INTERNATIONAL MONETARY FUND

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# CANADA

## FINANCIAL SECTOR ASSESSMENT PROGRAM

## TECHNICAL NOTE ON SYSTEMIC RISK ANALYSIS

August 2025

This Technical Note on Systemic Risk Analysis was prepared by a staff team of the International Monetary Fund. It is based on the information available at the time it was completed on July 28, 2025.

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**International Monetary Fund**
**Washington, D.C.**

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# TECHNICAL NOTE

## SYSTEMIC RISK ANALYSIS

Prepared By
**Monetary and Capital Markets Department**

This Technical Note was prepared by IMF staff in the context of the Financial Sector Assessment Program in Country. It contains technical analysis and detailed information underpinning the FSAP's findings and recommendations. Further information on the FSAP can be found at http://www.imf.org/external/np/fsap/fssa.aspx

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# Glossary

| | |
|---|---|
| AC | Amortized Cost |
| AMF | Autorité des marchés financiers (Québec) |
| ASPP | Accounting Standards for Pension Plans |
| BMA | Bayesian Model Averaging |
| BOC | Bank of Canada |
| CAD | Canadian Dollar |
| CET1 | Common Equity Tier 1 |
| CCoB | Capital Conservation Buffer |
| CPI | Consumer Price Index |
| CRE | Commercial Real Estate |
| DB | Defined-Benefit |
| DSB | Domestic Stability Buffer |
| D-SIBs | Domestic Systemically Important Banks |
| D-SIFIs | Domestic Systemically Important Financial Institutions |
| DSR | Debt Service Ratio |
| FDI | Foreign Direct Investment |
| DTI | Debt-to-Income |
| EBIT | Earnings Before Interest and Taxes |
| EDF | Expected Default Frequency |
| EUR | Euro |
| FSAP | Financial Sector Assessment Program |
| EVS | Espinosa-Vega Sole |
| FSRA | Financial Services Regulatory Authority of Ontario |
| FVPL | Fair Value through Profit and Loss |
| FVOCI | Fair Value through Other Comprehensive Income |
| FX | Foreign Exchange |
| G-SIBs | Global Systemically Important Banks |
| GDP | Gross Domestic Product |
| HELOC | Home Equity Line of Credit |
| HQLA | High-Quality Liquid Asset |
| HRAM | Household Risk Assessment Model |
| ICR | Interest Coverage Ratio |
| IFRS | International Financial Reporting Standards |
| LCR | Liquidity Coverage Ratio |
| LGD | Loss Given Default |
| LTV | Loan-to-Value |
| MSB | Medium-Sized Bank |
| NBFI | Non-Bank Financial Institutions |
| NCCF | Net Cumulative Cash Flow |
| NFC | Non-Financial Corporation |

| | |
|---|---|
| NII | Net Interest Income |
| NIIR | Non-Interest Income Ratio |
| NIER | Non-Interest Expense Ratio |
| NPL | Non-Performing Loan |
| OFI | Other Financial Intermediaries |
| OSFI | Office of the Superintendent of Financial Institutions |
| P&C | Property and Casualty |
| P&L | Profit and Loss |
| PD | Probability of Default |
| PiT | Point-in-Time |
| QSFS | Quarterly Survey of Financial Statistics |
| RESL | Real Estate Secured Lending |
| ROA | Return on Assets |
| RWA | Risk-Weighted Assets |
| RAM | Risk Assessment Matri |
| SME | Small and Mid-Sized Enterprise |
| STeM | Stress Testing Matrix |
| TTC | Through the Cycle |
| US | United States |
| USD | United States Dollar |
| VRMFP | Variable Rate Mortgage with Fixed Payments |
| WEO | World Economic Outlook |

# EXECUTIVE SUMMARY[1]

**The Canadian economy has navigated the pandemic well and achieved a soft landing but rising trade tensions pose significant challenges.** Amid sharp monetary tightening to control high levels of inflation, the economy slowed in 2023–24 but avoided a recession. The Bank of Canada (BOC) began easing monetary policy in June 2024, but challenges persist, including rising trade tensions and policy uncertainties, among other factors.

**The financial system has remained stable amid sizable swings in output, inflation, and interest rates.** Credit performance of deposit-taking institutions (DTIs) is robust, and capital and liquidity buffers exceed regulatory minima. And despite a recent uptick, nonperforming loans have remained at a low level. Likewise, nonbank financial institutions (NBFIs)—including Canada's large and globally significant insurance, pensions, and investment fund sectors—have weathered shocks well.

**Structural vulnerabilities persist among Canadian households, with high debt levels and rising debt-servicing costs compared to G7 peers.** While mortgage arrears remain below pre-pandemic levels due to household adjustments through increased savings and disciplined spending, financial risks could materialize in a severe downturn, particularly if unemployment rises sharply and income growth stagnates. Financial strain is most evident among renters and lower-income households, with delinquency rates in non-mortgage credit increasing. Households continue to prioritize mortgage repayments, but rising unemployment and elevated renewal payments could exacerbate financial vulnerabilities for those with limited buffers.

**The corporate sector has remained resilient despite sluggish growth during the pandemic and tighter financial conditions thereafter.** Non-financial corporations remain stable on leverage and liquidity, particularly large ones. However, vulnerabilities persist among small and mid-sized businesses, particularly in consumer-facing sectors such as food services, accommodation, and retail. The expiration of pandemic-era support measures has exposed pockets of weakness, with small business insolvencies rising sharply in 2023 before moderating.

**However, a materialization of downside macroeconomic risks could impact the financial sector through several channels.** Housing-related vulnerabilities remain among the top financial stability risks as banks and NBFIs have significant exposures to residential real estate lending and investments. Negative impacts on corporate performance, or materialization of commercial real-estate risks, would also test the financial sector.

[1] This note was prepared by Paola Morales-Acevedo (bank solvency and liquidity stress tests), Shijia Luo (interconnectedness and contagion analysis), Xuege Zhang (household and corporate analysis), Yuanchen Yang (macroeconomic landscape) (all IMF) and Timo Broszeit (insurance and pension fund analyses) (expert). Technical support on the generation of macroeconomic scenarios was provided by Zoltan Jakab, Ruy Lama and Mátyás Farkas (all IMF). The analysis has benefitted from discussions with the staff of the Bank of Canada, the Office of the Superintendent of Financial Institutions, the Autorité des Marchés Financiers, the Financial Services Regulatory Authority of Ontario, and the Canada FSAP team.

**Financial sector resilience was assessed against a severe but plausible adverse scenario.** The scenario spans a three-year horizon (2025–27) and features deepening geoeconomic fragmentation, protectionism, and increased cross-border restrictions. Disruption of global production chains causes a sharp economic slowdown and creates temporary supply shortages, initially raising inflation with substantial knock-on effects on inflation expectations. These prompt central banks to pause or reverse interest rate cuts and keep them elevated during the initial years of the scenario. As growth slows and unemployment rises, oil prices drop. A reassessment of market fundamentals triggers corrections in valuations, including a sharp drop in residential real estate prices and a correction in equity prices, and a depreciation of the exchange rate. Canada experiences a slowdown of economic growth with a cumulative decline of 4.7 percent in real Gross Domestic Product (GDP) over the initial two years of the scenario and a modest recovery in 2027.

**Financial Sector Assessment Program (FSAP) bank solvency stress tests indicate that the seven Canadian systemic DTIs are resilient to the adverse scenario.** Common Equity Tier 1 (CET1) ratio for the systemic DTIs declines by 2.3 percentage points on average at the trough but remains above the regulatory minimum. At the individual level, the seven systemic DTIs would remain well above the 4.5 percent CET1 minimum requirement, and even above the 8 percent threshold, below which dividend distributions would be affected. The changes to systemic DTIs' capital ratios are primarily driven by a rise in loan losses and an increase in risk-weighted assets (RWAs). The impact on credit risk and losses draws on household and corporate sector analyses. Mortgage Debt Service Ratio (DSR) increases from 8.1 percent in 2024: Q4 to 10.3 percent by end-2026 under the adverse scenario before easing to 8.6 percent, with low-income households most affected. Mortgage probabilities of default (PDs) increase under the adverse scenario, reaching 0.9 percent for uninsured and 1.4 percent for insured loans by end-2027. Corporate PDs increase from 0.5 percent in 2024: Q4 to 1.3 percent by end-2027 under the adverse scenario, reflecting heightened financial stress.

**Liquidity stress tests show that the systemic DTIs are overall liquid and resilient to sizable withdrawals of funding and market valuation shocks.** Liquidity coverage ratios (LCR) based tests indicate that, over a 30-days horizon, the seven systemic DTIs are relatively insulated from market-valuation shocks but are more vulnerable to significant wholesale deposit outflows. Additionally, cash flow analysis (CF) suggests that the system can withstand large liquidity shocks over a three-month horizon.

**Canadian insurers remain solvent in an adverse scenario focused on market and credit risks.** Life insurers would experience some larger variations of their capital position but are overall resilient with only a small cumulative decline of their solvency ratios over the three-year projection horizon. In the first year, life insurers even benefit from higher interest rates and a depreciation of the Canadian dollar (CAD); afterwards, solvency ratios start to decline—however, none of them sees solvency ratios falling below the regulatory threshold, and the vast majority remains above or close to their internal operational capital targets. Property and Casualty (P&C) insurers exhibit lower sensitivities to market and credit risks, and are therefore very resilient in the adverse scenario. Compared to life insurers, the scenario has a relatively larger impact in the first year as the benefiting impact from interest rates is lower in the P&C sector.

**Pension plans would face a deterioration of their funding ratios in the adverse scenario, but funding levels remain considerably above those seen prior to 2020**. With rising interest rates, the funding position has improved since then. Similar to the test for the insurance sector, most of the scenario shocks are felt in the second year, while afterwards funding ratios would stabilize and increase slightly for most plans. Still, over a quarter of the plans would experience a funding deficit in the third year (which, however, would not trigger any immediate refunding requirement).

**Life insurers and pension plans are resilient to liquidity risks stemming from margin and collateral calls.** A severe adverse scenario with considerably higher short-term interest rates and a depreciation of the CAD was tested in a bottom-up analysis. The analysis shows that margin calls for 19 pension plans and three large life insurers would amount to CAD 32 billion (around 1 percent of combined balance sheet assets), of which 26 billion are due for the pension plans. Life insurers would rely mostly on their sizable holdings of liquid assets as a source of liquidity. Pension plans would source a bit more than half of their liquidity needs from financing transactions, including expiring reverse repos and committed credit lines; another third would be funded through liquid assets. Many participating entities use contractual arrangements which allow for settlement in kind, thereby lowering the need to liquidate assets.

**An interconnectedness and contagion analysis evaluated the impact of funding and credit shocks among the six D-SIBs and across sectors and borders.** While interbank exposures are significant, the analysis suggests that spillover risks associated with bank failures are mitigated by banks' capital buffers. On the other hand, cross-sectoral and cross-border risks are relatively high. The presence of multiple transmission channels in Canada's complex and interconnected financial sector implies that risks can propagate quite easily and substantially across sectors. This interconnectedness, and the associated risks, require vigilant monitoring and analysis to identify potential vulnerabilities that could emerge in times of stress.

| Table 1. Canada: Recommendations on Systemic Risk Analysis | | | |
|---|---|---|---|
| | **Recommendations** | **Agency** | **Timing[1]** |
| **1.** | Establish regular coordination meetings among BOC and regulatory agencies to discuss stress testing methodologies, results, and implications. | BOC, OSFI, AMF | ST |
| **2.** | Continue developing structural models for households and corporates supported by the continuous investment in rich datasets. | BOC, OSFI, AMF | ST |
| **3.** | Continue to closely monitor mortgage refinancing risks, household and corporate liquidity buffers, and employment-driven vulnerabilities. | BOC, OSFI, AMF | ST |
| **4.** | Start building a credit register for corporate, commercial and consumption loans and continue working towards improving the quality and coverage of Real Estate Secured Lending (RESL) data. | OSFI, AMF | ST |
| **5.** | Collect long historical time-series data on default rates across various sectors and asset classes by country of exposure | OSFI, AMF | ST |
| **6.** | Calculate provisions in DTIs top-down stress test exercises in accordance with the International Financial Reporting Standards (IFRS) 9 framework. | BOC, OSFI, AMF | MT |
| **7.** | Collect and maintain comprehensive information on IFRS 9 transition matrices and relevant parameters, both prospectively and retrospectively. | BOC, OSFI, AMF | MT |
| **8.** | Develop a top-down approach for assessing systemic DTIs' market risk that evaluates the impact of sudden market shocks, while factoring in the effects of hedging strategies. | BOC, OSFI, AMF | ST |
| **9.** | Consider publishing regularly top-down stress test results on an aggregate basis in the Financial Stability Report and/or Staff Analytical Notes. | BOC | MT |
| **10.** | Introduce macroprudential stress testing in the insurance sector. | OSFI, AMF (in cooperation with BOC) | MT |
| **11.** | Expand supervisory reporting for large pension plans (on investments, derivatives, liquidity, and leverage), and roll out LCR monitoring to all large plans. | OSFI, FSRA, FA, PA BOC | ST |

[1] I—Immediate (within 1 year), ST—Short term (within 1–3 years), MT—Medium term (within 3–5 years)

# INTRODUCTION

## A. Macroeconomic Landscape and Sectoral Vulnerabilities

**1. The Canadian economy emerged well from the pandemic and achieved a soft landing** (Figure 1). Amid a sharp monetary tightening, the economy slowed in 2023–24 without slipping into recession. Headline inflation has eased to 2.3 percent, as of March 2025, despite a slight uptick in February. As the first G7 country to reduce policy rates, from June 2024 Canada trimmed monetary policy rates by 225 basis points to 2.75 percent in March 2025. Canada's real per capita GDP grew slowly after consecutive declines in 2023–24, due in part to near-record population growth. By March 2025, Canada's unemployment rate rose to 6.7 percent, reflecting a broader upward trend over the past year.

**2. However, challenges loom due to weaker growth and rising geopolitical uncertainties.** Trade policy uncertainties and economic challenges continue to weigh on growth, employment, and inflation. An intensification of trade tensions can exacerbate trade and supply chains disruptions given strong linkages—even if Canada could potentially experience some short-term benefits from trade diversion. Real GDP growth is expected to soften, mainly due to the US tariffs, affecting especially sectors like autos and energy, and weaker global conditions affecting business sentiment. Retaliatory tariffs and persistently high inflation in key Consumer Price Index (CPI) components are expected to slow the disinflationary process.

**3. The housing market has been stabilizing, but vulnerabilities remain.** Canada faces severe housing affordability issues as the large gap between housing supply and demand persists. Home prices surged nearly 60 percent during 2020–22, fueled by low pandemic interest rates and a surge in immigration, before correcting by about 15 percent in late 2022, as mortgage rates rose. House prices then saw a mild rebound of around 5 percent in 2023. While the large price run-up has increased equity for most homeowners and provided a financial buffer[1], heightened trade tensions and weaker growth prospects could amplify housing sector vulnerabilities.[2]

**4. Commercial real estate (CRE) has been under pressure but the financial sector's exposure to the CRE market is contained.** Certain segments of the CRE sector, especially the office space, are facing pressure, whereas industrial and retail subsectors have fared better. Relatedly, construction sector delinquency rates have also been on the rise. Financial institutions, particularly nonbanks, have been active lenders or property owners in the CRE sector. According to the BOC,

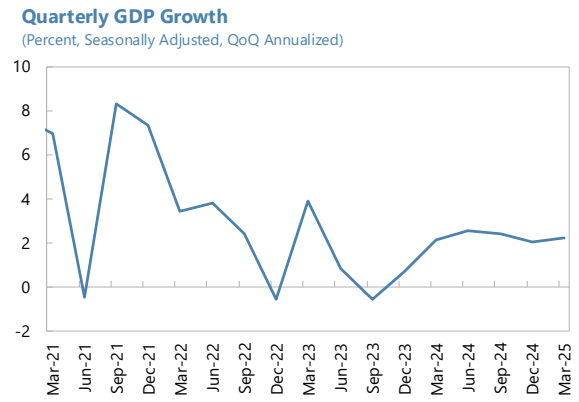
[1] The aggregate house price index provided by the Canadian Real Estate Association has been used in this note. This is also the preferred house price index used by the Bank of Canada in its Monetary Policy Report.

[2] According to a report issued by Equifax in December 2024, financial trade delinquencies over 60 days in the construction sector rose from 2.9 percent in 2023: Q2 to 3.3 percent in 2024: Q2. Meanwhile, the delinquency rate on asset-based loans—loans that are secured by the borrower's assets, such as equipment, inventory, or accounts receivable—more than doubled over the same period.

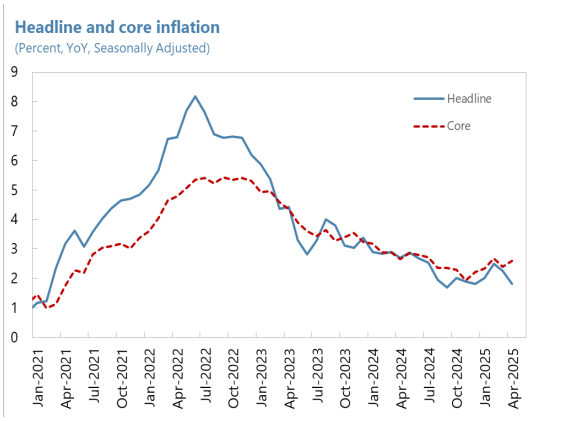
large insurance companies and pension funds have an asset exposure of approximately 2–3 percent to the office CRE segment, whereas banks' exposure stands at around 1 percent. With ongoing pressures in the market, these institutions—particularly those for which CRE represents a significant portion of their portfolio—could face losses if the CRE risk materializes.[3]

**Figure 1. Canada: Recent Macroeconomic Developments**

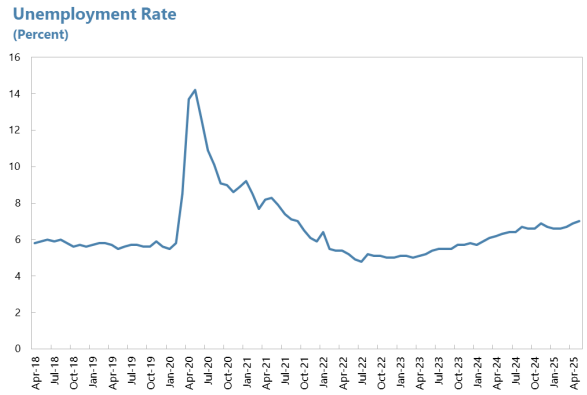
*GDP growth recovered after the pandemic but slowed down following monetary tightening…*



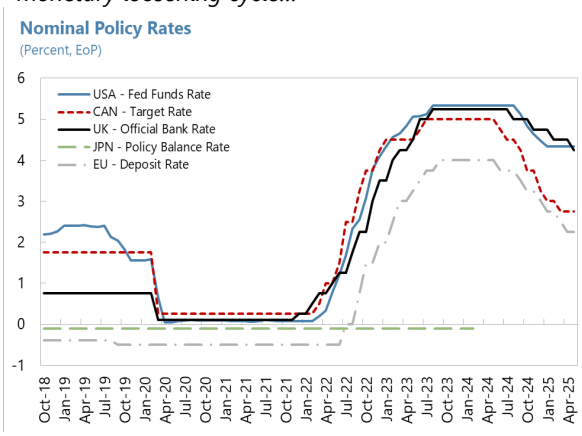

*… Inflation has been declining after the peak in 2022…*




*… and the labor market has softened.*



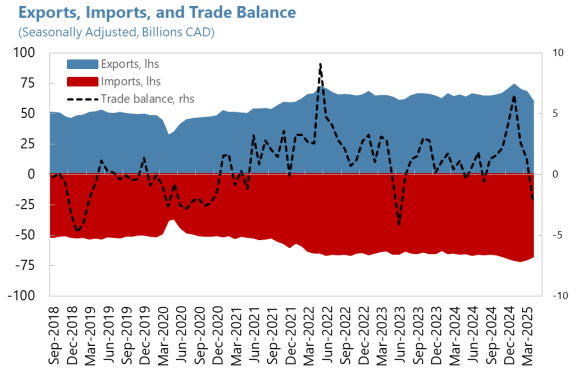

*Canada was the first country among G7 to begin the monetary loosening cycle…*



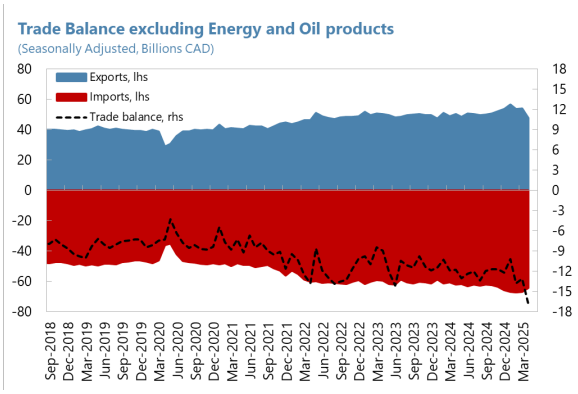

[3] The Bank of Canada conducted an in-depth analysis of the Canadian financial system's exposure to the commercial real estate sector in Box 2 of its Financial Stability Report—2024. Approximately 5 percent of large banks' assets are exposed to the CRE sector, with 0.6 percent in the office subsector. For small and medium-sized banks, CRE exposure is higher at 16 percent, including 1.2 percent in office CRE. Large insurance companies and pension funds have 12 percent and 15 percent of their assets in CRE, respectively, with office CRE accounting for 2.8 percent and 2.5 percent.

## Figure 1. Canada: Recent Macroeconomic Developments (Concluded)

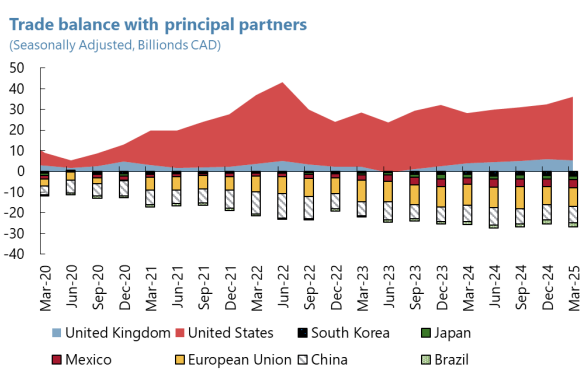
*Canadian merchandise exports grew after the pandemic but are facing tariff headwinds…*



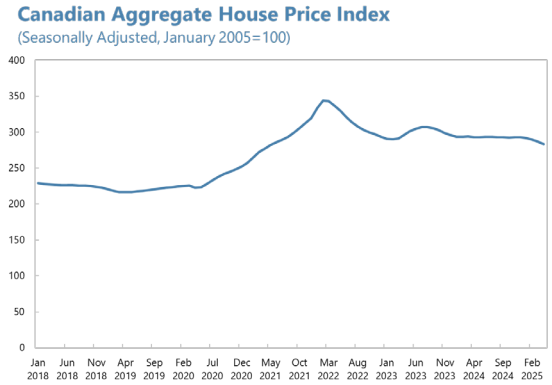

*… excluding energy products, Canada's net export value becomes negative*



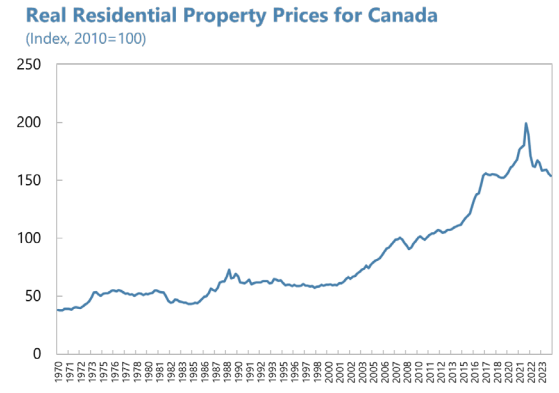

*The United States is Canada's largest trading partner, followed by the United Kingdom and China.*




*Canada's housing prices have been stabilizing after a roughly 60 percent increase during the pandemic, followed by an about 20 percent correction.*

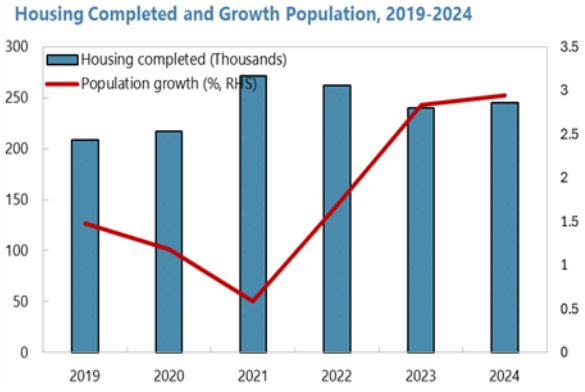



*Canada's real house prices have been rising substantially over the past two decades.*




Sources: BIS and IMF staff calculations

*… but new units did not keep pace with the increase in demand as the population grew.*




Sources: IMF; World Economic Outlook database; Have Analytics; Bank of Canada; Statistics Canada ; Canadian Real Estate Association; Bank for International Settlements; and IMF staff calculations.

**5. Household vulnerabilities persist, with debt levels among the highest in the G7 and mortgage debt dominating household liabilities.** While mortgage delinquencies remain low, financial pressures mounted due to persistent inflation, slower-than-expected rate cuts, rising mortgage renewal payments, and labor market deterioration until late 2024. Lower-income households, with limited liquidity buffers, are most exposed to higher borrowing costs and inflationary pressures, as delinquency rates have risen more sharply for non-mortgage credit. The household DSR peaked in late 2023 before easing slightly, but remains near historical highs, with mortgage DSR exceeding pre-pandemic levels. Looking ahead, households remain vulnerable despite recent rate cuts and inflation easing to around the 2 percent midpoint. Rising unemployment and trade policy uncertainties—amid an increasingly uncertain macroeconomic environment since early 2025—could erode disposable income and strain debt repayment capacity, particularly for highly leveraged households. While the soft landing of the Canadian economy has provided some relief, persistent geopolitical risks, trade uncertainties and slower growth continue to weigh on household finances, posing challenges to financial stability.

