, reducing nominal figures that could be replaced/complemented by relative indicators, or moving to annexes. In addition, financial stability indicators need to be communicated together with the key aspects of the existing regulatory framework, allowing readers to interpret the numbers. The FSR and the corresponding toolkit should be strengthened to be more forward-looking. In this context, credit risk and market risk analysis should especially be improved. Granular banking data should be used to monitor credit risk models for different segments of loans, such as mortgages, consumer loans, or loans to industry-specific sectors. Similarly, analyses of the impact of interest rate risk should be elaborated for market risk. Therefore, the key information on duration should be included in the regular reporting.

71. **It is necessary to enhance the BOJ financial stability analytical toolkit further.** To project important financial stability factors such as NPLs, credit growth, and net interest rate revenue for banks, the BOJ should work on econometric models. The mission explained the Bayesian Model Averaging (BMA) technique as an appropriate methodology for short time series, which might pose difficulties for conventional methods. The adaptability of BMA in considering various models aids in managing uncertainty in parameter estimates and forecasts. It tackles problems like variable selection and dynamic relationships, which makes it a useful method for concluding with limited information. The mission provided the R script with an initial estimate for each of the five sectoral credit risk models: mortgages to households, personal loans to households, corporate loans – tourism, corporate loans – construction, and other corporate loans. The BOJ should become familiar with the provided R script for the sectoral credit risk models and further work on improvements to the initial estimates.

72. **The BOJ must improve non-bank analyses and regularly report and assess new emerging risks, especially climate and cyber risks.** Therefore, climate and cyber risk must be a regular component of the financial stability department's activity. The FSC is in charge of overseeing the non-banking industry, while the BOJ is the macroprudential authority. The anticipated twin-peek model should assist in enhancing the financial stability analyses and assessment for the insurance and pension industries.

73. **The BOJ should implement a multi-factor, multiperiod solvency stress testing tool for deposit-taking institutions.** The current simple static methodology for stress testing should be replaced with a dynamic approach, allowing the BOJ to project the impact of different macroeconomic scenarios on institutions' balance sheets over time. This could be facilitated via the foreseen CARTAC technical assistance mission on stress testing.

74. **The BOJ should organize all data in one data warehouse and fully utilize them to support the financial stability analytical toolkit.** A mirroring database duplicate of the original database should be set up for

analytical purposes. As data should be analyzed directly at the server, the statistical mirroring database must allow analytical tools (e.g., Power BI, R) to process large data. Any data management system that is selected must offer full flexibility to carry out intricate analyses that have yet to be anticipated during the setup of the BOJ data management system. In addition, the BOJ should consider creating a centralized credit register as a rich data source for research. Meanwhile, surveys conducted with the industry may fill the current data gaps.