**6. The Canadian corporate sector has demonstrated resilience despite sluggish growth during the pandemic and high interest rates afterwards.** Large nonfinancial corporations remain relatively stable, while small businesses have struggled with financial stress, reflected in a surge of insolvencies post-pandemic. Although key vulnerability metrics have stabilized somewhat since 2022, debt-servicing burdens have increased in certain sectors. The pandemic-era government support and loan deferrals helped suppress corporate stress, keeping insolvencies below pre-pandemic levels until late 2022. While insolvencies spiked in late 2023 and early 2024, they have since declined, suggesting a temporary catch-up effect rather than a persistent deterioration, particularly affecting very small firms and industries most impacted by the pandemic, such as food and accommodation, transportation, and services.

## B. Financial Sector Structure

**7. Canada has a large, highly developed, and sophisticated financial system.** It is the 8$^{th}$ largest financial system in the world by total financial assets. As of 2024, the total assets of financial institutions reached 756 percent of GDP, increasing by 43.3 percent since 2019. Relative to other G7 countries, Canada has one of the largest NBFIs sectors, accounting for about 60 percent of financial system assets—mainly investment funds, pension funds, and insurance firms. Financial subsectors are highly interconnected and globally relevant, with significant exposures in the United States (US) (Figure 2, Table 2).

**8. The banking system is highly concentrated.** The six largest banks account for 94 percent of the sector's assets, with the two largest institutions alone representing 47 percent. The remaining 6 percent is held by small and medium sized banks. With the inclusion of another domestically important cooperative credit institution in Québec (Desjardins), the seven Domestic Systemically Important Deposit-taking Institutions (DTIs) hold over 90 percent of all DTIs' assets. The balance sheet of those seven systemic DTIs has expanded by almost 50 percent during the last five years,

with a significant increase of international activities for banks. As of 2023, banks' cross-border exposures in the U.S. represented 29 percent of total assets (Figures 2 and 3).

**9. The asset side of banks' balance sheets is dominated by loans which are heavily concentrated in real estate** (Figure 3). By end-2024, for the 7 systemic DTIs, loans constitute 50 percent of total assets, with residential mortgage loans making up the largest share at 40 percent of the total loan portfolio. Loans to Non-Financial Corporations (NFCs) account for 33 percent of the loan portfolio of which 4.9 percent corresponds to CRE and 7.7 percent are linked to construction and real estate. Securities, on the other hand, represent 24 percent of total assets and primarily consist of government securities (70 percent). The balance sheet of medium-sized banks (MSB) is highly concentrated in loans, representing 84 percent of total assets.

**10. Banks have a diversified mix of funding sources.** Retail and commercial deposits account for 55 percent and the remainder corresponds to a mix of wholesale funding instruments, including repos, derivatives, covered bonds and senior debt. MSBs rely more heavily on retail and commercial deposits, representing 73 percent of their total liabilities. Foreign funding has increased over time, and it accounts for more than 50 percent of total liabilities.

**11. Income generation has remained robust due to increases in interest income, despite increases in interest expense and loan loss provisions** (Figures 4 and 5). Canadian banks exhibit a mixed profitability profile when compared to their peers in other countries. The Return on Assets (ROA) for the 6-DSIBs hovers around 0.7 percent, which is generally lower than that of banks in the U.S, where ROA often exceeds 1 percent. In contrast, Canadian banks have an average Return on Equity (ROE) of 12 percent as of 2024, which is higher than that of its peers. The non-performing loans (NPL) ratio remains low at 0.7 percent, despite a recent increase driven by credit cards and auto loans. Mortgage delinquency rates stand at 0.2 percent, below the historical average. However, as of early 2025, approximately 60 percent of outstanding mortgages will renew by 2026 and around half of them could be subject to a higher interest rate at renewal. Nevertheless, the percentage of Variable Rate Mortgage with Fixed Payments (VRMFP)[4] in negative amortization has declined from a peak of 31 percent in 2023 to about 12 percent as of September 2024 (representing 2 percent of all mortgages) as interest rates decrease.[5] Additionally, valuation risks in CRE may lead to losses.

**12. Banks' capital and liquidity buffers exceed regulatory minima, making them well positioned to continue providing credit to the economy.** The average CET1 ratio for the 6 D-SIBs was 13.3 percent as of end-2024, which is comparable to other G7 countries. Moreover, the LCRs for the 6 largest banks remained above the regulatory minimum of 100 percent, with an average LCR of 125 percent.

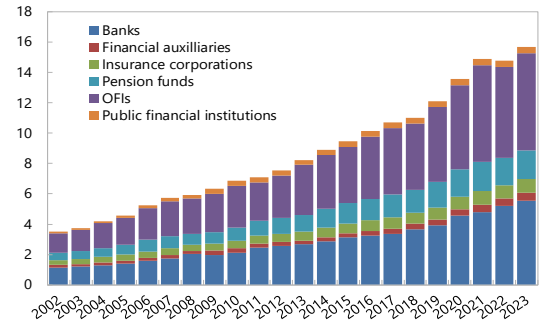
[4] In Canada, 80 percent of the residential mortgage portfolio consists of fixed-rate loans, while the remaining 20 percent are variable-rate loans, 75 percent of which are Variable Rate Mortgage with Fixed Payments.

[5] This number is expected to further decrease due to interest rate cuts in early 2025 and no more Variable Rate Mortgage with Fixed Payments should reach their trigger rate based on authorities' estimation.

## Figure 2. Canada: Structure of the Financial System

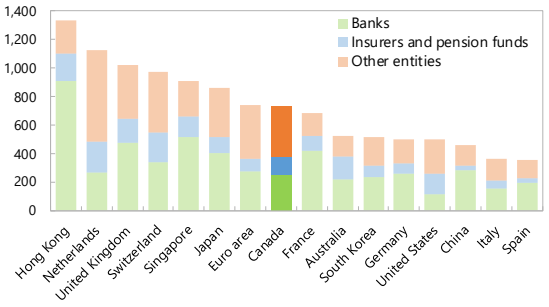
*Financial system assets have grown substantially in recent decades …*

**Financial Sector Structure, 2002-2023**
(USD Trillions)



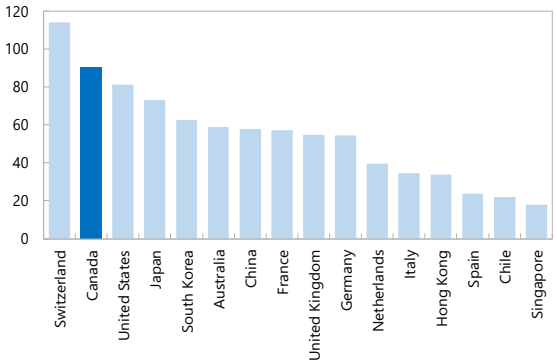

*… the size of the financial system is comparable to the average of other advanced peer economies.*

**Total Assets of Financial Insitutions, 2023**
(In percent of GDP)



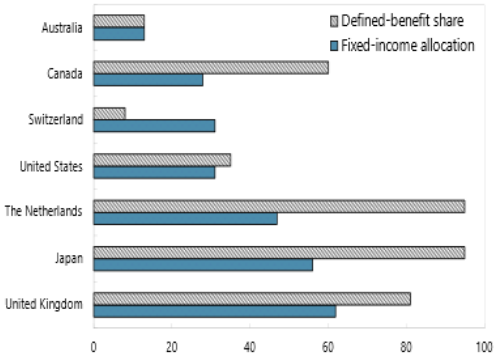

*Canada's NBFI sector is among the largest relative to the size of the economy.*

**Nonbank Financial Intermediation, 2023**
Based on the FSB's "narrow measure" of "shadow banking" (in percent of GDP)



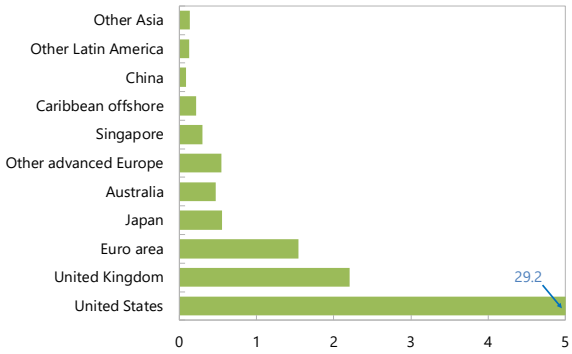

*… while DB pensions represent more than half of pension assets, fixed income holdings are more modest*

**Fixed Income Allocation and Share of Defined Benefit Plans, 2022**
(In percent)



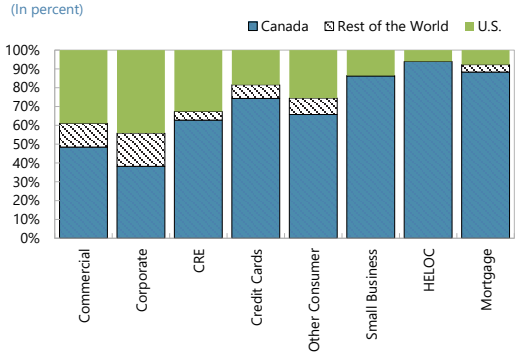

*Banks have large cross-border US exposures …*

**Banking Sector's Overseas Exposures, 2024Q4**
(In percent of total Canadian bank assets)




*… notably for commercial, corporate and CRE loans.*

**Banks' Loan Exposures, October 2024**
(In percent)




Sources: Haver Analytics; Bank of Canada; Financial Stability Board, Global Monitoring Report on Nonbank Financial Intermediation 2023; Global Financial Stability Report (GFSR), April 2023; Investment Industry Regulatory Organization of Canada; Bank of International Settlements; and IMF staff calculations.

Notes: Other Financial Intermediaries (OFIs) include Money Market Funds (MMFs), Hedge Funds, Other Investment Funds, Real Estate Investment Trusts (REITs), Trust Companies, Finance Companies, Broker-Dealers, Structured Finance Vehicles, Central Counterparties, Captive Financial Institutions and Money Lenders.

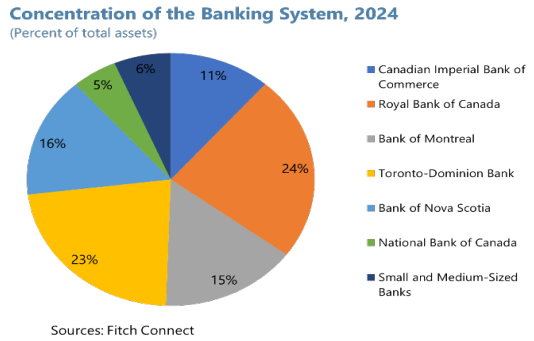
## Table 2. Canada: Financial System Structure

| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **In Billions of CAD** | | | | | | | | | | | |
| Chartered banks | 3402.6 | 3710.6 | 3873.4 | 3981.3 | 4333.3 | 4648.2 | 5423.9 | 5695.3 | 6246.2 | 6633.6 | 7172.3 |
| Quasi banks 1/ | 445.5 | 474.7 | 498.8 | 520.4 | 553.4 | 584.5 | 666.9 | 698.0 | 736.8 | 798.3 | 844.3 |
| Insurance and pension funds | 2530.8 | 2648.2 | 2801.7 | 2960.7 | 2952.0 | 3276.7 | 3512.9 | 3764.4 | 3532.0 | 3732.1 | 4064.5 |
| o/w Life insurance business | 438.4 | 435.4 | 468.5 | 475.3 | 475.0 | 514.1 | 542.5 | 564.2 | 525.0 | 560.8 | 601.1 |
| o/w Property and casualty insurance companies | 143.4 | 139.9 | 154.0 | 169.8 | 174.5 | 188.6 | 194.1 | 215.1 | 208.6 | 225.7 | 237.0 |
| o/w Segregated funds of life insurance companies | 272.6 | 287.4 | 308.6 | 334.5 | 315.2 | 362.5 | 392.2 | 439.2 | 406.5 | 439.9 | 507.0 |
| o/w Trusteed pension plans | 1676.5 | 1785.5 | 1870.6 | 1981.0 | 1987.4 | 2211.5 | 2384.1 | 2546.0 | 2392.0 | 2505.8 | 2719.4 |
| Mutual funds | 1605.4 | 1787.2 | 2015.6 | 2222.4 | 2202.3 | 2541.7 | 2829.0 | 3352.5 | 2971.3 | 3200.8 | 3789.3 |
| o/w Money market funds | 28.1 | 32.4 | 33.6 | 30.4 | 36.0 | 42.8 | 47.5 | 38.8 | 55.5 | 81.0 | 92.6 |
| o/w Other mutual funds | 1577.3 | 1754.8 | 1982.0 | 2192.0 | 2166.3 | 2498.9 | 2781.6 | 3313.7 | 2915.7 | 3119.9 | 3696.6 |
| Other financial intermediaries 2/ | 1063.3 | 1174.2 | 1386.3 | 1498.0 | 1568.9 | 1716.9 | 1806.2 | 2070.0 | 2057.2 | 2096.0 | 2256.9 |
| Financial auxiliaries | 335.5 | 349.1 | 391.6 | 465.0 | 502.2 | 528.2 | 548.2 | 666.1 | 647.7 | 694.1 | 747.7 |
| Captive financial institutions and money lenders | 1865.3 | 1866.4 | 2026.8 | 2169.0 | 2048.6 | 2277.6 | 2544.0 | 3003.4 | 2786.4 | 2946.2 | 3260.7 |
| Social security funds | 344.7 | 427.8 | 432.3 | 488.8 | 537.3 | 615.4 | 673.0 | 798.8 | 798.5 | 892.8 | 1061.7 |
| **In Percent of Total Assets** | | | | | | | | | | | |
| Chartered banks | 29.4 | 29.8 | 28.8 | 27.8 | 29.5 | 28.7 | 30.1 | 28.4 | 31.6 | 31.6 | 30.9 |
| Quasi banks 1/ | 3.8 | 3.8 | 3.7 | 3.6 | 3.8 | 3.6 | 3.7 | 3.5 | 3.7 | 3.8 | 3.6 |
| Insurance and pension funds | 21.8 | 21.3 | 20.9 | 20.7 | 20.1 | 20.2 | 19.5 | 18.8 | 17.9 | 17.8 | 17.5 |
| o/w Life insurance business | 3.8 | 3.5 | 3.5 | 3.3 | 3.2 | 3.2 | 3.0 | 2.8 | 2.7 | 2.7 | 2.6 |
| o/w Property and casualty insurance companies | 1.2 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.1 | 1.1 | 1.1 | 1.1 | 1.0 |
| o/w Segregated funds of life insurance companies | 2.4 | 2.3 | 2.3 | 2.3 | 2.1 | 2.2 | 2.2 | 2.2 | 2.1 | 2.1 | 2.2 |
| o/w Trusteed pension plans | 14.5 | 14.4 | 13.9 | 13.8 | 13.5 | 13.7 | 13.2 | 12.7 | 12.1 | 11.9 | 11.7 |
| Mutual funds | 13.8 | 14.4 | 15.0 | 15.5 | 15.0 | 15.7 | 15.7 | 16.7 | 15.0 | 15.2 | 16.3 |
| o/w Money market funds | 0.2 | 0.3 | 0.3 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 | 0.3 | 0.4 | 0.4 |
| o/w Other mutual funds | 13.6 | 14.1 | 14.8 | 15.3 | 14.7 | 15.4 | 15.4 | 16.5 | 14.7 | 14.9 | 15.9 |
| Other financial intermediaries 2/ | 9.2 | 9.4 | 10.3 | 10.5 | 10.7 | 10.6 | 10.0 | 10.3 | 10.4 | 10.0 | 9.7 |
| Financial auxiliaries | 2.9 | 2.8 | 2.9 | 3.3 | 3.4 | 3.3 | 3.0 | 3.3 | 3.3 | 3.3 | 3.2 |
| Captive financial institutions and money lenders | 16.1 | 15.0 | 15.1 | 15.2 | 13.9 | 14.1 | 14.1 | 15.0 | 14.1 | 14.0 | 14.1 |
| Social security funds | 3.0 | 3.4 | 3.2 | 3.4 | 3.7 | 3.8 | 3.7 | 4.0 | 4.0 | 4.3 | 4.6 |
| **In Percent of GDP** | | | | | | | | | | | |
| Chartered banks | 170.6 | 186.4 | 191.2 | 186.0 | 193.8 | 200.9 | 244.3 | 224.6 | 219.1 | 226.1 | 233.7 |
| Quasi banks 1/ | 22.3 | 23.8 | 24.6 | 24.3 | 24.8 | 25.3 | 30.0 | 27.5 | 25.8 | 27.2 | 27.5 |
| Insurance and pension funds | 126.9 | 133.0 | 138.3 | 138.3 | 132.0 | 141.6 | 158.2 | 148.4 | 123.9 | 127.2 | 132.4 |
| o/w Life insurance business | 22.0 | 21.9 | 23.1 | 22.2 | 21.2 | 22.2 | 24.4 | 22.2 | 18.4 | 19.1 | 19.6 |
| o/w Property and casualty insurance companies | 7.2 | 7.0 | 7.6 | 7.9 | 7.8 | 8.2 | 8.7 | 8.5 | 7.3 | 7.7 | 7.7 |
| o/w Segregated funds of life insurance companies | 13.7 | 14.4 | 15.2 | 15.6 | 14.1 | 15.7 | 17.7 | 17.3 | 14.3 | 15.0 | 16.5 |
| o/w Trusteed pension plans | 84.0 | 89.7 | 92.3 | 92.5 | 88.9 | 95.6 | 107.4 | 100.4 | 83.9 | 85.4 | 88.6 |
| Mutual funds | 80.5 | 89.8 | 99.5 | 103.8 | 98.5 | 109.9 | 127.4 | 132.2 | 104.2 | 109.1 | 123.5 |
| o/w Money market funds | 1.4 | 1.6 | 1.7 | 1.4 | 1.6 | 1.9 | 2.1 | 1.5 | 1.9 | 2.8 | 3.0 |
| o/w Other mutual funds | 79.1 | 88.2 | 97.9 | 102.4 | 96.9 | 108.0 | 125.3 | 130.7 | 102.3 | 106.3 | 120.4 |
| Other financial intermediaries 2/ | 53.3 | 59.0 | 68.4 | 70.0 | 70.2 | 74.2 | 81.3 | 81.6 | 72.2 | 71.4 | 73.5 |
| Financial auxiliaries | 16.8 | 17.5 | 19.3 | 21.7 | 22.5 | 22.8 | 24.7 | 26.3 | 22.7 | 23.7 | 24.4 |
| Captive financial institutions and money lenders | 93.5 | 93.8 | 100.1 | 101.3 | 91.6 | 98.4 | 114.6 | 118.4 | 97.7 | 100.4 | 106.2 |
| Social security funds | 17.3 | 21.5 | 21.3 | 22.8 | 24.0 | 26.6 | 30.3 | 31.5 | 28.0 | 30.4 | 34.6 |

Sources: StatCan, National Balance Sheet Account and Fund staff calculations.
1/ Include credit unions, trust companies and mortgage loan companies.
2/ Other financial intermediaries, except insurance corporations and pension funds.

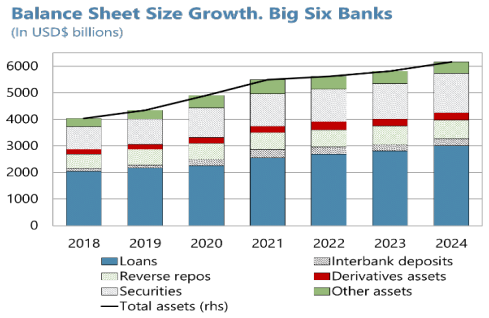
## Figure 3. Canada: Banking Sector Key Performance Indicators

*The banking system is highly concentrated.*



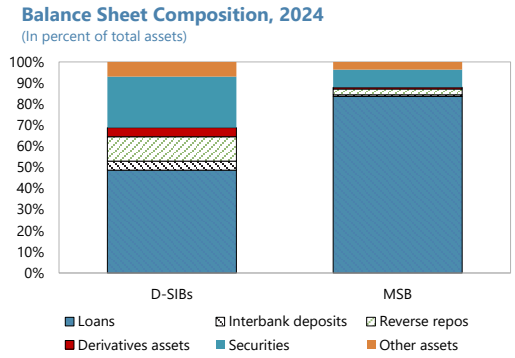

Sources: Fitch Connect

*Banks' balance sheets expanded by 42 percent since the last FSAP, reflecting a faster growth rate compared to other G7 countries.*



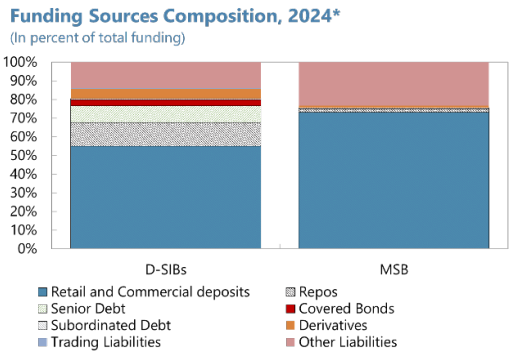

Sources: Fitch connect; and IMF staff estimates.

*Banks' balance sheets are dominated by loans, particularly for MSBs….*



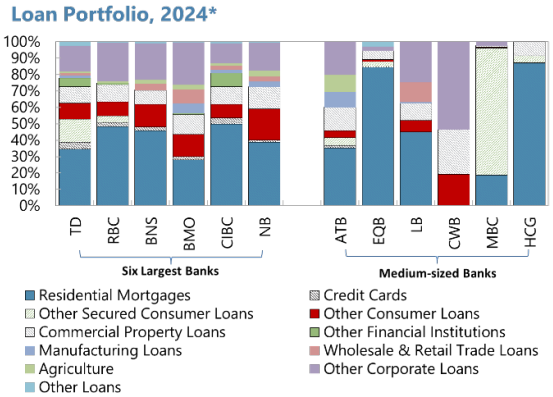

Sources: Fitch connect; and IMF staff estimates.
Note: MSB stands for Medium-sized banks.

*… and the six D-SIBs have a diversified mix of funding sources.*



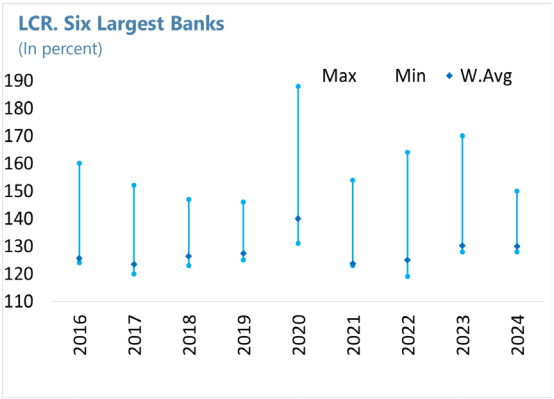

Sources: Fitch connect; and IMF staff estimates.
Note: MSB stands for Medium-sized banks. Note: *2023 for MSB.

*MSBs are less diversified than the D-SIBs, with some of them holding more than 87 percent exposures to residential mortgages.*




Sources: Fitch connect; and IMF staff estimations. Note: *2023 for MSB.

*The LCR of the six D-SIBs have been above the 100 percent regulatory minimum.*

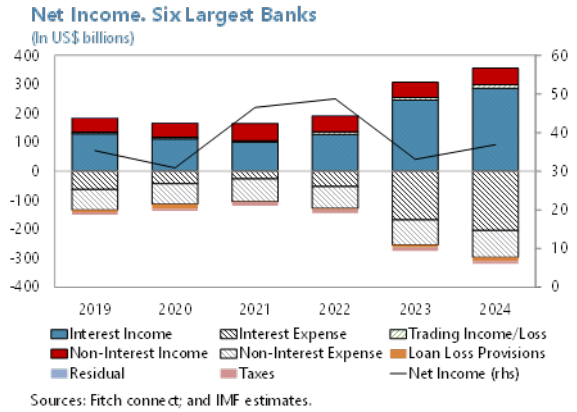



*Source: Fitch connect; and IMF staff estimates.*

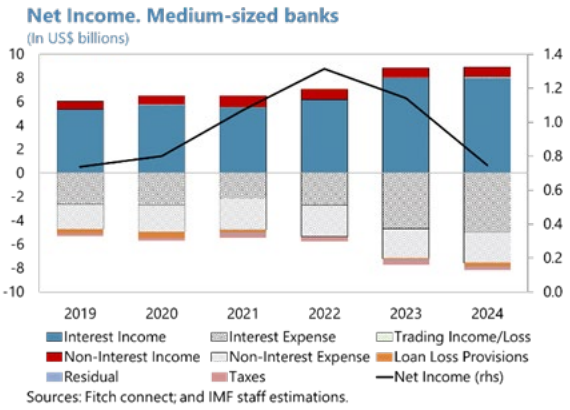
Notes: TD: Toronto-Dominion Bank, RBC: Royal Bank of Canada, BNS: Bank of Nova Scotia, BMO: Bank of Montreal, CIBC: Canadian Imperial Bank of Commerce, NBC: National Bank of Canada. ATB: ATB Financial, EQB: Equitable Bank, LB: Laurentian Bank of Canada, CWB: Canadian Western Bank, MBC: Manulife Bank of Canada, HCG: Home Capital Group.

## Figure 4. Canada: Banking Sector Key Performance Indicators

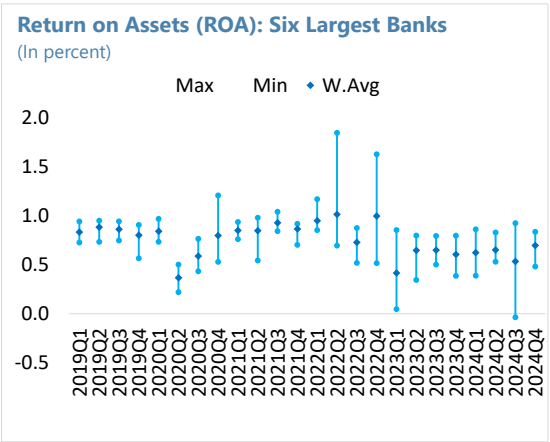
*Net income has remained strong despite recent declines due to rising interest expenses and loan loss provisions.*



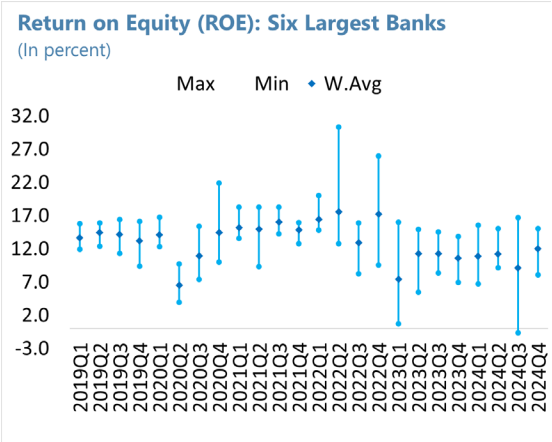

*... not only for D-SIBs, but also for MSBs.*



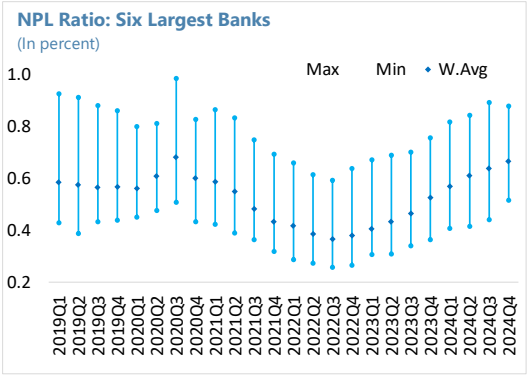

*The ROA has stayed stable...*



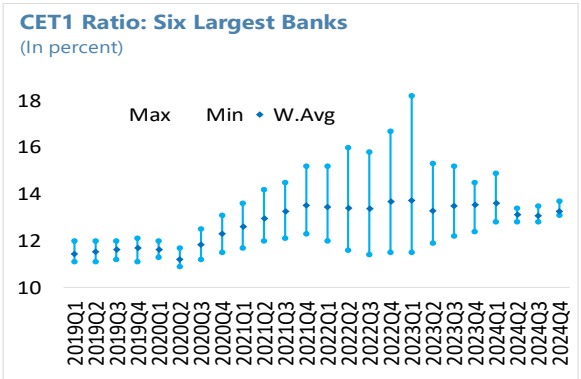

*... while the ROE remains high.*




*NPL ratios remain low despite a recent increase...*




*... and banks remain well capitalized.*

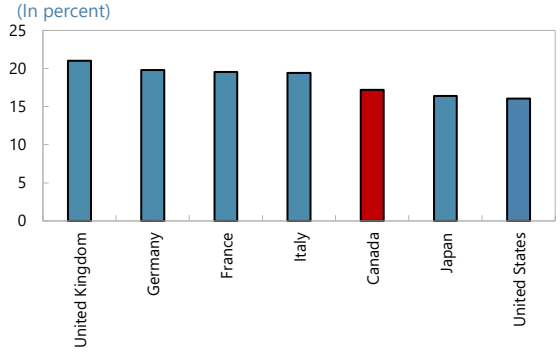



Sources: Fitch Connect, Capital IQ and IMF staff calculations.

## Figure 5. Canada: Canada and Selected Countries: Key Financial Soundness Indicators

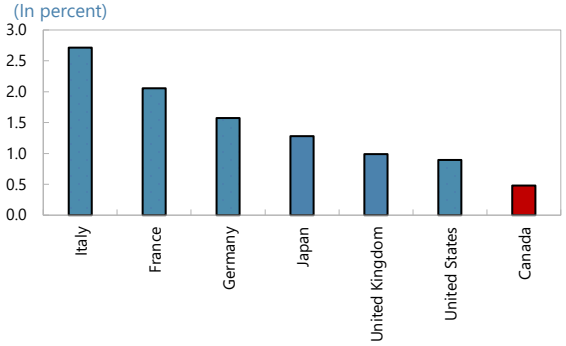
*The banking sector's capital adequacy is comparable to other G7 countries …*

**Regulatory Capital to Risk-Weighted Assets**
(In percent)



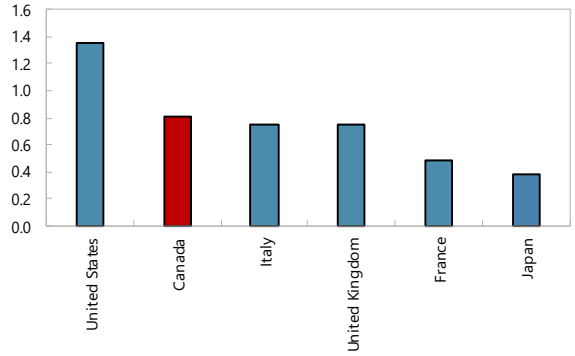

*… while NPL levels are low relative to other G7 countries.*

**Non-performing Loans to Total Gross Loans**
(In percent)



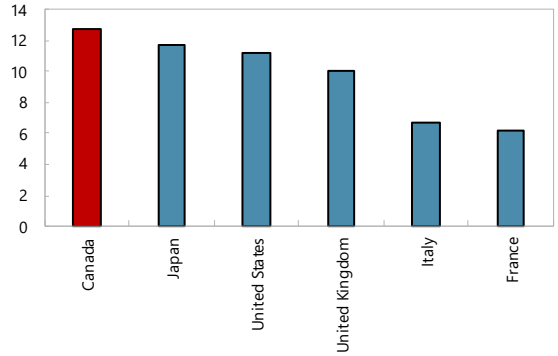

*Banks' profitability is comparable to other G7 countries though lower than the US …*

**Return on Assets**
(In percent)



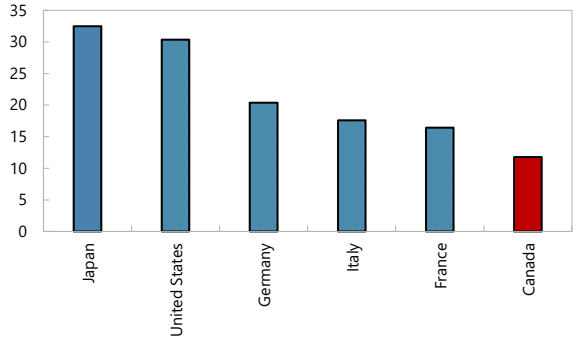

*… while it outperforms its peers in terms of ROE.*

**Return on Equity**
(In percent)



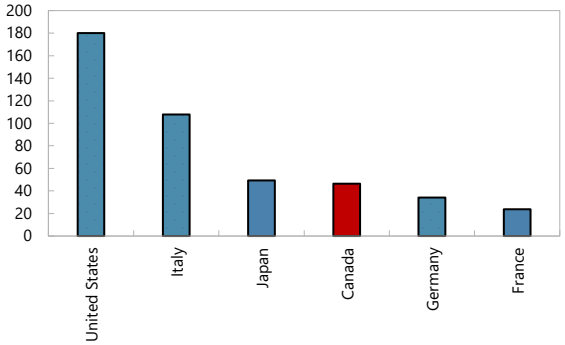

*Liquid assets are the lowest in G7 countries when compared to total assets ….*

**Liquid Assets to Total Assets**
(In percent)




*…. and are moderate compared to short-term liabilities.*

**Liquid Assets to Short Term Liabilities**
(In percent)




Sources: IMF and Financial Soundness Indicators database.
Note: Canada's data for these series are as of 2024: Q4 while others' values are based on 2024: Q3, except for Italy's data for 2024: Q2.

**13. The insurance sector is large and interconnected with the rest of the financial system.** Canada's insurance market ranks ninth globally in terms of written insurance premiums. In the life insurance sector, concentration is very high, with the three largest insurers accounting for around 85 percent of the total market, while nonlife is more diversified (motor vehicle and property insurance are the leading subsectors). Mortgage insurance—while a small niche—plays an important role in housing finance and is vulnerable to economic downturns and house price declines.

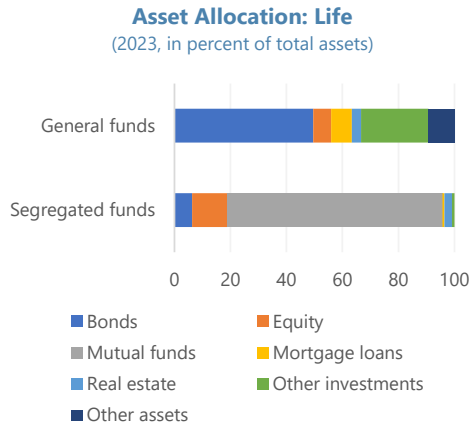
**14. Due to the prolonged low-interest rate environment in prior years, the life insurance industry's risk appetite generally increased for higher yielding and less liquid investments.** In 2023, federally regulated life insurers managed total assets of CAD 1,749 billion, of which 56 percent are managed as general funds and the remaining 44 percent as segregated funds. Within the general funds, almost 50 percent are invested in bonds; equity investments account for only 6 percent, and real estate for 3 percent (Figure 6). More recently, it has been noticed that some insurers reduced their risk appetite in the CRE sector and accordingly their exposures. Non-life insurers have generally more liquid and less risky assets; they also make only very little use of derivatives. Fixed-income investments both in the life and the non-life sector are generally of high quality, and the share of assets below investment grade is below 2 percent for both sectors combined. In the life sector, though, the share of unrated bonds is considerably larger than in the non-life sector—these are mainly private placements.

**15. The solvency ratios of Canadian insurers are well above the regulatory thresholds**. At the federal level, life insurers show rather stable solvency ratios, reaching 172 percent for the median firm in 2023; in the non-life sector, the median insurer reached a solvency ratio of 398 percent, steadily improving since 2019.

## Figure 6. Canada: Insurance Asset Allocation and Solvency

*General funds are mainly invested in bonds (50 percent) with a substantial portion also in other investments (e.g., infrastructure).*

*In the non-life sector, less than 1 percent of fixed-income assets are invested below investment grade, compared to 3 percent in the life sector (which also holds a larger share of unrated assets).*



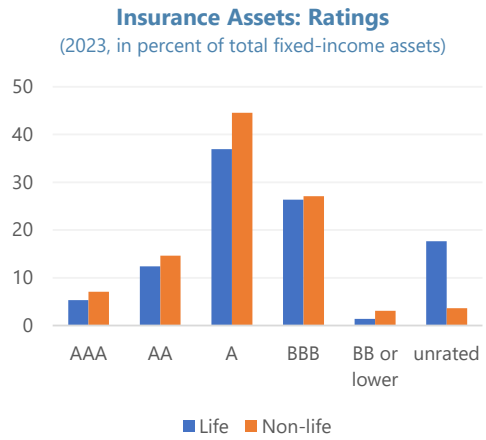
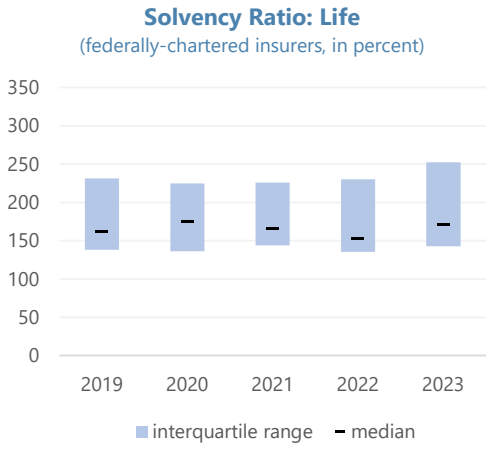
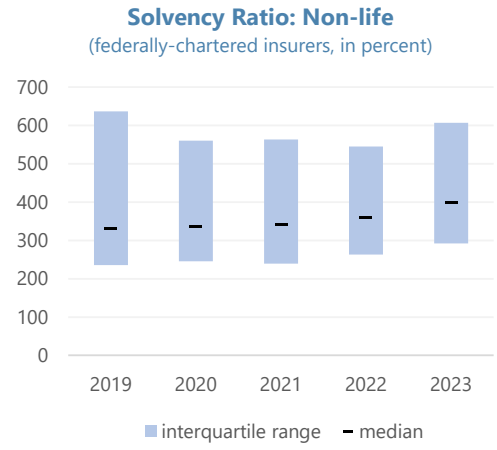



**Figure 6. Canada: Insurance Asset Allocation and Solvency (concluded)**

*Solvency ratios of federally chartered life insurers have been very stable, with the median insurer between 150 and 175 percent since 2019.*




*In the federally chartered non-life sector, solvency ratios have been trending upward since 2021, reaching almost 400 percent for the median insurer in 2023.*




Sources: IMF staff calculations based on Canadian Life and Health Insurance Association, Office of the Superintendent of Financial Institutions.

Notes: Rating breakdown for federally regulated insurers only.

**16. The pension sector is also large by international comparison and interconnected.** Assets of trusteed pension funds reached CAD 2.2 trillion in 2023 (75 percent of GDP), four-fifths of which are held by public sector funds. In total, more than 16,000 plans exist, many of them extremely small. The largest public-sector plans, the so-called "Maple Eight," are defined-benefit (DB) schemes and faced significant funding pressures during the prolonged phase of low interest rates—since 2021, funding positions have considerably improved. Low interest rates and the maturity of most plans (with benefit payments exceeding contributions) have contributed to a search for yield through investments in longer-term (and less liquid) assets and increases in leverage using derivatives.

**17. Pension plans' investment assets are by nature very long-term, with a significant amount being invested in equities, real estate, and infrastructure**. Over the last two years, the share of the two latter categories increased further (to 11 and 10 percent, respectively, at end-2023), while the relative shares of equities (37 percent) and bonds (26 percent) have declined slightly. Equities, real estate and infrastructure are predominantly invested abroad, while more than 80 percent of the bond investments are domestic (Figure 7).

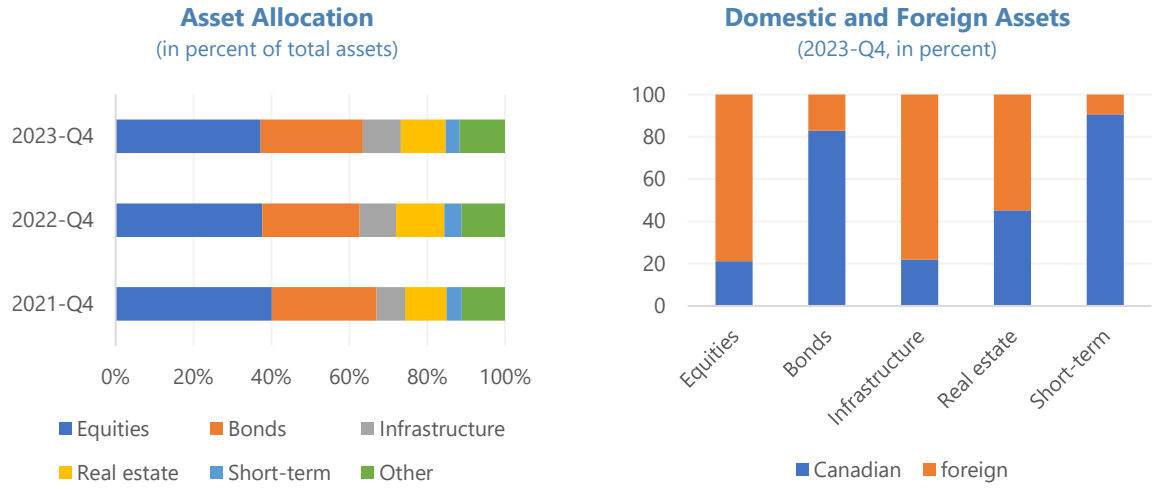
**18. Funding ratios of DB plans have significantly improved since 2020.** This development is driven both by rising interest rates (which reduce the valuation of liabilities) and positive investment returns, driven inter alia by the increase in stock markets. While the median funding ratio of a representative sample of pension plans has long been fluctuating below 100 percent, it reached

values around 120 percent in 2023/24. The number of underfunded pension plans has at the same time declined substantially.

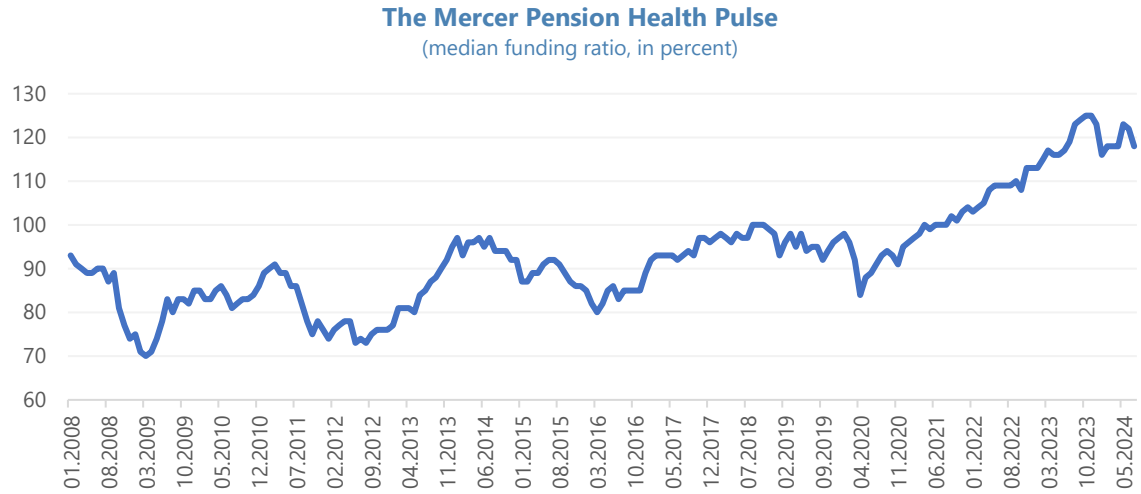
**Figure 7. Canada: Pension Plan Investments and Funding Ratios**

*The sector-wide asset allocation has been rather stable since 2021, with some increases in real estate and infrastructure investments.*

*While bonds and short-term assets are largely invested domestically, around 80 percent of equity and infrastructure investments are foreign.*




*With rising interest rates, funding ratios have steadily increased since 2020 and plateaued around 120 percent.*




Source: IMF staff calculations based on Statistics Canada and Mercer.

Note: Median funding ratio based on a sample of around 450 to 500 Canadian pension plans (varying composition).

# MACROECONOMIC SCENARIOS

**19. The FSAP evaluated the resilience of the corporate, household, banking, insurance, and pensions sectors under two scenarios.** A baseline scenario, consistent with the October 2024 World Economic Outlook (WEO) projections and an adverse scenario consistent with the FSAP Risk Assessment Matrix (RAM) (Appendix I). The adverse scenario is simulated using the IMF's Global Macro financial Model[6], a structural macro-economic model of the world economy, disaggregated into forty economies, including Canada, the US, the Euro Area, China and Mexico. The scenarios span three years (2025–27). Since the mission, some downside risks associated with geoeconomic fragmentation materialized and the April WEO 2025 projections show lower growth, higher unemployment, and higher inflation compared to the October WEO 2024 projections. However, the gap between the adverse scenario paths and the April 2025 WEO projections remains large, and the adverse scenario remains a severe and appropriate test of the system. [7]

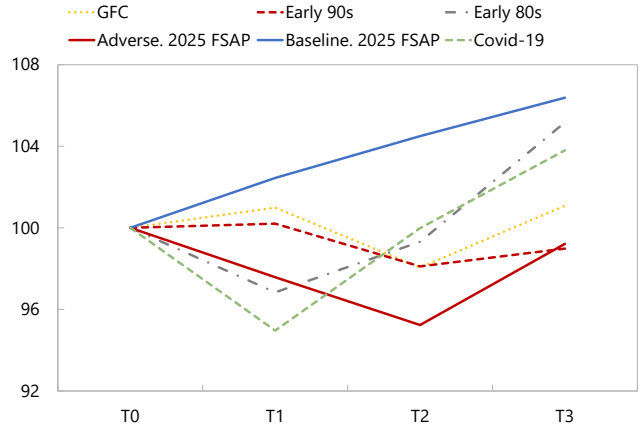
**20. The adverse scenario features deepening geoeconomic fragmentation that fuels greater protectionism and increasing use of cross-border restrictions**. Deepening geopolitical fragmentation is evidenced as a severe supply shock operating through various channels, including international trade, restrictions on cross-border migration, limitations on foreign direct investment (FDI), and technology diffusion. The disruption of established global production chains puts downward pressure on global economic growth and creates a series of temporary supply shortages, initially raising inflation with substantial knock-on effects on inflation expectations. This prompts central banks to pause cutting interest rates (or reverse some of the recent cuts) and keep them elevated during the first years of the scenario. A slowdown in global economic growth increases unemployment and reduces commodity demand, causing oil prices to drop. Limitations on FDI and reduced technological diffusion dent innovation and lead to significant productivity decline. A reassessment of market fundamentals triggers a widespread risk-off event and asset valuation corrections. This results in the real equity price falling in Canada, US, China and the Euro Area over two years and a sizable downward adjustment in real estate prices, particularly in countries with higher overvaluation. The CAD depreciates.

[6] Vitek, F. (2015), Macrofinancial analysis in the world economy: A Panel Dynamic Stochastic General Equilibrium Approach, International Monetary Fund Working Paper, 227.

[7] Figure 9 plots the adverse scenario against both the October 2024 and April 2025 WEO projections.

**21. Canada experiences a slowdown of economic growth with a cumulative decline of 4.8 percent in real GDP over the initial two years of the scenario** (Figure 8). The decline encompasses a contraction of 2.4 percent in both 2025 and 2026. The two-year cumulative loss represents a 2.7 standard deviation shock from the mean of the historical distribution. The slowdown is driven by a reduction in trade, given a sharp de-integration of highly integrated North American supply chains and goods and services markets that leads to large deadweight losses. Potential growth is also reduced due to investment distortions associated with trade protectionism. Inflation expectations increase as supply chains and production networks are disrupted. And unemployment rises, reaching a level of 9.2 percent at the peak. Residential real estate prices drop by 25 percent, driven not just by high interest rates, increased unemployment, and reduced household income, but also by a sharp decline in immigration (see Figure 9 and Appendix II).

**Figure 8. Canada: Real Gross Domestic Product (2024=T0=100)**



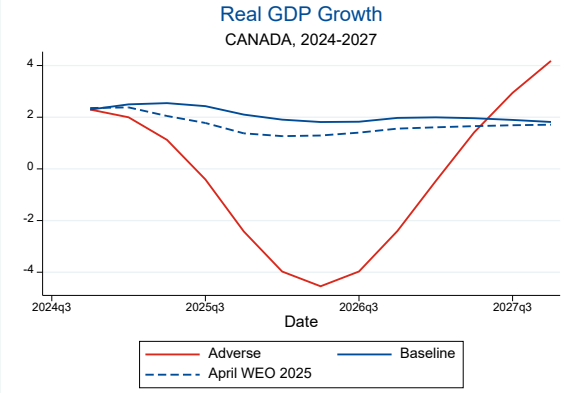

Sources: Haver and IMF staff calculations.

# HOUSEHOLD ANALYSIS

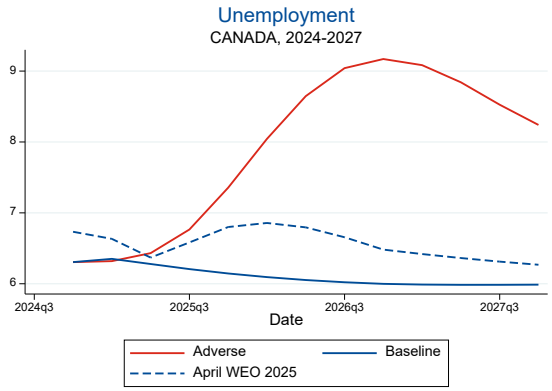
**22. Structural vulnerabilities among Canadian households remain.** Canada's household sector is the most indebted among G7 economies, with household debt levels exceeding 100 percent of GDP and 170 percent of disposable income as of 2024 (Figure 10). In the assessment of household vulnerabilities, the mortgage market plays a critical role, given that residential mortgages constitute 74 percent of total credit liabilities of household (2024: Q4) and account for a substantial portion of DTIs' lending portfolios. While mortgage arrears are below pre-pandemic levels, reflecting household adaptation to higher interest rates through precautionary savings and expenditure adjustments, risks remain. A deep macroeconomic downturn, particularly if accompanied by sharply rising unemployment and stagnating income growth, could trigger a materialization of household risks.

## Figure 9. Canada: Macrofinancial Scenarios

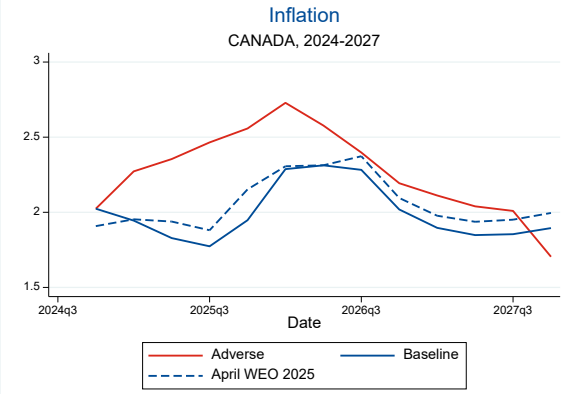
*Under the adverse scenario real GDP growth drops to -4.8 percent….*




*… while unemployment increases to 9.2 percent.*

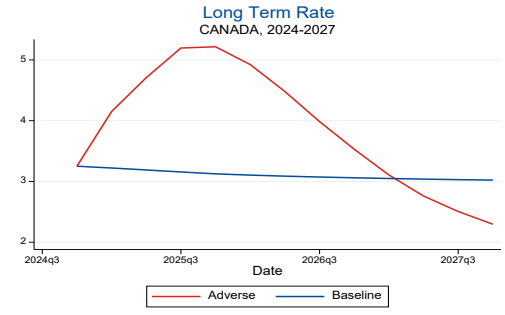



*Inflation increases moderately, by about 1pp….*




*… and short-term rates increase 60 bps… driven by high inflation expectations….*


*There is an increase in long term rates…*




*… and the exchange rate depreciates by about 10 percent.*

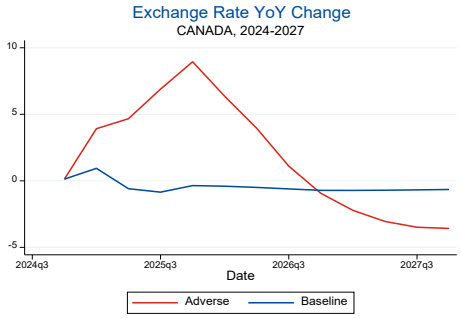
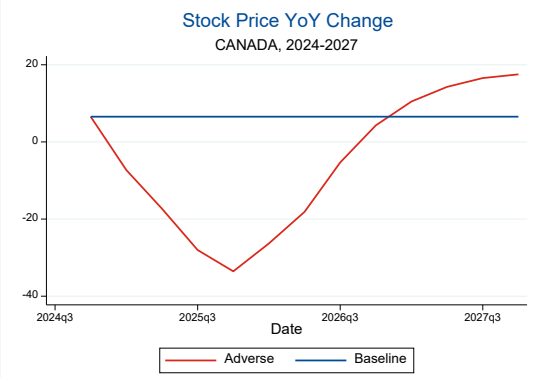
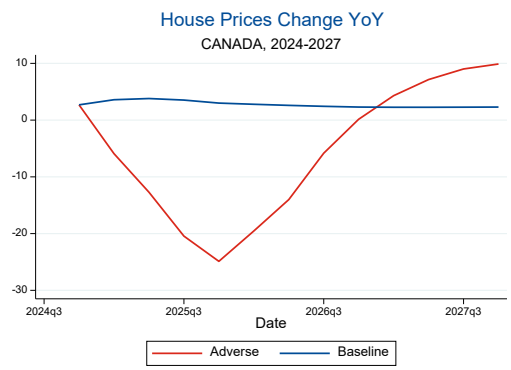


**Figure 9. Canada: Macrofinancial Scenarios (concluded)**

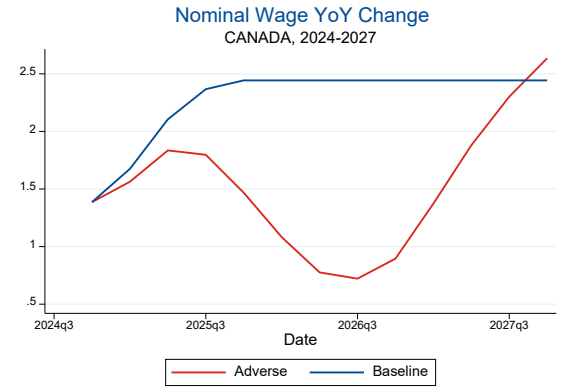
*Stock prices fall by 33 percent…*



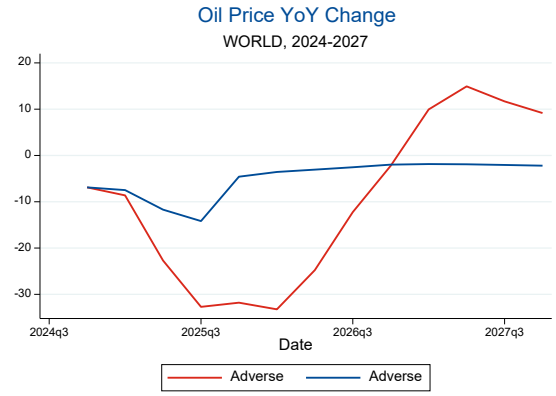

*… and house prices drop by 25 percent.*




*Nominal wage growth experiences a decline of 0.7 percentage points….*




*… and oil prices slump by 33 percent.*




Sources: WEO and staff calculations.

**23. There is heterogeneity across different income groups and debt instruments.** Canadian households with mortgages generally prioritize mortgage repayments over non-mortgage credit obligations, reflecting strong incentives to maintain homeownership under a full-recourse system in most provinces. However, inflationary pressures, a slower-than-expected pace of interest rate cuts, and increases in debt service payments as mortgage rates reset from pandemic lows could exacerbate financial vulnerabilities, particularly for borrowers with limited liquidity buffers. The impact of higher borrowing costs weighs most heavily on lower-income households, which have less flexibility to absorb shocks and are highly sensitive to changes in employment status and wage growth. Signaling an accentuation of household vulnerabilities, delinquency rates have increased more pronouncedly in non-mortgage credit instruments especially credit cards and auto loans (Figure 10), particularly among renters and lower-income borrowers. Since 2017, uninsured mortgages have dominated Canada's residential mortgage market (around 75 percent as of

2024Q4), growing more rapidly than insured loans, particularly during the pandemic, and continuing to outpace them despite the recent market slowdown.[8]

**24. Wealth distribution in Canada is uneven, with financial conditions affecting households differently post pandemic.** In 2024: Q2, the top 20 percent of households in the wealth distribution held about 68 percent of total net worth, averaging 3.4 million CAD per household, while the bottom 40 percent accounted for only 2.8 percent, with an average net worth of about 70 thousand CAD, according to Statistics Canada's modelling estimates.[9] Post-pandemic, wealth disparities have widened, driven by financial asset gains benefiting higher-income households, while lower- and middle-income households faced rising debt burdens. Higher interest rates in 2023 had mixed effects—boosting investment earnings for wealthier households but straining disposable income for middle-income households as interest payments outpaced wage growth (Figure 11). While the lowest-income households saw real income gains in early 2024, these gains were offset by rising mortgage debt. Consistent with this, debt-to-income (DTI) ratios are markedly higher for the lowest-income quintile, which has also experienced the largest increase in indebtedness since 2020, underscoring heightened vulnerability among financially constrained households.

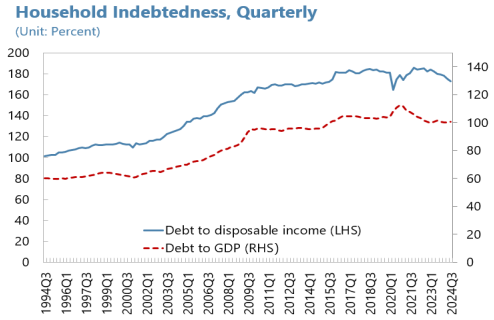
**25. Rising debt service burdens due to higher interest rates pose risks to household financial resilience.** The overall household DSR has trended upward—after a temporary decline following the pandemic in 2020: Q2—peaking at 15.1 percent in 2023: Q4 before moderating to14.7 percent in 2024: Q3. While this marks some relief, the DSR remains elevated, and close to pre-pandemic levels, which were among the highest in Canada's history, and remains high relative to longer-term trends (around 15 percent in both end-2007 and end-2019). The post-pandemic increase has been driven mainly by mortgage debt, with the mortgage DSR for all households rising above the non-mortgage DSR post-2022, for the first time since mid-1990s, reaching a record 8.2 percent in 2023: Q2 before easing slightly to 8.0 percent in 2024: Q3 (Figure 11). The share of income allocated to mortgage payments has increased significantly for households that took on mortgages after interest rates began rising in 2022, as reflected in elevated DSR levels at origination, despite borrowers opting for smaller loan sizes and extended amortization periods. Some comfort is provided by the sharp decline in negative amortization loans, which accounted for around 2 percent of all mortgages as of 2024: Q3. This reflects proactive actions by lenders and borrowers, as well as recent interest rate declines. The fact that employment dynamics play a crucial role in mortgage repayment capacity and arrear rates (Figure 11) is considered in the modeling of PD in later stages.

[8] The rise in uninsured mortgages reflects regulatory constraints that render homes valued over CAD 1 million ineligible for mortgage insurance and require a minimum 20 percent down payment. As a result, uninsured lending is more prevalent among higher-value properties, particularly single-detached homes.

[9] Statistics Canada's modelling estimates based on 2024: Q2 data. See Statistics Canada (2024), "Wealth Inequality in Canada, Second Quarter 2024".

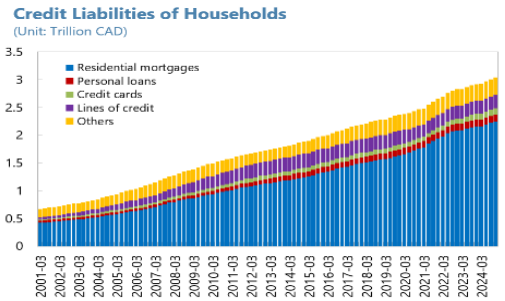
## Figure 10. Canada: Household Credit Market and Indebtedness

*Household debt remains elevated relative to income and GDP, despite some recent moderation.*



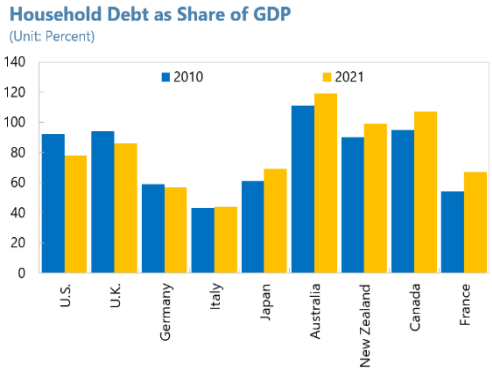

Sources: Statistics Canada, Haver, and IMF staff calculations.

*Household credit liabilities have risen steadily, driven primarily by growth in residential mortgages post-pandemic.*



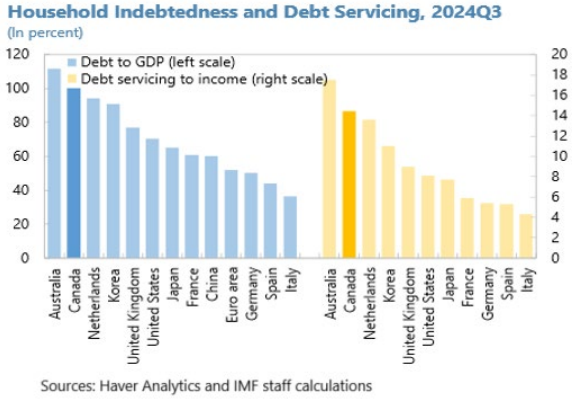

Sources: Statistics Canada and IMF staff calculations.

*Household debt has increased across most advanced economies since 2010, with Canada among the highest.*



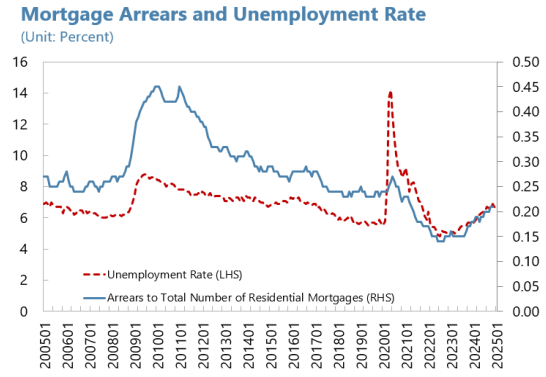

Sources: CMHC and IMF staff calculations.

*Canada has one of the highest household debt levels compared to G7 peers, with elevated debt servicing costs.*



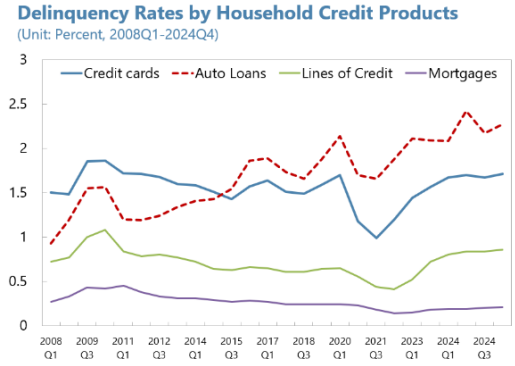

Sources: Haver Analytics and IMF staff calculations

*Mortgage arrears closely track the unemployment rate, rising during economic downturns.*




Sources: Canadian Bankers Association, Statistics Canada, and and IMF staff calculations.

*Delinquency rates for credit cards, auto loans, and credit lines have risen more sharply since 2021, while mortgage arrears remain low.*



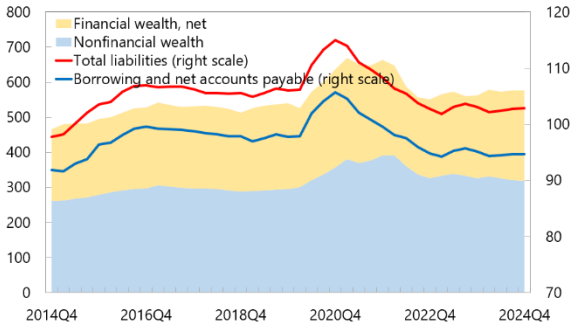

Sources: CMHC and IMF staff calculations.

## Figure 11. Canada: Household Wealth, Income, Saving and Debt Servicing

*Household wealth and liabilities, relative to GDP, have dropped since the pandemic…*

**Household Indebtedness and Wealth, 2014-24**

(In percent of GDP)

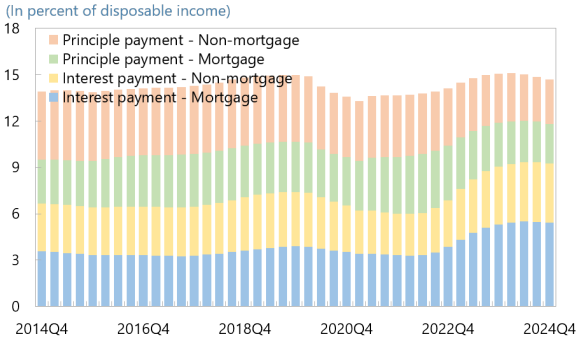



Sources: Haver Analytics and IMF staff calculations.

*…and household debt service to income is increasing due to higher interest costs.*

**Household Debt-Servicing, 2014-24**

(In percent of disposable income)

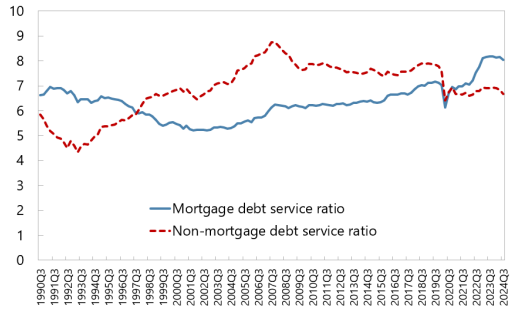



Sources: Haver Analytics and IMF staff calculations.

*Mortgage DSRs have risen post-2022, particulalry in mortgage debt.*

**Household Debt Service Indicators, Quarterly**

(Unit: Percent)

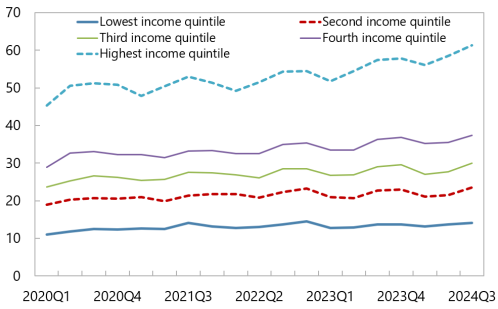



Sources: Statistics Canada and IMF staff calculations.

*Income has increased across all quintiles, with higher-quintile group making larger gains.*

**Household Disposable Income**

(Unit: Value per Household, in Thousands of CAD)

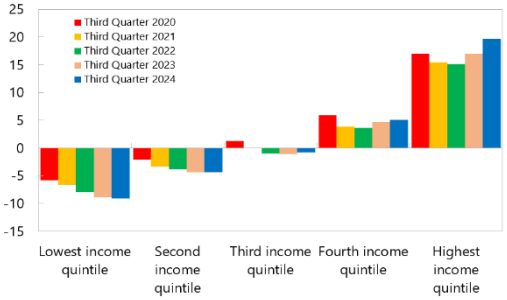



Sources: Statistics Canada and IMF staff calculations.

*Savings declined post-pandemic across groups, higher-income groups maintained higher savings while lower income dissaved post-2022.*

**Household Net Saving by Income Quintile**

(Unit: Thousands of CAD per Household)

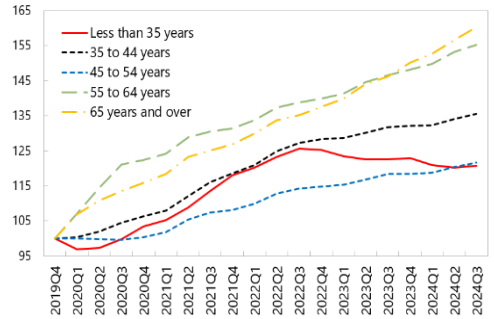



Sources: Statistics Canada and IMF staff calculations.

*Younger households reduced mortgage debt amid affordability challenges compared to other age groups.*

**Household Mortgage Debt Balance by Age Group**

(Unit: Index, 2019Q4=100)




Sources: Statistics Canada and IMF staff calculations.

**26. The FSAP conducted a quantitative mortgage risk analysis integrating a structural simulation method with a Bayesian Model Averaging (BMA) econometric framework.** The analysis relies on granular loan-level data from Office of the Superintendent of Financial Institutions (OSFI's) Real Estate Secured Lending (RESL) dataset to conduct a bottom-up simulation of DSR. For the projection of PDs, aggregate household financial statistics from Statistics Canada were used, together with the historical "Actual PDs"[10] sourced from banks' public pillar 3 disclosures covering 2014 through 2024.

**27. The FSAP team first employs a structural simulation framework to assess borrower's debt service burden under baseline and adverse scenarios.** The simulation first initializes household financial variables to reflect end-2024 economic conditions, accounting for realized trends in employment, income growth, and household debt metrics. A bootstrap approach is used to model employment dynamics, ensuring alignment with projected unemployment dynamics and other macroeconomic trends in the FSAP's overarching scenarios. Household income is then adjusted based on simulated employment outcomes and wage growth expectations, feeding into DSR projections. Through sufficient iterations, the model aggregates these loan-level outcomes and use them as an input for the second stage (see Appendix VII. Household Analysis Methodology for simulation details).

**28. Then, the FSAP team applies a BMA framework to project mortgage PDs by incorporating key macro-financial indicators.** The econometric framework systematically selects the most relevant predictors, ensuring robustness across different model specifications. Mortgage DSRs from the first stage are anchored to the equivalent end-2024 aggregate statistics from Statistics Canada, allowing for a calibrated assessment of household financial burden. Key variables considered in the BMA include GDP growth, inflation, interest rates, labor market dynamics, and external macroeconomic conditions (see Appendix VII. Household Analysis Methodology for BMA model specification details).

**29. Results suggest stability under normal conditions, but increases in debt service burden under the adverse scenario.** Under the baseline scenario, mortgage DSR is expected to decline from 8.1 percent in 2024: Q4 to 6.7 percent in 2027Q4, reflecting steady income growth and stable debt burdens. In contrast, under the adverse scenario, DSR peaks at 10.3 percent in 2026: Q4 before easing to 8.6 percent by 2027: Q4, driven by higher interest rates, weaker income growth, and rising unemployment.[11] Low-income households face the sharpest DSR increase, exceeding the baseline by over 2 percentage points in 2025–26, while middle-income borrowers see a moderate rise with less volatility (Figure 12). High-income groups remain largely insulated, reflecting greater financial resilience.

[10] The "Actual PD" reflects the experience of the past 12 months and is different from the regulatory TTC PD.

[11] Due to data limitations, the projection does not incorporate new mortgage originations after late 2023 (based on the RESL dataset received). As such, the decline in DSR primarily reflects amortization and improving repayment capacity among existing borrowers, without accounting for potential dilution from new entrants to the loan pool.

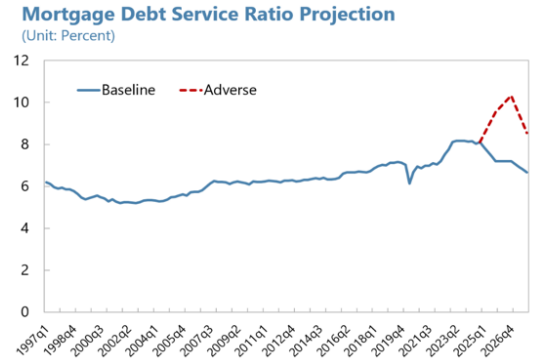
**30. The PD projection results highlight that while most mortgage holders demonstrate financial resilience, certain borrower segments remain vulnerable under adverse conditions.** Projected mortgage PDs rise under the adverse scenario, reaching 0.9 percent for uninsured loans and 1.4 percent for insured loans.[12] The primary driver of mortgage defaults is unemployment, with lower-income households and those facing significant payment increases at the highest risk. The decomposition of risk factors indicates that while interest rate increases exert pressure on debt-servicing capacity, the most significant trigger for mortgage distress is a sharp deterioration in labor market conditions (Figure 12). The relatively higher rise in PDs for insured loans reflects the higher loan-to-value (LTV) ratios and lower income profiles typical of this group. For these borrowers, wage growth plays a more prominent role than unemployment in driving default risk, underscoring their heightened sensitivity to income and employment shocks.

**31. Despite these vulnerabilities, the household sector remains overall resilient under the adverse scenario.** While this finding offers some comfort, it highlights the need for continued close monitoring of refinancing and default risks in various debt instruments in the household sector. Savings accumulation and liquidity buffers remain critical, particularly for lower-income borrowers with limited financial flexibility and vulnerability exposed to unemployment shocks. The authorities should further develop structural models (such as the latest BOC's Household Risk Assessment Model (HRAM)) leveraging rich data access to micro-level household information and incorporating counterfactual analysis to assess vulnerabilities more comprehensively particularly in the context of low arrears in past cycles.

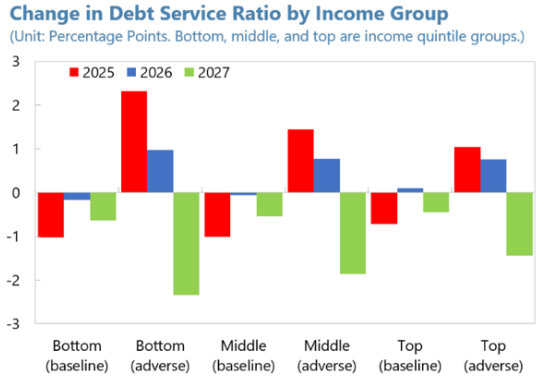
[12] The mortgage PD projections should be interpreted with caution, as they are based on a short time series for the panel BMA estimation due to the unavailability of longer historical data.

## Figure 12. Canada: Household Mortgage Probability of Default Projection

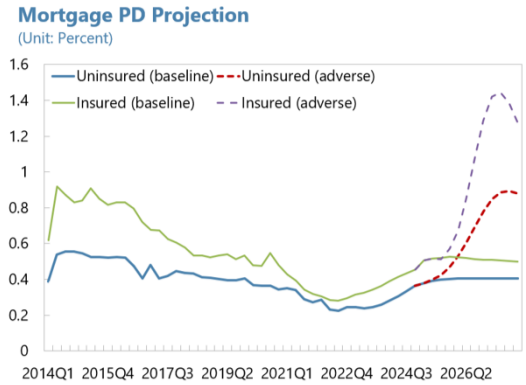
*DSR projections show a sharp increase under adverse scenarios.*



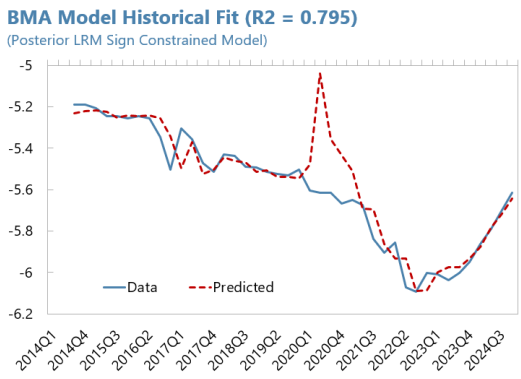

*Lower-income households face the largest rise in debt service burdens under adverse conditions.*



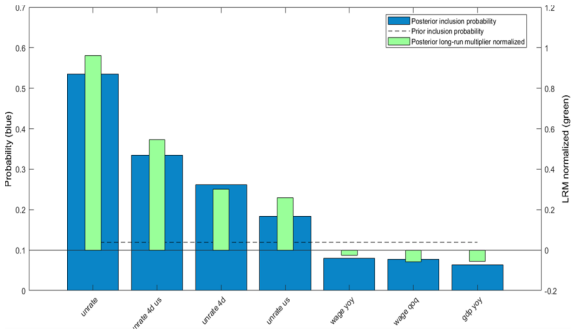

*Mortgage default probabilities remain low but rise under adverse scenarios, particularly for insured loans.*



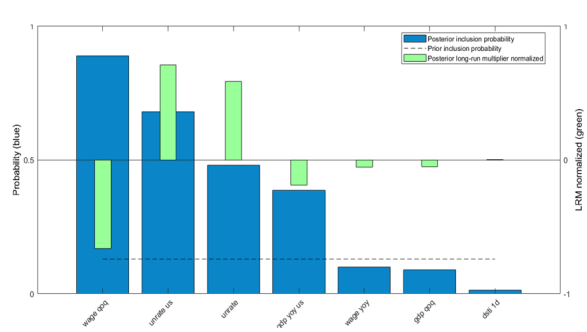

*The model exhibits a strong fit to historical data, capturing key downturns and recovery trends, with the COVID-19 period excluded from estimation.*




*Unemployment is the key risk driver for uninsured loans…*




*… while wage growth is the main factor for insured loans.*




Sources: Office of the Superintendent of Financial Institutions, Real Estate Secured Lending, Statistics Canada and IMF staff calculations.

# CORPORATE ANALYSIS

**32. The Canadian corporate sector has demonstrated resilience despite tightening financial conditions, though vulnerabilities persist in specific industries and firm segments.** Large nonfinancial corporations remain stable due to diversified funding sources, robust capitalization, and access to long-term financing. However, financial stress has risen for small and mid-sized enterprises (SMEs), particularly in consumer-facing sectors such as food services, accommodation, and retail. Key corporate vulnerability metrics[13] have shown signs of stabilization since 2022 (Figure 13), but debt-servicing burdens remain elevated in some industries, reflecting the impact of higher interest rates and tighter credit conditions. Firms with weaker financial positions and high debt-servicing costs continue to face refinancing challenges as credit spreads widen and borrowing costs rise.

**33. Extraordinary government support and loan deferrals[14] played a critical role in containing corporate stress during the pandemic, but their expiration has exposed pockets of weakness, particularly among small firms.** Business insolvencies remained subdued relative to pre-pandemic levels until late 2022, reflecting the effects of these policy interventions. However, insolvencies surged in the second half of 2023 and early 2024 before moderating again, suggesting that the initial increase largely reflected a catch-up effect as support measures were phased out. This effect was most pronounced among very small firms and sectors that were disproportionately affected by the pandemic, including accommodation and food services, transportation, and services (Figure 13). While overall financial stress in the small business sector has not yet reached systemic levels, indicators of rising impairment rates on small business loans warrant close monitoring, particularly as refinancing risks increase.

**34. Since the pandemic, private NFCs demand for funds has remained elevated, reflecting shifts in financing conditions and corporate funding strategies.** Borrowing has been primarily driven by bond issuances and non-mortgage loans, while listed share redemptions have persisted, reflecting weak initial public offering (IPO) activity and continued corporate buybacks, particularly in the energy sector. Although overall demand for funds has moderated from the peaks observed during the immediate post-pandemic recovery, it remains above historical norms, suggesting ongoing adjustments to higher interest rates and evolving business investment needs.

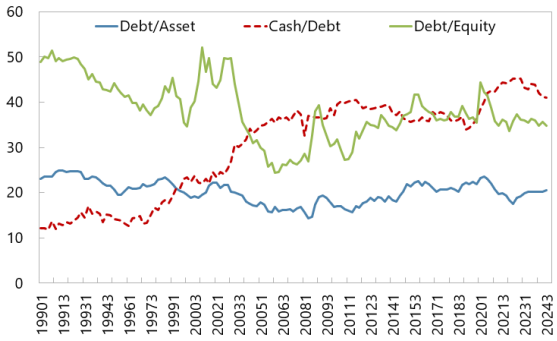
[13] The debt measure in the Canada Non-Financial Corporations indebtedness and liquidity chart excludes corporate claims to align with the authorities' methodology, while the cross-country corporate indebtedness chart includes them to maintain consistency given data limitations.

[14] Major federal government support during the pandemic included interest-free, partially forgivable loans under the Canada Emergency Business Account (CEBA), wage subsidies through the Canada Emergency Wage Subsidy (CEWS), and commercial rent assistance via the Canada Emergency Rent Subsidy (CERS).

## Figure 13. Canada: Corporate Sector Credit Market and Indebtedness

*Corporate leverage has remained stable, and cash buffers have increased overall since the pandemic, but decreased moderately since 2023.*

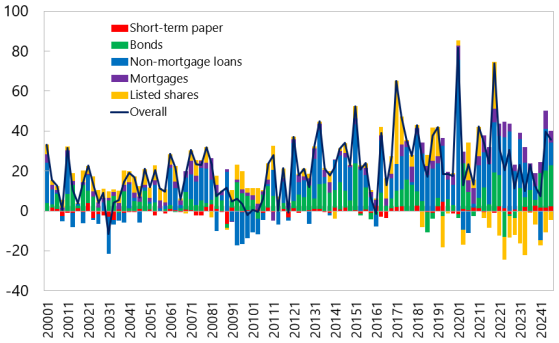
**NFC Indebtedness and Liquidity**
(Unit: Percent)




Sources: Statistics Canada and IMF staff calculations.

*Corporate funding demand remains elevated post-pandemic, briefly eased in 2022–23, and picked up again in early 2024 before easing slightly by year-end.*

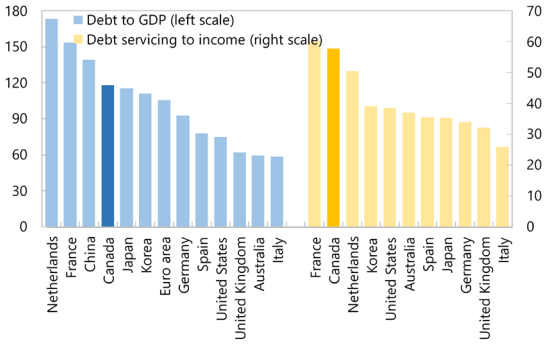
**Demand for Funds by Private NFC, Quarterly**
(Unit: Billion CAD)




Sources: Statistics Canada and IMF staff calculations.

*Corporate debt and debt service are also high relative to other industrial countries…*

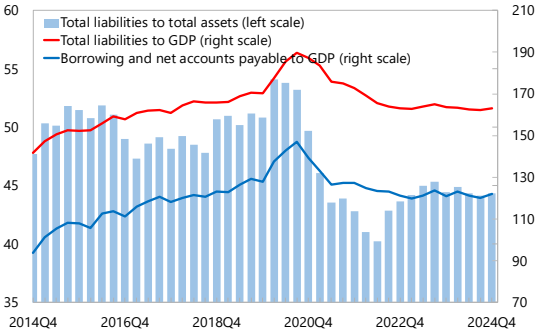
**Corporate Indebtedness and Debt Servicing, 2024Q3**
(In percent)




Source: Haver Analytics and IMF staff calculations.

*…despite some post-pandemic moderation.*

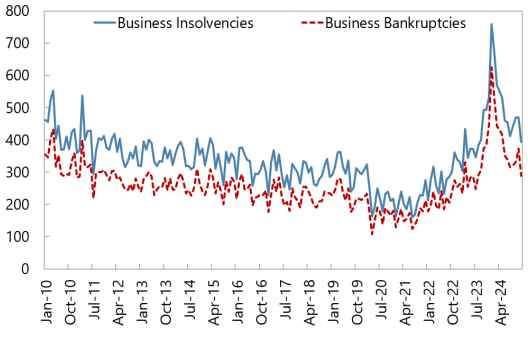
**Corporate Indebtedness and Leverage, 2014-24**
(In percent)




Source: Haver Analytics and IMF staff calculations.

*Insolvencies have surged post-pandemic, exceeding pre-pandemic levels, then begun to normalize since 2024H2.*

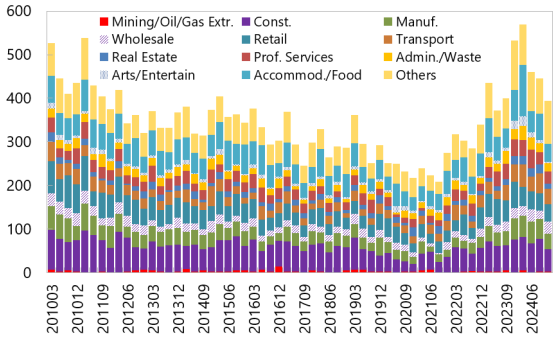
**Business Insolvencies and Bankruptcies, Monthly**
(Unit: Number of Filing)




Sources: Office of the Superintendent of Bankruptcy and IMF staff calculations.

*Insolvencies have increased most notably in trade, accommodation, food services and manufacturing.*

**Business Insolvencies by Industry, Quarterly**
(Unit: Number of Filing)

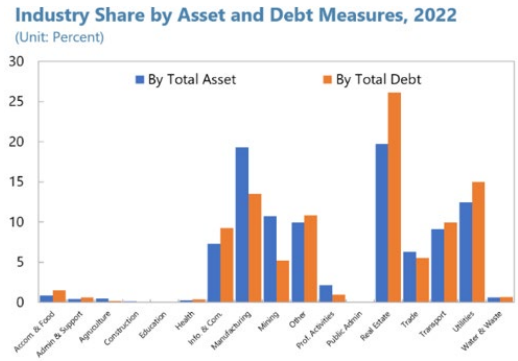



Sources: Office of the Superintendent of Bankruptcy and IMF staff calculations.

**35. The FSAP team assessed corporate sector vulnerabilities using a combination of aggregate and firm-level data sources to analyze financial resilience and default risk.** Headline indicators of corporate strength were derived from Statistics Canada data, while firm-level financial risks were assessed using Moody's Orbis database (Figure 14. See detailed data steps and statistics in Appendix VIII). The data are updated through 2022, with complementary information from the authorities indicating sectoral improvement since then. The assessment focused on key financial indicators—leverage, profitability, and liquidity—across firm sizes and sectors. Financially weak firms were identified based on debt-servicing capacity, while firm-level Expected Default Frequencies (EDFs) were estimated using firm-level fixed-effects regressions on Moody's data.

**Figure 14. Canada: Orbis Descriptive Statistics and Industry Dynamics**

*Real estate, utilities and manufacturing hold the largest shares of total debt and asset.*




*While manufacturing and mining have declined since GFC, real estate has seen the largest increase in asset share.*


Sources: Moody's Orbis and IMF staff calculations.

**36. BMA methods were applied to project corporate PDs at the aggregate and sectoral levels.** The model incorporates macroeconomic factors such as GDP growth, inflation, interest rates, equity market performance, exchange rate fluctuations, corporate bond spreads, and U.S. economic conditions. Data limitations were addressed by incorporating additional information provided by the BOC.

**37. Corporate financial conditions have shown notable shifts across key indicators, reflecting the uneven recovery across firms.** According to firm-level data up to 2022, the interest coverage ratio (ICR) spiked in 2020 amid temporary policy support but has since declined, stabilizing at pre-pandemic levels. While the share of firms with ICR, measured by Earnings Before Interest and Taxes (EBIT) over interest, less than 1 remains elevated, these firms account for a relatively small portion of total corporate debt, suggesting that financial vulnerabilities are concentrated among smaller or weaker firms rather than being systemic (Figure 15). The debt-at-risk measure, which captures the share of corporate debt held by firms with ICR less than 1, fell sharply post-pandemic,

reaching 11 percent as of 2022, below pre-pandemic levels, indicating an improvement in financial resilience among indebted firms.[15]

**38. More recent data from the authorities, extending through 2024, suggest improving corporate financial resilience, with stronger ICRs, stable leverage, and declining debt-at-risk.** ICRs have broadly remained stable since 2022, for both publicly traded firms as well as aggregate measures for NFCs.[16] Furthermore, the lower tail of the ICR distribution has narrowed sharply, suggesting reduced financial stress among the most vulnerable firms. [17] This trend aligns with stabilizing corporate earnings and easing financing pressures. Debt-at-risk has continued to decline in 2023 and 2024, particularly in non-oil and gas industries, signaling improved debt-servicing capacity. Corporate leverage has remained stable since 2022, indicating that firms have maintained a balanced approach to debt accumulation amid shifting macroeconomic conditions.

**39. Indicators of firms' profitability and liquidity further illustrate the uneven financial recovery.** While ROA has remained stable for the median firm and top-performing firms, profitability has deteriorated among firms in the lower quartile, particularly in the post-pandemic period. The liquidity ratio, measured as current assets over current liabilities, has remained stable for large firms, reflecting their stronger balance sheets and financing access. However, liquidity conditions have been more volatile for medium-sized firms, suggesting greater exposure to financial constraints with less sufficient buffer. These trends underscore an improving aggregate financial risk profile but highlight continued vulnerabilities among lower-profitability and highly leveraged firms in a tightening financial environment.

**40. Debt-at-risk dynamics exhibit notable sectoral divergence, with most industries experiencing a declining trend post-pandemic, while some sectors remain volatile.** In trade, real estate, professional activities, information and communication, and accommodation and food services, debt-at-risk has steadily declined over time, reaching lower levels compared to historical trends. This suggests improved financial conditions, potentially supported by stronger earnings recovery and better liquidity management. In contrast, mining, manufacturing, and agriculture have exhibited higher and more volatile debt-at-risk levels, reflecting sector-specific vulnerabilities. These industries are more exposed to fluctuations in commodity prices, global supply chain disruptions, and capital-intensive financing structures, contributing to persistent financial risk.

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[15] Similar dynamics were found both at overall and at industry level when using the BOC measure, which relies on ICR based on Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA) rather than EBIT, and applies an alternative pre-filtering of firms based on negative earnings and firm size. Using the BOC measure results in a level shift of ICR to a lower range.

[16] Based on IMF analysis and complementary data provided by the authorities using Statistics Canada's Quarterly Survey of Financial Statistics (QSFS) and FactSet for public firms. The QSFS covers both publicly traded and private firms, and serves as an input to Canada's National Balance Sheet Accounts (Grieder and Schaffter, 2019), allowing for consistent monitoring of firm-level financial indicators such as ICRs and leverage.

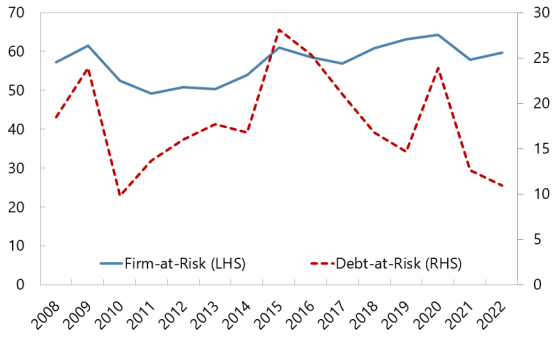
[17] The observed dynamics pre-2022 remain consistent with the FSAP's earlier findings, with similar trends emerging from the IMF's work and the BOC's analysis applying the same measures to different sets of data. We thank the authorities for their collaboration in confirming the trends using both the IMF and BOC measures with BOC's latest data.

## Figure 15. Canada: Firm-Level Performance

*Debt-at-risk decreased post-pandemic and reached historical low level post-GFC.*

**Share of Firms and Debt with ICR<1**

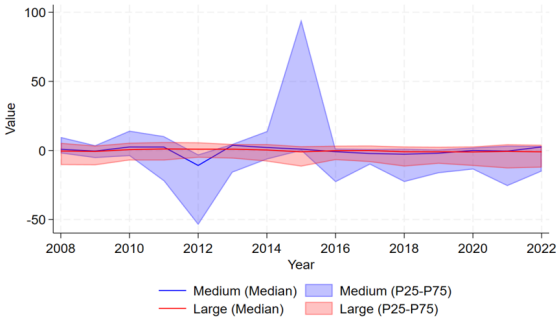
(Unit: Percent, ICR = EBIT/Interest)




Sources: Moody's Orbis and IMF staff calculations.

*Large firms exhibit stable ICR while medium firms are much more volatile.*

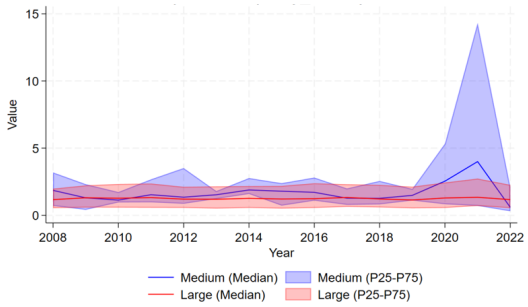
**ICR by Firm Size, 2008-2022**




Sources: Moody's Orbis and IMF staff calculations.

*Liquidity ratio in medium firms experienced a hike post pandemic but moderated in 2022. Large firms have been stable overtime.*

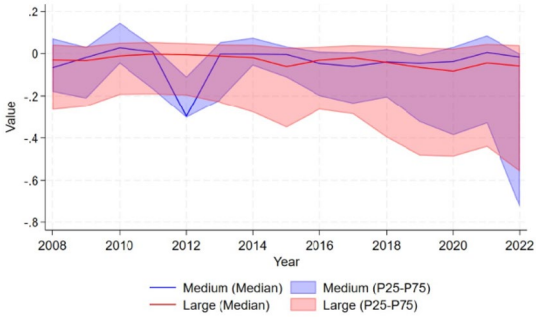
**Liquidity Ratio by Firm Size, 2008-2022**




Sources: Moody's Orbis and IMF staff calculations.

*While the profitability of median and top quartile firms remained stable, lower quartile deteriorated in both medium and large firms.*

**ROA by Firm Size, 2008-2022**

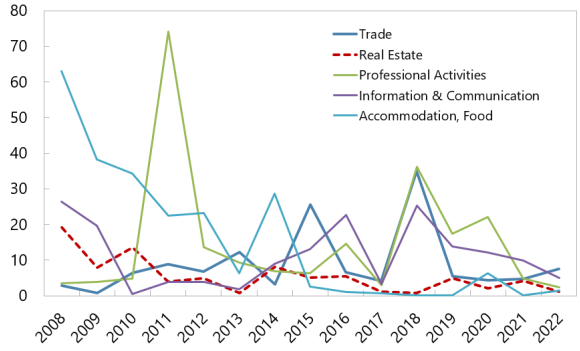



Sources: Moody's Orbis and IMF staff calculations.

*Debt-at-risk decreased in many industries over time post-GFC and post-pandemic....*

**Debt-at-Risk by Industry**

(Unit: Percent)

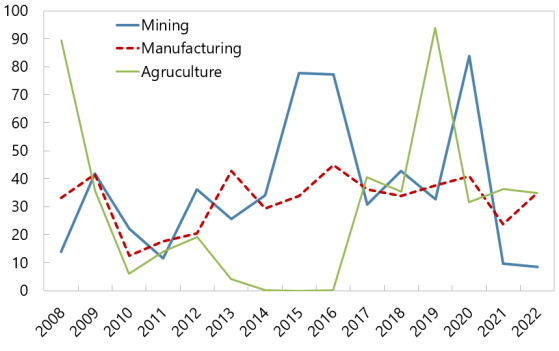



Sources: Moody's Orbis and IMF staff calculations.

*...while some capital-intensive industries remain volatile or show high debt-at-risk over time.*

**Debt-at-Risk by Industry**

(Unit: Percent)




Sources: Moody's Orbis and IMF staff calculations.

**41. Firm-level fixed-effects regressions highlight the important role of liquidity buffers and debt structures in shaping corporate default risk.** Across all specifications, liquidity constraints emerge as a key driver of financial distress, with firms that maintain higher cash buffers experiencing significantly lower probabilities of default. This underscores the importance of liquidity management as a defensive measure against financial instability. The positive interaction term indicates that lower profitability increases the importance of cash buffers in mitigating default risk. This implies that firms with lower profitability face greater financial vulnerabilities, even when they hold liquidity reserves, reinforcing the importance of prudent financial planning, particularly for firms operating in cyclical industries or those exposed to external shocks.

**42. Industry heterogeneity is evident in the differential impact of liquidity constraints.** The interaction between ICR and cash buffers is particularly pronounced in trade and services, where firms operate on thinner margins and are more sensitive to liquidity shocks. The findings reinforce the sector-specific nature of financial vulnerabilities, with capital-intensive sectors more exposed to leverage risks, while lower-margin industries depend more on maintaining liquidity buffers. These results highlight the need for tailored risk management strategies, ensuring sufficient liquidity for firms facing earnings volatility while addressing refinancing risks in highly leveraged sectors.[18]

**43. Key corporate vulnerabilities stem from rising debt-service costs, external trade risks, and structural weaknesses in specific industries.** BMA results show, under the baseline scenario, corporate PDs remain stable at approximately 0.5 percent in early 2025 before gradually declining, reflecting continued economic normalization. However, under the adverse scenario, corporate PDs rise to 1.3 percent by late 2027, reflecting heightened financial stress (Figure 16).[19] The projected increase in default risk is particularly pronounced in industries with high sensitivity to commodity price movements or capital-intensive operations, including mining, quarrying, oil and gas, construction, and real estate. These sectors face elevated refinancing risks due to their reliance on external financing and the impact of higher borrowing costs on their capital structures.

**44. The BMA results also highlight the sector-specific impact of macro-financial factors on corporate default risk.** Foreign Exchange (FX) volatility is most relevant for mining, quarrying, oil, and manufacturing, reflecting exposure to cross-border trade and currency fluctuations. Unemployment shocks have the strongest effect on natural resources, retail trade, and mining, underscoring their sensitivity to labor market conditions and demand fluctuations. Corporate spreads matter most for wholesale trade, natural resources, and construction and real estate, highlighting the role of credit conditions in debt-reliant sectors. These underscore the industry-specific balance sheet vulnerabilities and profit-and-loss risk management challenges, reflecting

[18] The FSAP team also applied the Bank of Canada filter and measures and conducted a similar set of firm-level fixed-effects regressions. The key findings remain broadly consistent with the results presented above. See Appendix Table C1–4 for detailed regression results. We also thank discussions with the BOC, OSFI, and AMF during the FSAP mission for useful institutional background and suggestions.

[19] Exchange rate variables lack significance in the majority of corporate PD models estimated using BMA.

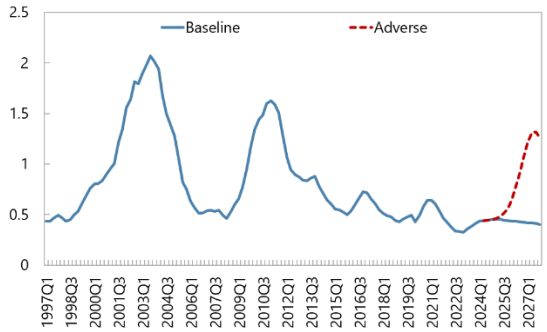
how sectors navigate macro-financial shocks through varying exposures to currency fluctuations, labor market conditions, and credit dynamics.

**45. Policy priorities should focus on monitoring corporate performance and financing costs and integrating bottom-up risk assessments into financial stability frameworks.** Key areas for monitoring include: (1) Continue close surveillance of corporate liquidity indicators and debt-servicing burdens, particularly in capital-intensive and commodity price-sensitive sectors; (2) Keep assessing the financial position of SMEs to gauge potential spillover effects on employment and financial stability; (3) Evaluate the potential impact of trade disruptions on corporate sector financial health and implications for labor markets; and (4) Continue integrating firm-level corporate default modeling into financial stability assessments to better capture sectoral risks and firm-specific vulnerabilities, particularly under conditions of trade uncertainty and global economic volatility.

## Figure 16. Canada: Corporate Probability of Default Projection Results

*Results show sharper corporate PD spike under the adverse scenario.*

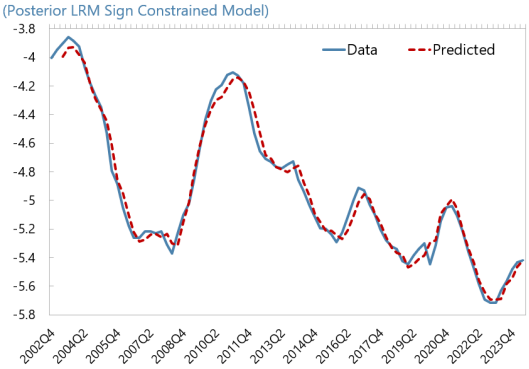
**Corporate PD Projection**
(Unit: Percent)




Sources: BoC, Statistics Canada, and IMF staff calculations.

*Historical model fit is good, including the COVID-19 period, despite its exclusion from estimation.*

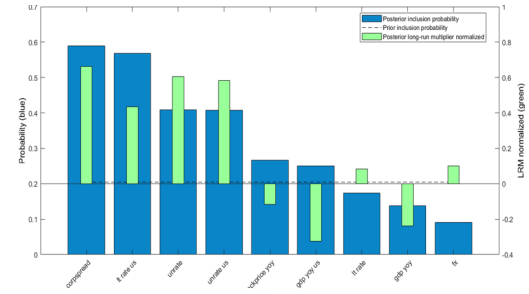
**BMA Model Historical Fit (R2 = 0.984)**
(Posterior LRM Sign Constrained Model)




Sources: IMF staff calculations.

*Corporate spread turns out to be the most important macro factor driving overall PD…*

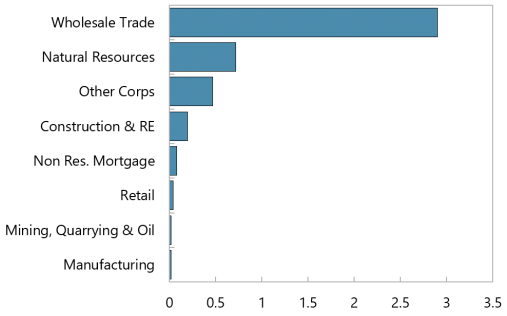
**Inclusion Probability and Long-Run Multipliers (LRM)**
(BMA Posterior Model, Sign Constrained)




Sources: IMF staff calculations.

*…while heterogeneity exists at industry level. Corporate spread matters most for wholesale, resource, construction and real estate sectors.*

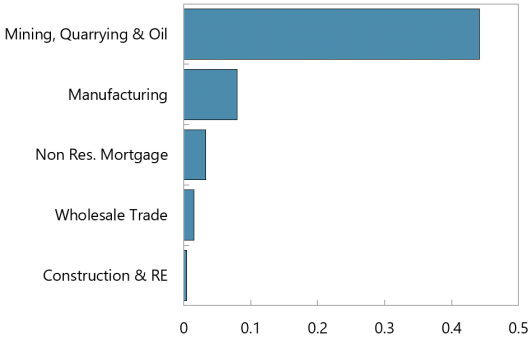
**Long-Run Multiplier by Industry: Corporate Spread**
(Normalized LRM)




Sources: IMF staff calculations.

*FX matters more for mining, quarrying, oil, manufacturing and real estate sectors.*

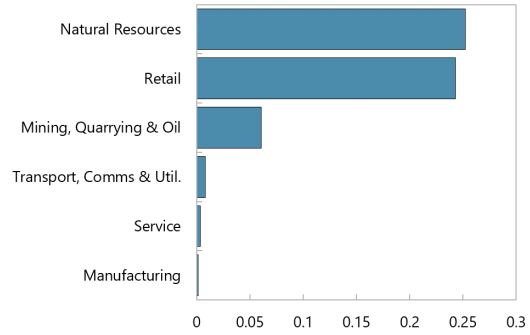
**Long-Run Multiplier by Industry: FX**
(Normalized LRM. FX: Year-on-Year)




Sources: IMF staff calculations.

*Unemployment factor is more pronounced for resources, retail, mining, quarrying and oil sectors.*

**Long-Run Multiplier by Industry: Unemployment Rate**
(Normalized LRM. Unemployment Rate: Year-on-Year)




Sources: IMF staff calculations.

# BANK SOLVENCY STRESS TEST

**46. The FSAP assessed the resilience of the banking system to the macroeconomic scenarios with a top-down solvency stress-test.** The exercise comprised the seven systemic DTIs which include the six D-SIBs and Québec's domestic systemically important institution (D-SIFI). Those seven systemic DTIs hold over 90 percent of the overall DTI sector's assets. The cutoff date for the exercise was end of fiscal year 2024[20], and the main source of data was supervisory returns collected by the OSFI and the Autorité des Marchés Financiers (AMF). The solvency stress tests measured the impact on DTIs' buffers via several channels, including credit risk, interest rate risks and market risk (Appendix III STeM).

**47. The solvency stress test follows the standard FSAP stress test approach.** It assesses whether the systemic DTIs have adequate capital buffers to withstand a set of macroeconomic shocks projected under the two scenarios—a baseline and an adverse scenario—with a three-year horizon. The diagram below displays selected components of the solvency stress testing framework. The link between the macroeconomic scenario and the financial statements of an institution is made through various satellite models for credit risk and profit and loss (P&L) components. Credit risk models were estimated using a BMA approach, as explained in the previous sections. DTIs' financial statements are affected via changes in the loan loss provisions, RWAs, net interest income (NII), non-interest income, non-interest expense, taxes and dividends paid. For the market risk sensitivity analysis, market losses/gains are estimated following a mark-to-market approach. A modified duration formula is used to re-evaluate exposures as a function of risk-free rates and credit spreads.

**48. The test assumes a static balance sheet.** The allocation of assets and the composition of funding sources remain unchanged from the cutoff date. Dividends are linked to DTIs' net profits. Under positive profits, and if the Capital Conservation Buffer (CCoB) is not breached, the dividend payout ratio is set at the ratio observed at the cutoff point. If the CCoB is breached (i.e., CET1 ratios are below 8 percent), restrictions on dividend distributions are aligned with the regulatory framework. If net profits are negative, no dividend payout is assumed. In addition, it is assumed that DTIs can build capital buffers only through retained earnings (i.e., no new equity issuance). Post stress capital is calculated by adjusting the initial capital ($C_0$) of each institution with the stressed income ($Income^*$) and the stressed RWA ($RWA^*$), as follows:

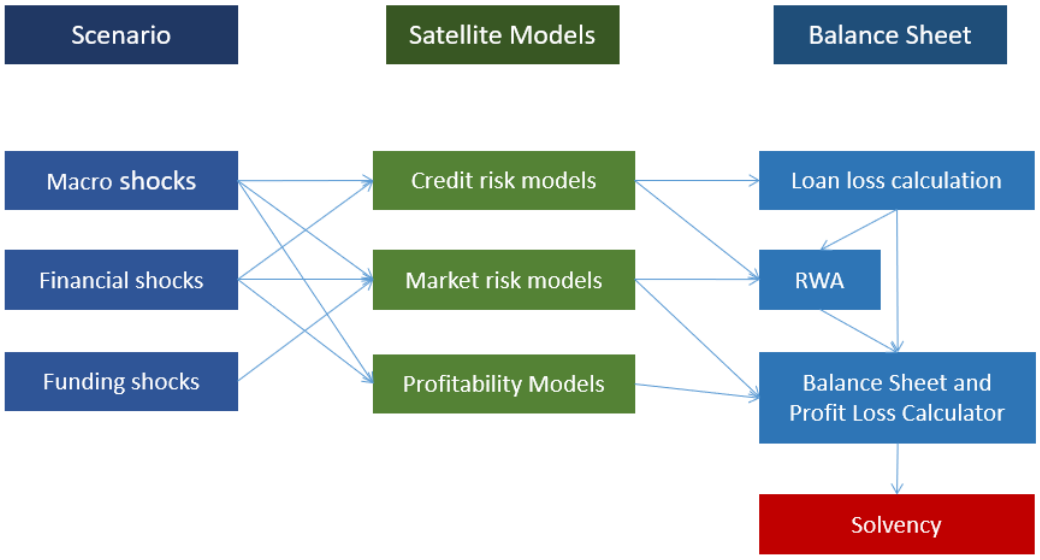
$$CR^* = \frac{C_0 + Income^*}{RWA^*}.$$

**49. Minimum capital requirements used as hurdle rates were consistent with OSFI and AMF regulatory standards.** Under the baseline, hurdle rates include the Pillar 1 CET1 (4.5 percent), the Capital Conservation Buffer (CCoB) (2.5 percent), the D-SIBs surcharge (1 percent) and the Domestic Stability Buffer (DSB) (3.5 percent). However, for Quebec's D-SIFI, DSB is not required. In

[20] The fiscal year-end for the six DSIBs is at the end of October, whereas the fiscal year for Québec's DSIFI ends in December. Since data for Québec's DSIFI was not yet available, end-of-September data were utilized instead.

the adverse scenario, DTIs are allowed to deplete the CCoB and the DSB. Other requirements remain in place.[21]

**Text Figure 1. Canada: Solvency Stress Test: A Block Diagram**




Source: Adapted from Henry and Kok, ECB Occasional Paper 152.

## A. Credit Risk

**50. Provisions were calculated as expected credit losses (ECL) for all asset classes/economic sectors.** The key risk parameters used include the PD, the Loss Given Default (LGD) and the performing and non-performing exposures. Provisions for performing exposures were calculated as: $PROV_t^{PE} = PD_t * LGD_t * PE_t$; and provisions for non-performing exposures as: $PROV_t^{NPE} = LGD_t * NPE_t$. The total stock of provisions is given by: $PROV_t = PROV_t^{PE} + PROV_t^{NPE}$. And the flow of provisions is calculated as: $Flow\ of\ provisions = PROV_t - PROV_{t-1}$.

**51. For corporate loans, PD projections under the two scenarios were generated using models estimated through a BMA approach.** These models, detailed in the Corporate Sector Analysis section, link historical reconstructed PDs provided by the BOC to macroeconomic variables. Given the limited availability of long time series for default rates, the BOC reconstructs historical default probabilities for banks' loan portfolios using as inputs the stock of total loans, the impaired loans and short time series of PDs reported in the RAPID2 dataset.[22] The latter is used to anchor the PD paths.[23] The models are estimated for the 11 corporate sectors presented in Figure 17. Since

[21] Pillar 2 capital requirements are not legally binding in Canada, they are treated as a supervisory expectation.

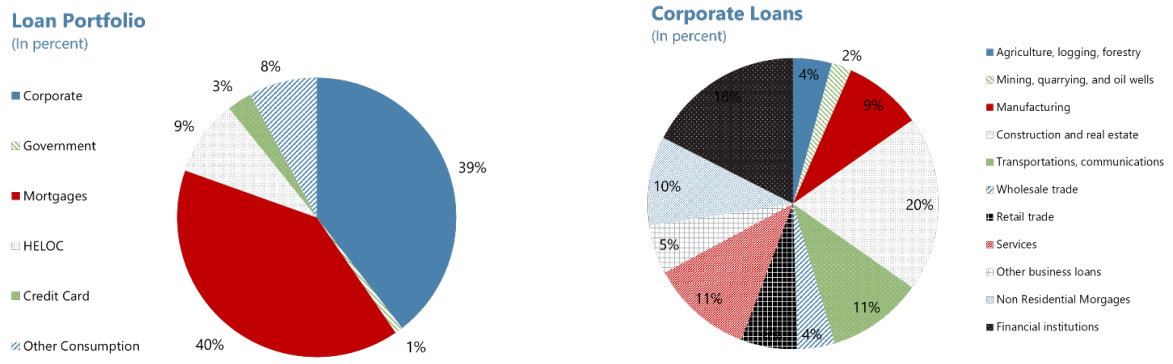
[22] The RAPID2 dataset includes loan-level data for business loans exceeding 10 million CAD. As smaller business loans are excluded, the reconstructed PD may be biased. For example, if smaller businesses tend to have systematically higher PDs, the reconstructed PDs might have a downward bias.

[23] See Bruneau, Duprey and Hipp (2022). Forecasting Banks' Corporate Loan Losses Under Stress: A New Corporate Default Model

historical proxy PDs are not available by sector and geography, US macroeconomic variables were included among the explanatory variables to be considered in the BMA approach.

**52. For mortgage loans, PD projections are generated using a Panel BMA approach.** The approach uses a structural model to accurately project DSR using loan level data, and an econometric model, estimated through Panel BMA, to project PDs conditional on macroeconomic variables (including the aggregate DSR[24]) (see the Household Sector Analysis section for details). The PD path of other consumer loans, including Home Equity Lines of Credit (HELOCs) and credit cards, were linked to the mortgage PD path using simple satellite models.

**Figure 17. Canada: Loan Composition for the 7 Systemic Debt-to-Incomes**




Source: OSFI, AMF, and IMF estimates.

**53. Aggregate PD paths are mapped at the bank level.** The mapping is done by using the standard score (z-score in a standard normal distribution) of aggregate PDs and of individual DTIs' starting PDs by segment.[25] This approach guarantees that the projected PDs of individual DTIs remain within the [0,1] range. Individual bank's PDs at the starting point are proxied by prorating the reconstructed aggregated BOC PDs with information from OSFI templates DT3 and DT4. These templates, however, have a less granular asset classification; therefore, assumptions were made to reconcile the different classification across datasets.

**54. LGD paths for mortgage and CRE related loans were linked to house price paths.** LGDs are derived by a simple model that links the starting point LGD ($LGD_0$) to the country-level house price path of a given scenario ($House\ Price_t$). The model is given by the following expression:

$$LGD_t = [1 - (1 - LGD_0) * House\ Price_t / House\ Price_0].$$

**55. Credit risk RWAs are updated according to the portfolio regulatory treatment**. For the standardized approach (SA), densities at the cut-off point are assumed constant over the scenario

[24] The model indicates low economic significance for DSR, possibly due to limited time series available.

[25] For instance, the mortgage PD paths for each bank are given by the formula $PD_{i,t} = \Phi\left(\Phi^{-1}(PD_{i,0}) + \left(\Phi^{-1}(PD_{Mortgage,t}) - \Phi^{-1}(PD_{Mortgage,0})\right)\right)$, where $\Phi(.)$ is the cumulated distribution function (CDF) of a the Normal Distribution and $\Phi^{-1}(.)$ is the inverse CDF.

horizon.[26] For the Internal Risk Based approach exposures, Basel formulas are used to calculate credit RWAs. Through the cycle (TTC) PDs are calculated using a formula that resembles a moving average, based on the projected PiT PDs.[27] Downturn LGDs are updated only if stressed LGDs exceed starting levels and kept constant otherwise.

## B. Interest Rate Risk

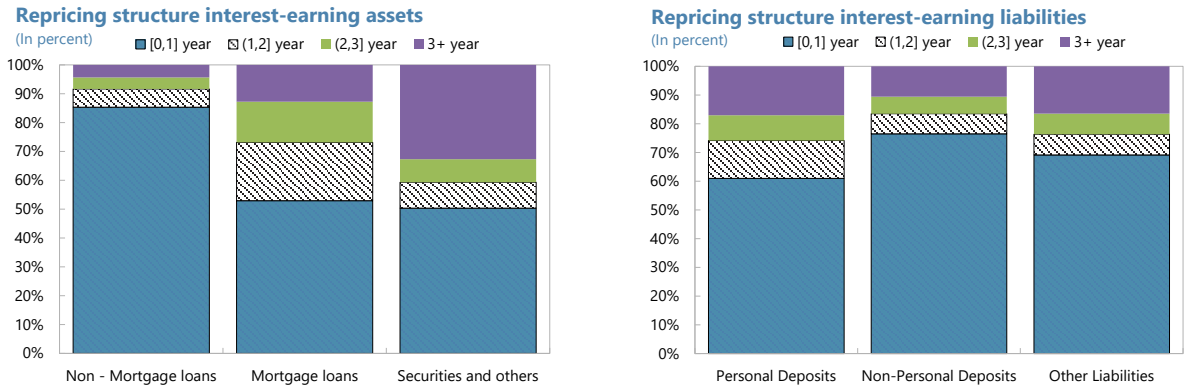
**56. The NII was projected using a structural model.** The model simulates the repricing/origination of exposures at the prevailing interest rate of newly issued exposures and liabilities (i.e., new business), and the time they stay in the portfolio until their next repricing/maturity. It is assumed that the distribution of assets/liabilities across repricing buckets remains constant throughout the stress test horizon. Interest on nonperforming exposures is excluded, but no relative changes in the composition of assets or liabilities are assumed. The equations underlying the model are summarized in Appendix IV. The inputs for DTI-specific projections include: (i) initial exposures generating interest income and expenses, (ii) the repricing and maturity profile, derived from OSFI's return on Interest Rate Risk (I3) and AMF ad-hoc data request, (iii) the initial effective interest rates and (iv) the projection of interest rates on new business.

**57. Three segments were considered on the asset side, namely non-mortgage loans, mortgage loans and securities and other interest-earning assets** (Figure 18). A significant majority of non-mortgage loans and approximately 50 percent of mortgage loans are subject to repricing within one year. Additionally, 34 percent of mortgage loans reprice within a timeframe of one to three years, while the remaining have repricing terms extending beyond three years. The repricing structure of mortgage loans reflects the large fraction of variable rate loans and of fixed rate loans with terms shorter than 5 years, which together account for over 50 percent of the entire mortgage portfolio. On the liability side, most deposits reprice within a year, with about 61 percent of personal deposits and 77 percent of non-personal deposits undergoing repricing in this timeframe.

[26] For each portfolio, $RWA(STA)_t = \rho_0 * (EAD_t - PROV_t)$, where $\rho_0 = RWA(STA)_0/(EAD_0 - PROV_0)$.

[27] $PD\ TTC_t = \left((TTC\ Window - (t+1) * ((PD\ TTC_0 * TTC\ Window - PD\ PiT_0)/(TTC\ Window - 1)) + \sum_{k=0}^{k=t} PD\ PiT_k\right)/TTC\ Window$

**Figure 18. Canada: Repricing Structure Assets and Liabilities**




Sources: OSFI, AMF, and IMF staff calculations.

**58. Interest rates on new business were projected using simple passthrough regressions.** Satellite models for both mortgage and non-mortgage loans were developed using time series data for the aggregated banking system on interest rates for new lending obtained from OSFI's "Report on New and Existing Lending (A4)". For deposits, the model relied on time series data on Guaranteed Investment Certificates (GICs) rates, provided by the BOC. The estimated lending—and deposit betas are presented in Table 3. For securities and other interest-earning assets, a pass—through rate of 100 percent was assumed.

**Table 3. Canada: Satellite Models Interest Rates on Newly Issued Assets/Liabilities**

| VARIABLES | Delta Interest Rate Non-mortgage loans | Delta Interest Rate Mortgage loans | Delta GIC rates |
|---|---|---|---|
| Delta Interest Rates | 0.955*** | 0.824*** | 0.907*** |
| | (0.0846) | (0.0809) | (0.156) |
| Constant | -0.0302 | -0.0743 | -0.0424 |
| | (0.0796) | (0.0761) | (0.179) |
| Observations | 55 | 55 | 37 |
| R-squared | 0.706 | 0.662 | 0.492 |

Source: IMF staff calculations.

Note: *** (**) (*) denotes 1 (5) (10) percent significance level.

## C. Modelling of Other Profit and Loss Components

**59. Satellite models for non-interest income and non-interest expense ratios (NIER) were also estimated** (Table 4). The key drivers of non-interest income include equity price and interest rates, which reflects the influence of market activity on fees and commission income. The main driver of non-interest expense is inflation, reflecting its influence over operational cost, through variations in salaries, rent, utilities and other fixed expenses. Under the baseline scenario, the non-interest income ratio (NIIR) maintains its recent upward trajectory, while under the adverse scenario, the ratio experiences a temporary decline in line with decreasing equity prices, before resuming an

upward trend. Non-interest expense decreases under the baseline and increases under the adverse scenario, consistent with the inflation paths (see Figure 19). Aggregated paths of P&L ratios are mapped at the DTI level based on the starting point of the ratios.

**Table 4. Canada: Other Profit and Loss Models**

| VARIABLES | Logit (NIIR) | Logit (NIER) |
|---|---|---|
| Logit (NIIR) (t-1) | 0.961*** | |
| | (0.0176) | |
| Logit (NIER) (t-1) | | 0.992*** |
| | | (0.0148) |
| Equity Price Growth | 0.000830*** | |
| | (0.000184) | |
| Interest Rate | 0.00558** | |
| | (0.00247) | |
| Inflation (t-1) | | 0.00569* |
| | | (0.00327) |
| Unemployment (t-1) | | 0.00367 |
| | | (0.00399) |
| Constant | -0.189** | -0.0734 |
| | (0.0786) | (0.0695) |
| Observations | 99 | 103 |
| R-squared | 0.978 | 0.979 |

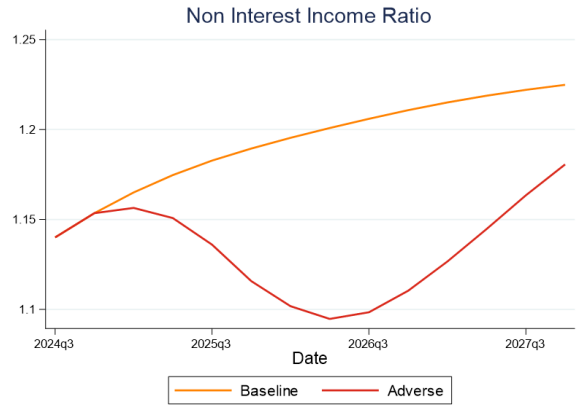
Note 1: *** (**) (*) denotes 1 (5) (10) percent significance level.
Standard errors in parentheses
Note 2: The are defined as follows: NIIR = Non-Interest Income/Total Assets, NIER = Non-Interest Expense/Total Assets.

Source: OSFI and IMF calculations.

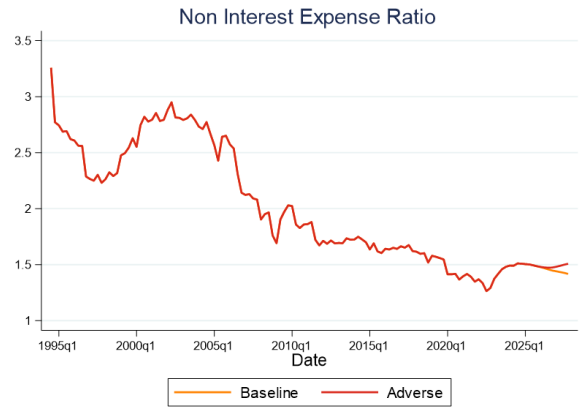
**Figure 19. Canada: Projected Non-Interest Income Ratio and Non-Interest Expense Ratio**

*Under the Baseline the NIIR maintain an upward trend….*

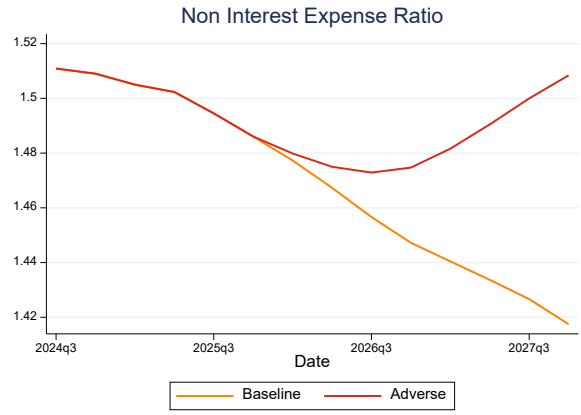

*… and under the adverse the NIIR temporarily decline.*




*NIER declines under the baseline…*




*and increases under the adverse, consistent with inflation.*



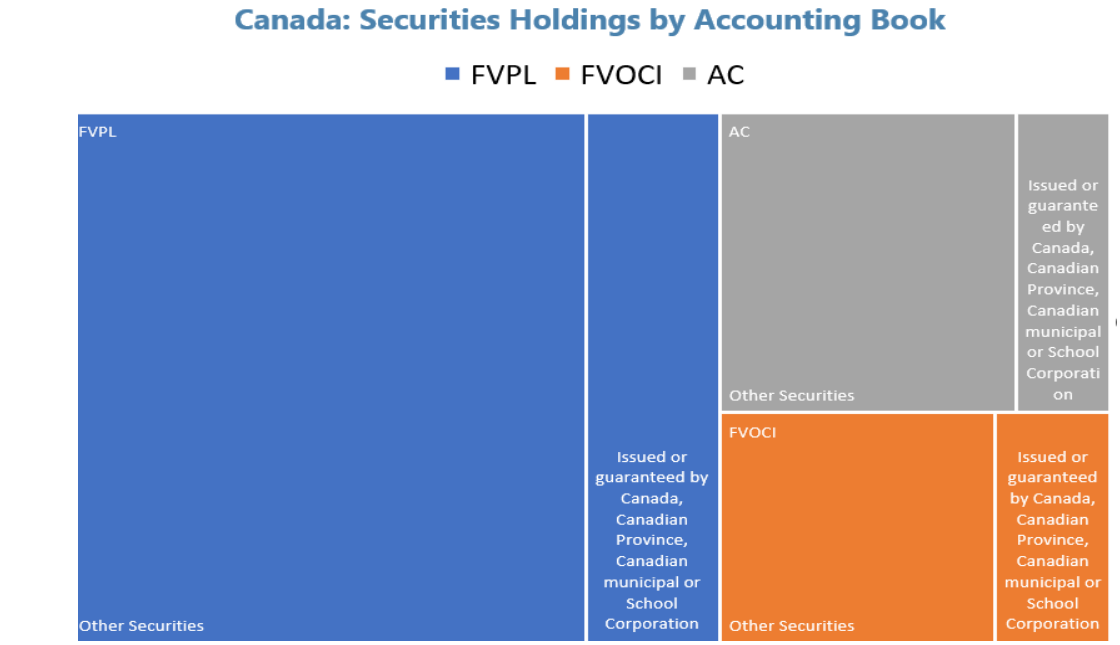

Source: OSFI and IMF calculations.

## D. Market Risk Modelling Approach

**60. DTIs' securities portfolios account for 24 percent of total assets.** Securities are primarily held at Fair Value through Profit and Loss (FVPL), which makes up 53 percent of the portfolio, followed by Amortized Cost (AC) at 26.5 percent, and Fair Value through Other Comprehensive Income (FVOCI) at 20.3 percent. Approximately 22.8 percent of the total securities are issued or guaranteed by the Government of Canada, Canadian provinces, or municipal and school corporations. Figure 20 illustrates the composition of the three accounting portfolios and provides a breakdown by security type.

**Figure 20. Canada: Securities Holdings**

*DTIs hold significant securities positions in all accounting portfolios.*




Source: OSFI, AMF and IMF calculations.

Note: FVPL=Fair-value Through Profit or Loss. FVOCI = Fair-value Through Other Comprehensive Income. AC=Amortized Cost. The figure represents the distribution of securities as of end of fiscal year 2024 and excludes Fair Value hedges.

**61. The market risk module, used for the sensitivity analysis, captures the valuation changes of debt securities due to changes in risk-free interest rates and credit spreads.** For FVPL and FVOCI, debt securities market losses/gains are estimated following a mark-to-market approach. A modified duration approach is employed to reevaluate exposures as a function of their residual duration, the relevant bond yield[28] and the stressed spreads. Stressed spreads are consistent with the macroeconomic scenario and are equal to those applied for the insurance stress test. For conservatism, and in the absence of information, existing hedges were assumed to be ineffective during the scenario horizon.

**62. The impact on regulatory capital varies depending on the accounting class.** Losses/gains from FVPL portfolios are considered realized losses/gains, affect net profits and are subject to taxation and dividend payout, while unrealized losses/gains from FVOCI portfolios affect capital through other comprehensive income.

## E. Results

**63. The results from solvency stress tests suggest the DTIs are resilient to the baseline and adverse scenarios** (Figure 21). Under the baseline scenario, the aggregate CET1 capital ratio exhibits an upward trajectory, reaching 15.7 percent by 2027, from 13.7 percent in 2024. Under the adverse

[28] The relevant yield for a portfolio, with a specific duration, is proxied via linear interpolation between the short- and long-term bond yields of a given scenario.

scenario the CET1 ratio for the seven systemic DTIs declines by 2.3 percentage points at the trough but remains above the regulatory minimum. At the individual level, all systemic DTIs would remain well above the 4.5 percent CET1 minimum requirement, and even above the 8 percent threshold, below which dividend distributions would be affected[29]. The changes to DTIs' capital ratio are primarily driven by a rise in loan losses and an increase in RWAs. To a lesser extent, they also reflect a decrease in NII and noninterest income, and an increase in noninterest expense**.**

**64. The results remain also robust to sensitivity analyses related to market and credit risks.** The FSAP team conducted three sensitivity analyses. The first one, on market risk, assessed valuation risks of the securities portfolio due to changes in risk-free interest rates and credit spreads. The second sensitivity analysis assessed the impact of a higher increase in the PDs for the two export sectors that could face a higher direct impact of tariffs, namely, the manufacturing and commodity sectors (Figure 22). The third sensitivity analysis took a more conservative path of PDs across all corporate and household loan portfolios, consistent with the projections generated by the models that produce the highest PD projections for each sector within the set of models considered in the BMA estimations.

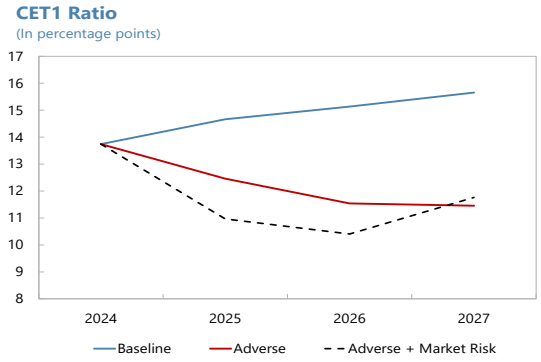
**65. The market risk sensitivity analysis implies only modest additional capital depletion for the DTIs compared to the main adverse scenario results**. The average CET1 ratio for the 7 systemic DTIs falls to 10.4 percent in 2026, and all institutions remain above the 8 percent threshold. The additional decline in capital is primarily driven by larger valuation losses on FVPL securities. Market risk losses are material only in the first year of the scenario horizon, and gains on securities contribute positively to DTIs' results in the outer years as rates start to normalize. Several caveats apply to the market risk sensitivity analysis. Notably, it is assumed that hedges are ineffective over the scenario horizon, implying that the results likely represent an upper bound of potential losses.

**66. The credit risk sensitivity analyses further confirm the resilience of the system**. Assuming higher PDs for the manufacturing and commodity sectors, as shown in Figure 22, would imply an additional drop of CET1 ratio of 40 basis points with respect to the adverse scenario. On the other hand, assuming more conservative PD paths across all corporate and household loan portfolios would cause an additional drop of 1.7 percentage points with respect to the adverse scenario, reaching 9.8 percent in 2027. Under these two sensitivity analyses, too, all institutions would remain above the 8 percent threshold.

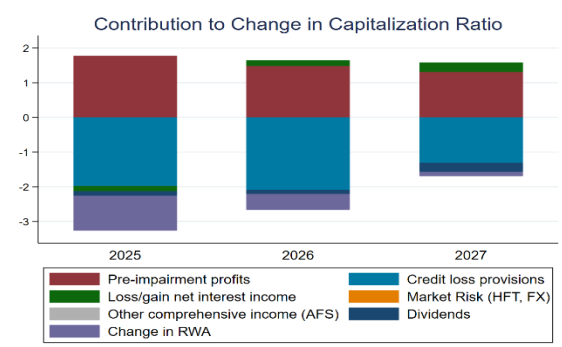
[29] The BOC used its own stress testing framework to assess the resilience of the banking sector to the FSAP adverse scenario. Although the BOC and FSAP frameworks differ in terms of methodology and assumptions, they provide broadly comparable results. A summary of the BOC stress test result was published in the May 2025 Financial Stability Report (FSR) following the completion of both exercises.

## Figure 21. Canada: Solvency Stress Test Results

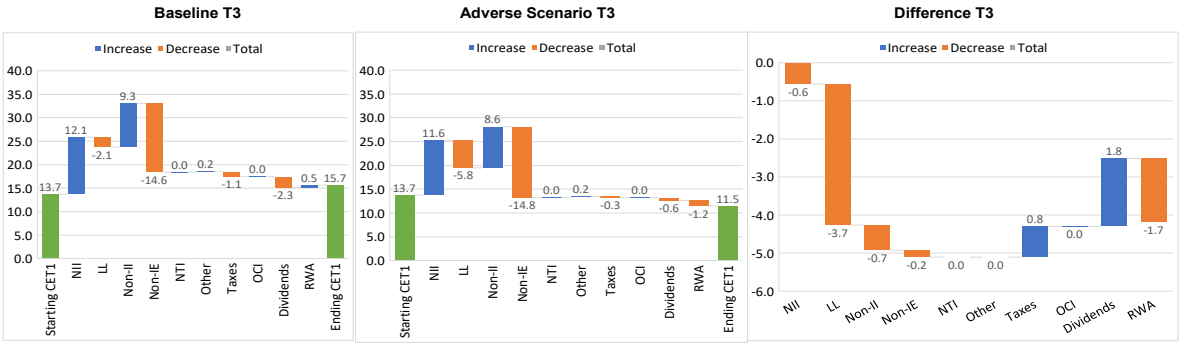
*The CET1 ratio for the 7 systemic DTIs declines by 2.3 percentage points under the adverse scenario ….*




*…. primarily driven by a rise in loan losses, an increase in RWAs and a decrease in pre-impairment profits.*

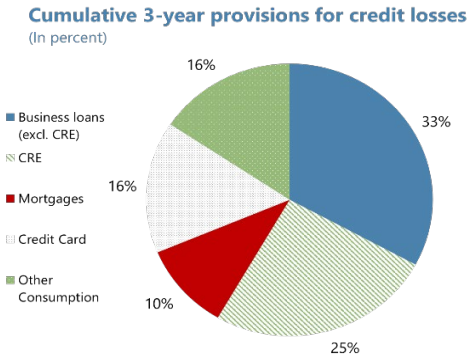



*Over the three-year horizon, the 7 systemic DTIs face lower NII, higher loan losses, lower non-interest income, higher non-interest expense, lower taxes, lower divided distribution and higher RWAs under the Adverse than under the Baseline.*



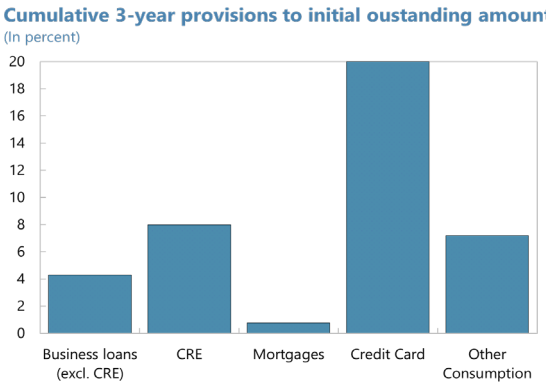

Note: NII stands for Net Interest Income, LL for Loan losses, Non-II for Non Interest Income, Non-IE for Non Interest Expenses, NTI for Net Traiding Income, OCI for other comprehensive income.

*A large portion of cumulative provisions consists of business and CRE loans…*




Note: CRE loans comprise non-residential mortgages and construction real estate.

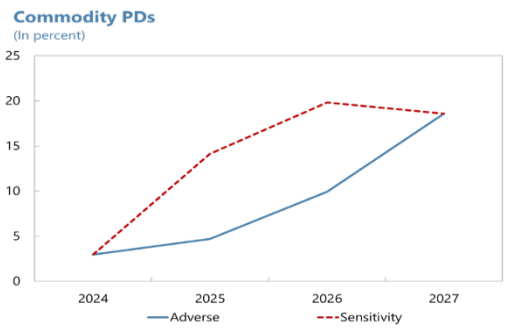
*…while the ratio of cumulative provisions over initial outstanding amount is higher for credit cards loans.*



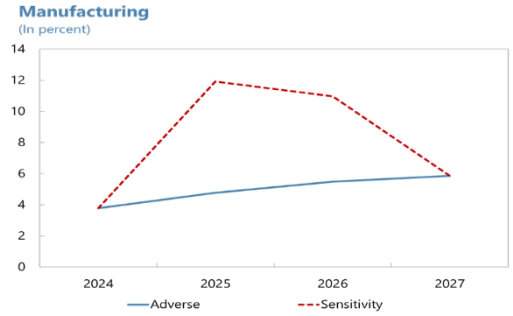

Source: IMF staff calculations.

## Figure 22. Canada: Solvency Stress Test. Sensitivity Analysis

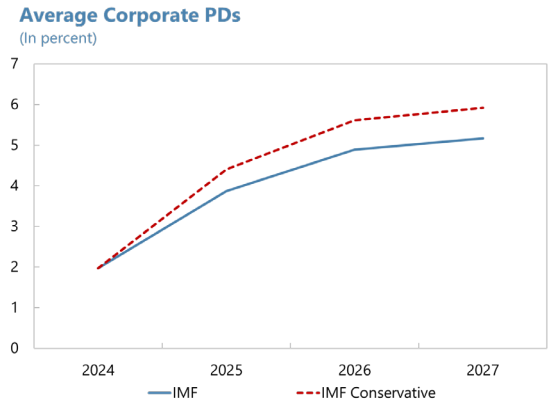
*Commodities PDs used for sensitivity 2....*



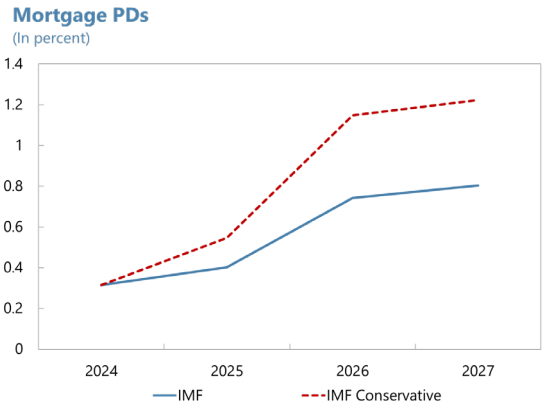

*... Manufacturing PDs used for sensitivity 2.*



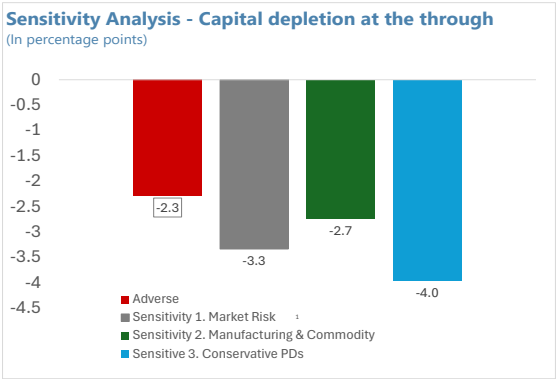

*Corporate PDs used for sensitivity 3....*



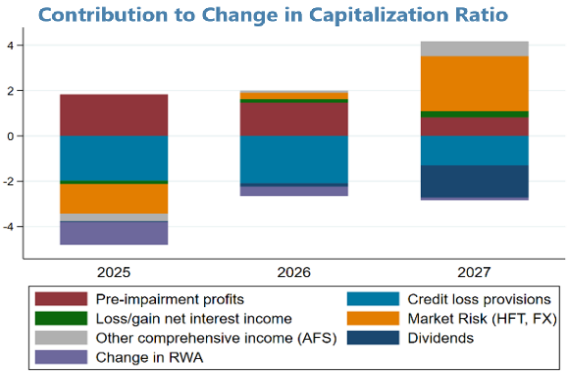

*...Mortgage PDs used for sensitivity 3.*




*The results remain robust to various sensitivity analysis related to market risk and credit risk...*




*Market risk losses are material only in the first year of the scenario horizon. Gains on securities contribute positively in the outer years ....*




Sources: OSFI and IMF staff calculations.

## F. Recommendations

**67. Interagency collaboration in the stress testing area should be enhanced.** The BOC, OSFI and AMF each has a top-down methodology for solvency stress test, each with varying degrees of development. Cooperation between agencies facilitates a valuable cross-validation of results. Cooperation appears to be strong between BOC and OSFI, and between BOC and AMF. However, simultaneous discussions among all three agencies seem to be hindered by barriers of information between federal and provincial authorities. Going forward, it is key to further enhance collaboration among the three agencies and establish regular coordination meetings to discuss stress testing methodologies, results, and implications. The agencies should also continue the standardization of regulatory returns, similar to what has been achieved for liquidity templates.

**68. Top-down stress testing frameworks could be further enhanced by the development of structural models for credit risk.** As Canada has not experienced a severe housing market crisis, using econometric modeling based on historical data may not effectively capture the nonlinear dynamics of mortgage defaults. Therefore, efforts to develop and enhance existing structural models, such as the BOC's Household Risk Assessment Model, should continue. Additionally, the estimation of credit losses for the corporate sector based on econometric models could be complemented by the development of corporate stress tests, which would allow for a more comprehensive evaluation of potential vulnerabilities within corporate portfolios. To facilitate the development of these structural models, the authorities should continue to invest in a comprehensive household and corporate dataset. Econometric models for credit risk could also be enhanced by the collection of long historical time series data on default rates or proxy PDs (e.g., flow of new NPLs/Performing Loans) across various sectors and asset classes by country of exposure.

**69. Authorities are also encouraged to develop an independent top-down methodology—separate from the solvency stress test—for assessing market risk that evaluates the impact of sudden market shocks (e.g., on interest rates, equity prices).** The approach should take into account hedging strategies employed by institutions, enabling a more accurate understanding of market dynamics and vulnerabilities. Relatively, the authorities would benefit from collecting information on relevant market sensitivities (e.g., "the greeks").

**70. OSFI and AMF should continue their efforts to build credit registers.** It should be a strategic priority to have data consistency across micro and macro datasets similar to other peer countries[30]. While the RESL dataset represents an important step in this direction, the authorities should build credit registers for the universe of corporate, commercial and consumption loans and to continue working towards improving the quality and coverage of RESL data (e.g., covering mortgage loans granted outside Canada). The availability of this type of data would open the door

[30] For instance, adopting a common and more granular loan segmentation would enable easier mapping across datasets, so that detailed micro-level data (e.g., loan-level by segment and jurisdiction) can be reliably aggregated and aligned with less granular sources (e.g., bank balance sheet aggregates).

for more granular analyses; and jointly with the development of structural models would allow for counterfactual analysis linked to prudential policies.

**71. It is also recommended that the authorities compute provisions in their top-down stress testing in alignment with the IFRS9 framework.** This approach is particularly relevant for Canada due to the large size of the mortgage portfolios, as the long maturities of these loans makes the concept of lifetime PDs more important. To facilitate this, authorities are encouraged to collect and maintain comprehensive information on IFRS 9 transition matrices and relevant parameters. Finally, the authorities are encouraged to consider regularly publishing top-down stress testing results in the Financial Stability Report and/or Staff Analytical Notes as done by similar jurisdictions such as the US, United Kingdom, Euro Area, and Japan. This would enhance transparency and offer valuable insights into the resilience of the financial system.

# BANK LIQUIDITY STRESS TESTS

**72. The liquidity analysis assessed the resilience of the 7 systemic DTIs to funding shocks and market-driven stress.** The analysis comprises a LCR-based test with a focus on a one-month horizon, and a CF that examines horizons from one week to one year, with particular emphasis on a three-month horizon. The LCR analysis is based on 12 scenarios ranging in severity from the Basel III LCR (benchmark) to a most severe scenario that combines a spike in retail and wholesale outflows and is characterized by a material loss in the market valuation of liquid assets. The CF analysis considers a grid with 20 levels of scenario severities. The scenarios are calibrated based on relevant historical episodes, the banking turmoil in March-2023 and concurrent FSAPs.[31] Additionally, a set of general principles guide the selection of run-off rates. First, more informed, and sophisticated depositors tend to withdraw funding more rapidly than less informed ones. This is why run-off rates applied to wholesale funding sources are higher than those applied to retail funding sources. Second, run-off rates on insured funding sources are lower than those applied to uninsured funding sources. These DTI-level tests use OSFI and AMF regulatory data from the LCR and the Net Cumulative Cash Flow (NCCF) returns as of October 2024.

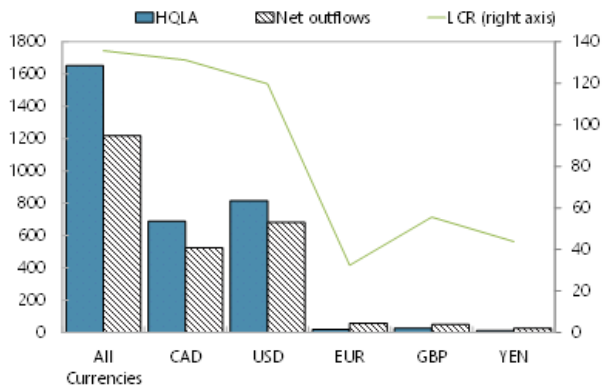
[31] Examples of relevant historical episodes include the following: retail deposits outflows reached 11 percent in a week for Saudi Arabia's Banking System (August 1990), 8 percent for Banesto (ES, 1994), 7.5 percent for IndyMac (USA, June 2008), 8.5 percent in 10 days for Washington Mutual (USA, September 2008), 30 percent in 12 days for Domestic Stability Buffer Bank (NL, 2009) and 25 percent in three months for Parex Bank (LV, 2008) (Schmieder et al. 2012, Table 3).

## A. Liquid Coverage Ratio–Based Test

**73. The LCR test measures a DTI's ability to meet its liquidity needs in a 30-day stress scenario by using its stock of unencumbered high-quality liquid assets (HQLA).** Basel III LCR promotes the short-term resilience of DTIs' liquidity profile by requiring that in normal times banks hold a stock of cash or unencumbered HQLA (the numerator of the ratio) at least as large as the expected total net cash outflows (the denominator) over a period of significant liquidity stress lasting 30 calendar days. The idea is that by converting HQLA into funding in private markets, DTIs can absorb shocks and reduce the risk of spillovers into the real economy. By October 2024, the 7 systemic DTIs had an aggregate LCR equal to 136 percent and no entity in the system had a ratio lower than the regulatory minimum (Figure 23).

**Figure 23. Canada: Liquidity Coverage Ratio by Currency**

(Canadian Dollars in billions)




Source: OSFI, AMF, and IMF calculations

**74. The LCR-based test adverse scenarios capture market driven stress and funding pressures via higher haircut on HQLA and higher run-off rates on outflows respectively.** The test combined three HQLA haircut scenarios with four outflows scenarios for a total of 12 combined scenarios. The regulatory haircut scenario corresponds to the haircuts prescribed by OSFI and AMF, which are aligned to the Basel standard. Haircuts scenario 1 and 2 assume increasingly severe haircuts on banks' counterbalancing capacity. The regulatory outflow scenario corresponds to the outflow scenario prescribed by OSFI and AMF. The retail outflow scenario increases the run-off rates for retail funding and keeps the run-off rates for wholesale funding as in the regulatory scenario. The wholesale scenario increases the run-off rates for wholesale funding and keeps the run-off rates on retail funding as in the regulatory scenario. Finally, the combined scenario brings together the stressed run-off rates of the retail and funding scenarios (see Appendix V for full details on the haircuts and run-off rates applied in the range of LCR scenarios considered).

**75. The results of the LCR-based stress tests indicate that the Canadian systemic DTIs are liquid and broadly resilient to sizable funding outflows over a 30-day horizon** (Figure 24). Under all of the individual retail scenarios, the aggregate LCR remains above the regulatory minimum of 100 percent. However, in the wholesale and combined scenarios, it falls somewhat below this threshold, highlighting a greater vulnerability to substantial wholesale outflows. At the individual level, three systemic DTIs remain resilient under all wholesale scenarios, while four fall below the threshold though not by large amounts. Overall, lower starting LCRs and greater exposure to wholesale outflows were the most common reasons for breaching the threshold.

**76. Due to the global footprint of some systemic DTIs, the LCR analysis was also conducted by significant currencies.** Specifically, this included the following four currencies: CAD, US dollars (USD), the British Pound (GBP), and the EUR.[32] As of October 2024, the aggregate LCR was 131 percent in CAD and 120 percent in USD, with larger variations across institutions. The analysis revealed a greater sensitivity of the CAD LCR to retail deposits outflows, with the aggregate CAD LCR dropping somehow below 100 percent for the two retail scenarios with higher haircuts. The USD LCR on the other hand shows higher sensitivity to wholesale outflows. This underscores the importance of continuing to monitor the LCR also across different currencies

**Figure 24. Canada: Liquidity Coverage Ratio-Based Stress Test**

*Three market scenarios are combined with four run-off rates scenarios for a total of 12 scenarios of varying severity.*

| 12 Scenarios | | | | |
|---|---|---|---|---|
| **Haircuts \ Run-off rates** | **Regulatory** | **Retail** ↑ | **Wholesale** ↑ | **Combined** ↑↑ |
| Regulatory | S1 | S2 | S3 | S4 |
| Haircut 1 ↑ | S5 | S6 | S7 | S8 |
| Haircut 2 ↑↑ | S9 | S10 | S11 | S12 |

| | Market Scenarios (weights) | | |
|---|---|---|---|
| **Assets** | **Regulatory** | **Haircut 1** | **Haircut 2** |
| Level 1 assets | 100% | 95%-100% | 90%-100% |
| Level 2A assets | 85% | 75%-80% | 65%-75% |
| Level 2B assets | 50%-75% | 40%-70% | 30%-70% |

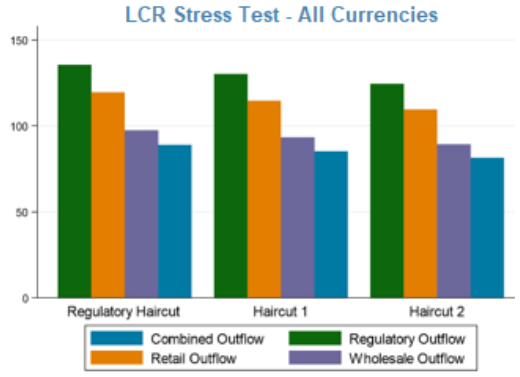
| | Run-off Rates | | | |
|---|---|---|---|---|
| | **Regulatory** | **Retail** | **Wholesale** | **Combined** |
| **Retail Liabilities** | | | | |
| Stable Deposits | 3-5% | 10% | 3-5% | 10% |
| Less-Stable Deposits | 10% | 20% | 10% | 20% |
| **Wholesale Liabilities** | | | | |
| Stable Deposits | 3-5% | 3-5% | 15% | 15% |
| Less-Stable Deposits | 10% | 10% | 30% | 30% |
| Operational | 3-25% | 3-25% | 15-45% | 15-45% |
| Non-Operational, no FI | 20-40% | 20-40% | 40-60% | 40-60% |

.

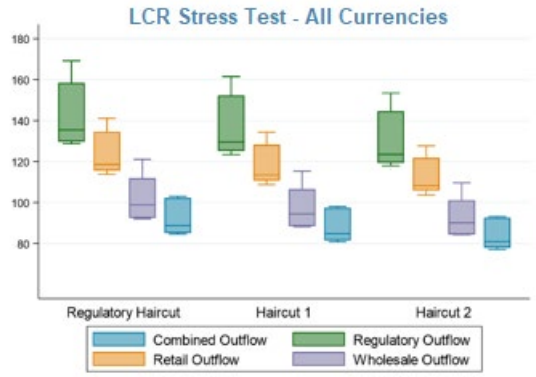
[32] OSFI monitors the LCR by currency but does not prescribe a regulatory minimum limit.

**Figure 24. Canada: Liquidity Coverage Ratio-based Stress Test (concluded)**

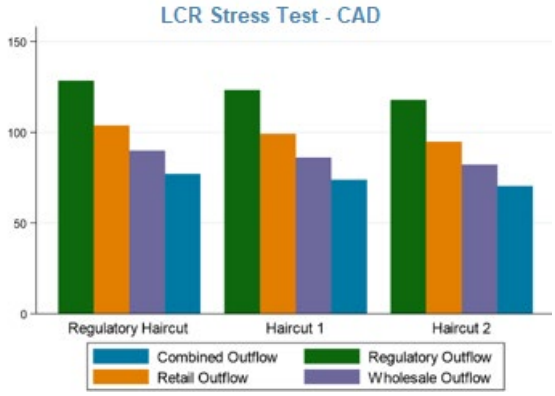
*The aggregate LCR for the 7 systemic DTIs remains above 100 percent under the retail scenarios….*



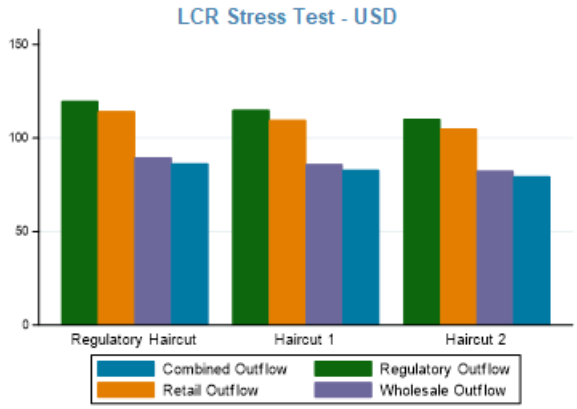

*…. under the wholesale scenario the LCR of some institutions falls below the threshold…*




*The CAD LCR has a greater sensitivity to retail deposit outflows…*




*…the USD LCR has a greater sensitivity to wholesale outflows.*




Sources: OSFI, AMF and IMF staff calculations.

## B. Cash Flow Analysis

**77. The CF assesses the seven systemic DTIs' liquidity risk using two indicators: the cumulative net funding gap and the counterbalancing capacity.** The net funding gap is the sum of the differences between cash inflows and outflows across all time buckets within a given horizon. Positive inflows from the loan portfolio are excluded under the assumption that DTIs do not reduce credit intermediation during the liquidity episode. Additionally, it is assumed that contingent credit lines are partially triggered, further increasing outflows[33]. The counterbalancing capacity refers to the cumulative value of liquid assets that banks can liquidate under stress at reasonable prices and is mainly composed of cash resources and securities. A liquidity shortfall arises when an institution's counterbalancing capacity is insufficient to meet its net funding gap.

[33] The sum of contractual cash inflows/outflows from USD FX and cross currency swap assets/liabilities over all time periods is recognized as an inflow/outflow in week 1.

**78. The analysis considers a range of 20 scenarios of increasing severity, affecting outflows and counterbalancing capacity.** The scenarios are based on a linear grid of scenario severities across factors (run-off rates, haircuts) ranging from a mild to an aggressive scenario (see Table 5 and Appendix VI for full details). For each scenario, a complete collateral revaluation is conducted, encompassing collateral utilized for both repo and reverse repo transactions. The CF offers a more granular, balance sheet-based approach to evaluating an institution's liquidity position, complementing traditional liquidity metrics such as the LCR, and provides valuable insights into potential vulnerabilities, thereby supporting policy decision-making.

**79. The systemic DTIs can withstand liquidity shocks over a three-month horizon under most of the cash flow scenarios considered** (Figure 25). The CF indicates that, overall, the 7 systemic DTIs would maintain a liquidity surplus under the milder scenario for horizons shorter than six months; and in the most aggressive scenario, for horizons equal or shorter than one month. Focusing on a three-month horizon, and exploring the impact of the 20 scenarios, the findings imply that, on average, the 7 systemic DTIs would maintain liquidity surpluses even under more severe scenarios, experiencing shortfalls only in the three most aggressive scenarios (scenarios 18–20). Under the most aggressive scenario, the aggregate shortfalls would amount to 237 billion CAD, which represent 12 percent of the initial counterbalancing capacity. Given the severity of the most aggressive scenario, this impact is considered moderate. At the level of individual institutions, there is some heterogeneity, with one institution starting to experience shortfalls in scenario 12 and two institutions maintaining surpluses under all scenarios considered.

## Table 5. Canada: Cash Flow Scenarios

*The CF considers a range of 20 scenarios affecting the outflows and the counterbalancing capacity…*

| | Run-off Rates | | | |
|---|---|---|---|---|
| | Mild Scenario | | Severe Scenario | |
| | Week 1-4 | Month 2-12 | Week 1-4 | Month 2-12 |
| **Retail and Small Business** | | | | |
| **Demand / Notice Deposits** | 0.25%-3.50% | 0.75%-5.0% | 1.0% - 8.0% | 2.0%-12.0% |
| **Term Deposits** | 0.25%-1.75% | 0.50%-3.5% | 0.75%-5.5% | 1.50%-8.50% |
| **Commercial, Corporate and Wholesale Deposits** | | | | |
| **Demand/Notice Deposits (Original Term ≤30 Days)** | | | | |
| Operational | 0.75%-2.50% | 3.0%-3.25% | 3.50%-4.0% | 7.0%-7.5% |
| Non-Operational | 3.00% | 5.5%-12.0% | 6.0%-7.0% | 8.5%-15.5% |
| **Notice Deposits (original term >30 days)** | | | | |
| Operational & Non-Operational | 20% | 20% | 50% | 50% |
| **Term Deposits** | | | | |
| **Other** | 100% | 100% | 100% | 100% |

*… The scenarios are based on a linear grid of scenario severities across factors (run-off rates, haircuts) spanning from a mild scenario to an aggressive scenario.*[1]

| | Haircuts | |
|---|---|---|
| | Mild Scenario | Severe Scenario |
| **Government Securities** | | |
| High Rated Government Securities | 0.5%-5.0% | 20%-60% |
| Medium Rated Government Securities | 10%-20% | 30%-100% |
| Low/Not Rated Government Securities | 100% | 100% |
| **Mortgage Backed Securities (MBS)** | | |
| Agency MBS (High rated) | 4.0% | 15.0% |
| Other | 100.0% | 100.0% |
| **Corporate Bonds and Paper** | | |
| High rated | 5.0%-9.0% | 10.0%-20.0% |
| Medium rated | 10%-11%% | 50%-100% |
| Low/not rated | 100% | 100% |
| **Asset Backed Securities (ABS) and Asset Backed Commercial Paper (ABCP)** | | |
| High rated | 2.0%-10.0% | 40.0%-100.0% |
| Other | 100% | 100% |

Source: IMF staff calculations.

[1] See Appendix VI for the Cash Flow Analysis scenarios' granular parameters.

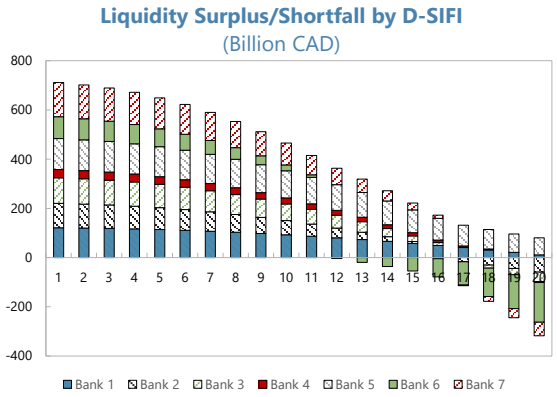
## Figure 25. Canada: Cash Flow Analysis

*The 7 systemic DTIs would maintain liquidity surpluses under the **milder scenario** for horizons shorter than 6 months….*


*Under the **most aggressive scenario,** the systemic DTIs would overall maintain liquidity surpluses for all horizons equal or shorter than one month….*


*Focusing on a three-month horizon, the 7 systemic DTIs experience shortfalls only in the three most aggressive scenarios…*


*… with some heterogeneity at each institution's level.*




Sources: OSFI, AMF and IMF staff calculations.

# INTERCONNECTEDNESS AND CONTAGION ANALYSIS

## A. Methodologies

**80. The interconnectedness and contagion analysis provides insights into systemic risks and potential contagion effects across various sectors, and from the rest of the world.** This section of the technical note summarizes the data sources and approach, results and key findings from an analysis using the Espinosa-Vega Sole (EVS) model of the Canadian financial system's interconnectedness and potential for contagion, focusing on the implications for financial stability and risk management. In this context, contagion is defined as the transmission of financial distress from one bank or sector to others, where defaults or issues in one area can negatively impact the capital positions of multiple entities. Conversely, vulnerability measures the potential capital losses a bank or sector may face if there are failures in other banks or sectors, providing a comprehensive understanding of the financial landscape's dynamics. The primary objective of this analysis is to illuminate potential vulnerabilities and weaker links within the Canadian financial system, helping understand the dynamics of systemic risk through the identification of interconnectedness and spillover pathways.

**81. The study employed exposure analysis of interbank, cross-sector and cross-border connections.** A network simulation was conducted to analyze credit and funding shocks (Figure 26) through bilateral linkages, with iterative tracking of contagion failure, which is the domino effects triggered by hypothetical credit and funding shocks to each bank or sector. The analysis utilized interbank cross-holding data from the BOC, covering the six D-SIBs and aggregated of the rest of all other banks data for interbank exposure. Cross-sectoral and cross-border exposures were assessed using the "from-whom-to whom" statistics from Statistics Canada.

- **Base Model for the Stylized Balance Sheet Identity for Bank i:**

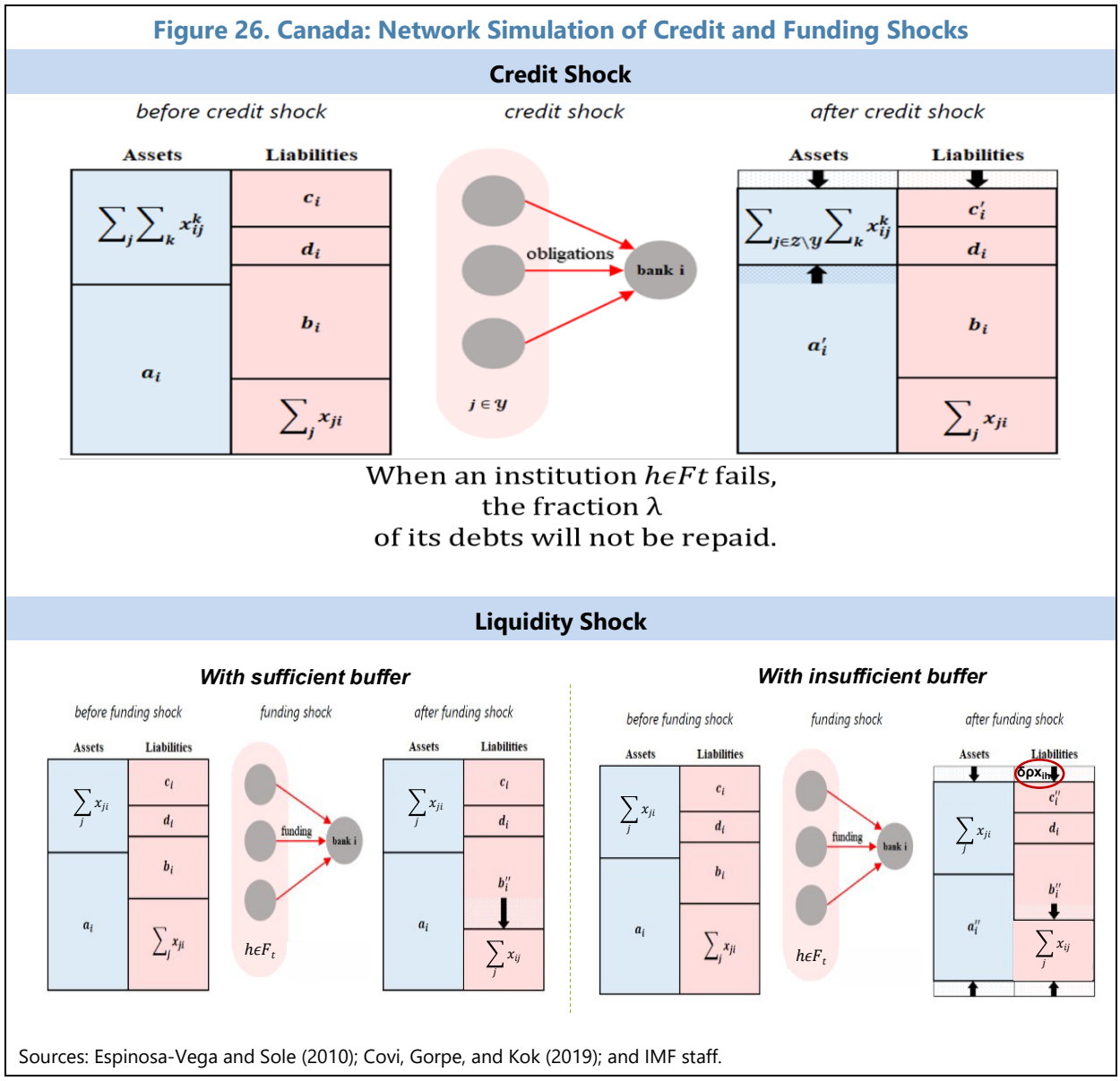
$$\sum_j x_{ji} + a_i = c_i + b_i + d_i + \sum_j x_{ij},$$

  Where $\sum_j \boldsymbol{x_{ji}}$ is bank *i* loans to bank *j;* $\boldsymbol{a_i}$ is bank *i*'s other assets; $\boldsymbol{c_i}$ is bank *i*'s capital; $\boldsymbol{b_i}$ is long-term and short-term borrowing; $\boldsymbol{d_i}$ is deposits; and $\sum_j \boldsymbol{x_{ij}}$ is bank *i* borrowing from bank *j.*

- **Network Simulation of Credit Shock:** the transmission of credit shock via bilateral linkages on bank i 's balance sheet.

- **Network Simulation of Funding Shock:** the transmission of a funding shock via bilateral linkages on bank i 's balance sheet when the liquidity surplus is sufficient to meet funding shortfall and when liquidity surplus is insufficient and hence the remaining liquidity shortage must be matched by fire-sale proceeds. Parameter calibrated for the analysis is described in Table 6 below.

**Figure 26. Canada: Network Simulation of Credit and Funding Shocks**




Sources: Espinosa-Vega and Sole (2010); Covi, Gorpe, and Kok (2019); and IMF staff.

**82. The model output produces two main indices that quantify Canadian interbank and cross-sectoral linkages**:

- The Index of Contagion averages losses of other Banks/Sectors due to the failure of a Bank. Index of Contagion of Bank/Sector $i = 100 \times \frac{1}{N-1}\sum_{j=1,j\neq i}^{N}\frac{L_{ji}}{K_j}$, where $K_j$ is the capital of Bank/Sector *j* and $L_{ji}$ is the loss to Bank/Sector *j* due to the default of Bank/Sector *i*.

- The Index of Vulnerability averages loss of a Bank/Sector due to the failure of other Bank/Sectors. Index of Vulnerability of Bank/Sector $i = 100 \times \frac{1}{N-1}\sum_{j=1,j\neq i}^{N}\frac{L_{ij}}{K_i}$, where $K_i$ is the capital of Bank/Sector *i* and $L_{ij}$ is the loss to Bank/Sector *i* due to the default of Bank/Sector *j*.

**Table 6. Canada: Espinosa-Vega Sole Model—Parameter Assumptions**

| Parameter/variable | Description |
|---|---|
| λ=0.4 and 1.0 | 40 and 100 percent LGD on exposures |
| ρ=0.35 | Share of lost funding that is non-replaceable |
| δ=0.5 and 1.0 | 50 and 100 percent discount on asset sales |

Source: IMF staff assumptions.

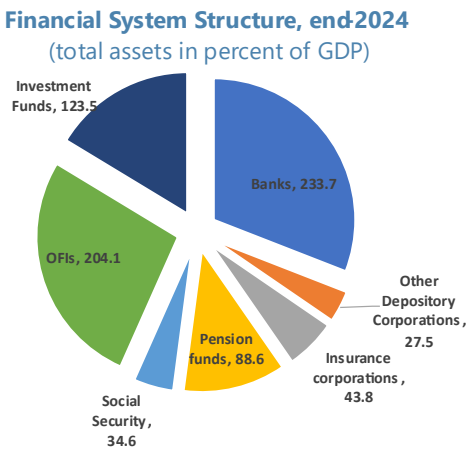
Note: 40 percent loss-given-default rate and 50 percent discount rate are applied for the cross-sectoral and cross-border estimates. While the results are sensitive to these assumptions, the relative weight of systemic importance remains the same.

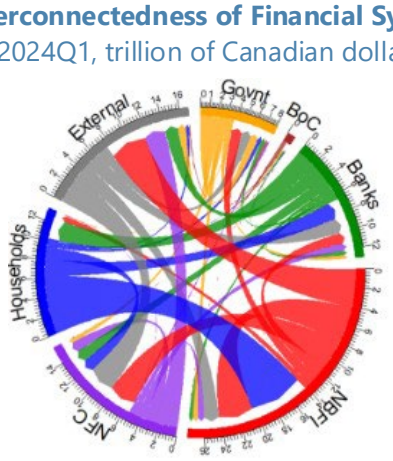
## B. Results

### Overview

**83. The Canadian financial system is characterized by high interconnectedness between banks and households, households and NBFIs, and NBFI and external sectors.** These interconnections all significantly influence systemic risk, and this underscores the importance of monitoring interbank relationships and cross-sectoral exposures (Figure 27).

**Figure 27. Canada: Financial System Structure and Interconnectedness**




Sources: StatCan and IMF staff calculations.

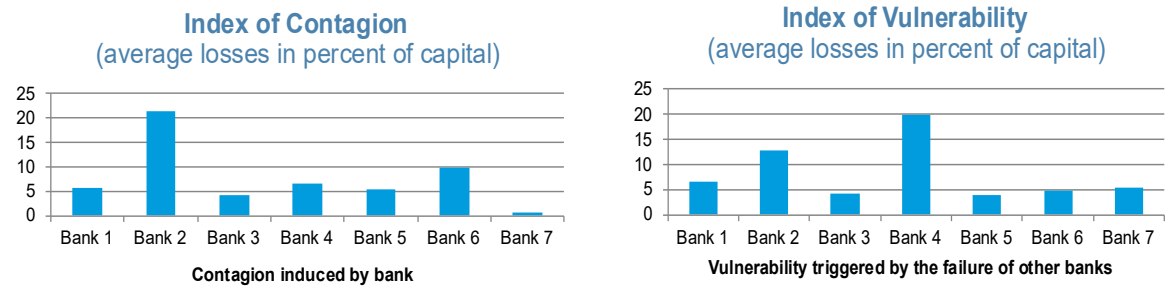
Note: NBFI in the right chart includes pension funds, insurance corporations, investment funds and other depository corporations (ODC). Govnt includes general government, social security funds and government business services.

### Interbank Network Analysis

**84. The analysis reveals that the average losses due to credit and funding shocks could reach approximately 5 percent of capital across various banks** (Figure 28). The contagion and vulnerability indices vary across banks, indicating differing risk profiles among institutions.

Significant interbank exposures exist. However, the spillover risks associated with bank defaults are cushioned by banks' robust capital levels. [34]

**Figure 28. Canada: Interbank Contagion and Vulnerability Output**

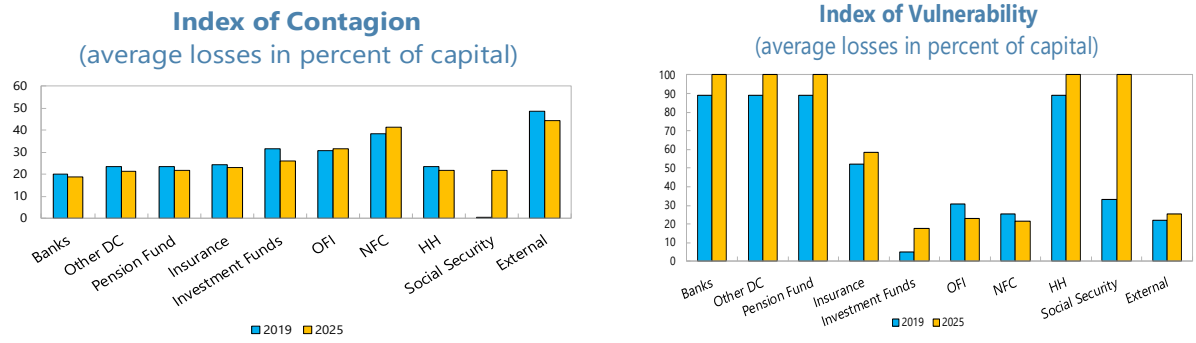



Source: IMF staff calculations.

## Cross-Sectoral Contagion

**85. NFCs and the external sector exhibit the highest contagion levels but maintain relatively low vulnerability, suggesting strong defenses against shocks** (Figure 29). In contrast, households, banks, and NBFIs are less contagious but more vulnerable, driven by high household debt and sensitivity to market fluctuations. These dynamics highlight the importance of tailored risk management strategies. For NFCs and the external sector, maintaining strong defenses through prudent financial practices and diversification is crucial. For households, banks, and NBFIs, strategies should focus on reducing debt levels, enhancing liquidity management, and improving resilience to market volatility.

**Figure 29. Canada: Cross-Sectoral Contagion and Vulnerability Output**




Source: IMF staff calculations.

Note: DC stands for Deposit-taking Corporations; OFI stands for Other Financial Intermediaries; and HH stands for Households.

[34] The estimated loss of capital should be seen as indicative rather than definitive due to the inherent uncertainties in modeling financial systems. Additionally, the definition of "default" within the financial system may appear overly severe, as it assumes total equity exhaustion, a scenario unlikely in Canada given the robust capital buffers that financial institutions maintain to absorb losses and enhance resilience.

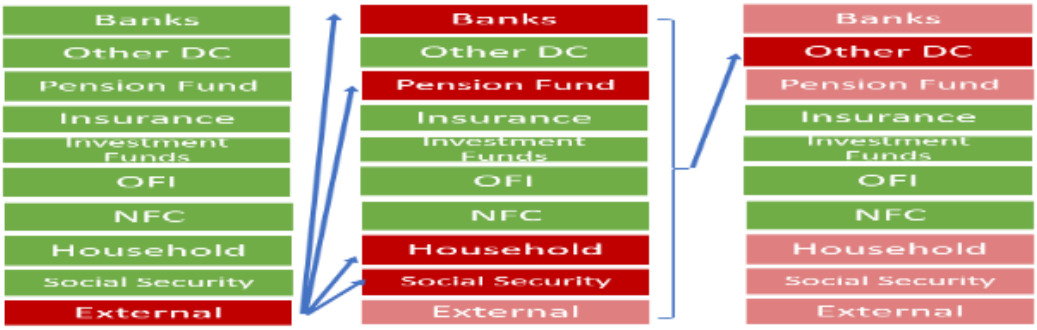
## Risk Transmission Channels

**86. Cross-border risks are significant, with vulnerabilities to external shocks affecting various sectors** (Figure 30). Most domestic Canadian sectors appear very vulnerable to external shocks (except for investment funds, insurance companies, OFI and NFC). The early impact of external shocks affects banks, pension funds, social security funds and households. The interconnectedness between domestic and international markets necessitates a comprehensive approach to risk assessment.

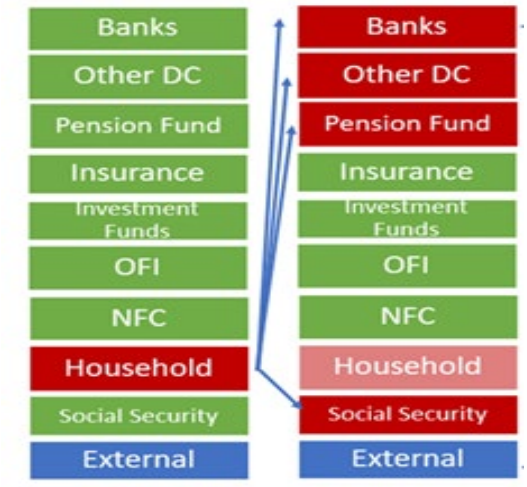
**87. The potential for household vulnerability poses risks to other sectors.** The initial transmission from household vulnerability operates via depository corporations, pension funds and social security funds. As households face financial pressures, the repercussions can ripple through the domestic economy, amplifying risks across interconnected entities. Monitoring household debt levels and their impact on overall financial stability is crucial.

**Figure 30. Canada: Risk Transmission Channels**

*From cross-border risks to Canadian financial system*




*From household vulnerability to Canadian financial system*




Source: IMF staff calculations.

# INSURANCE AND PENSION RISK ANALYSIS

**88. The FSAP conducted solvency stress tests and liquidity risk analyses for both insurers and pension funds.** For the insurance sector, a top-down solvency stress test covered insurers under federal supervision as well as Québec-chartered insurers. For the pension sector, the solvency analysis was conducted for 40 DB and hybrid schemes, supervised by OSFI and Ontario's Financial Services Regulatory Authority of Ontario (FSRA). The bottom-up liquidity risk analysis covered a sample of three life insurers and 19 pension plans, including six of the "Maple Eight" public pension plans—covering more than 50 percent of pension assets.

## A. Insurance Solvency Stress Test

### Scope

**89. A top-down solvency stress test was conducted for eight life insurers and 17 P&C insurers, covering around 90 percent and 50 percent of each sector, respectively, in terms of assets.** The life insurance sector in Canada is characterized by a very high degree of concentration, resulting in a sub-sample in that sector with three large entities and five considerably smaller insurers. In the P&C sector, insurers are more similar in size and typically well diversified in their mix of lines of business (Table 7)

**Table 7. Canada: Insurance Solvency Stress Test—Sample**

| | | Life | P&C |
|---|---|---|---|
| **Sample size** | | 8 | 17 |
| **Assets** (CAD bn) | Min | 9 | 1 |
| | Median | 78 | 5 |
| | Mean | 238 | 7 |
| | Max | 919 | 19 |
| **Insurance revenue** (CAD bn) | Min | 1 | 1 |
| | Median | 5 | 3 |
| | Mean | 10 | 4 |
| | Max | 24 | 11 |

Source: IMF staff based on company disclosures.

### Scenario

**90. The baseline and adverse scenarios used in the insurance and pension risk analysis follow the macrofinancial scenarios specified for the banking sector stress test with some smaller adjustments.** The adverse scenario, with relatively severe shocks for stock prices and CRE combined with substantial swings in interest rates, is aligned with the adverse macrofinancial scenario also used for the banking sector. Nevertheless, some adjustments were made to make the scenario directly applicable to an insurer's balance sheet, specifically the market risk stresses have been defined more granularly. The scenario includes shocks to the risk-free interest rate, equity and property prices, as well as credit spreads of corporate and sovereign bonds (Table 8).

**Table 8. Canada: Insurance and Pensions Stress Test Specification**

| | Baseline | | | Adverse | | |
|---|---|---|---|---|---|---|
| | Y1 | Y2 | Y3 | Y1 | Y2 | Y3 |
| **Interest rates (risk-free rates, bps)** | | | | | | |
| Canada | | | | | | |
| short-term | -119 | -49 | -15 | -33 | -80 | -22 |
| long-term | -12 | -10 | -5 | 114 | -53 | -133 |
| United States | | | | | | |
| short-term | -87 | -121 | -49 | -41 | -133 | -68 |
| long-term | -31 | -43 | -11 | 97 | -65 | -159 |
| Euro Area | | | | | | |
| short-term | 2 | 19 | 10 | -44 | -119 | 12 |
| long-term | -47 | -56 | -12 | 161 | -17 | -165 |
| **Stocks (%)** | | | | | | |
| Canada | 6,5% | 6,5% | 6,5% | -17,3% | -18,1% | 14,3% |
| United States | 7,4% | 7,4% | 7,4% | -24,5% | -29,5% | 22,8% |
| Euro Area | 4,5% | 4,5% | 4,5% | -27,0% | -31,3% | 18,6% |
| **Commercial real estate (%)** | | | | | | |
| Canada | 4,2% | 2,9% | 2,5% | -14,0% | -15,4% | 7,9% |
| United States | 2,3% | 2,8% | 2,8% | -20,1% | -19,9% | 10,9% |
| Other | 3,0% | 3,0% | 3,0% | -15,0% | -15,0% | 8,0% |

| | Baseline | | | Adverse | | |
|---|---|---|---|---|---|---|
| | Y1 | Y2 | Y3 | Y1 | Y2 | Y3 |
| **Credit spreads (bps)** | | | | | | |
| Sovereign bonds | | | | | | |
| Canada | 0 | 0 | 0 | 25 | 30 | -39 |
| United States | 0 | 0 | 0 | 9 | 11 | -14 |
| Euro Area | 0 | 0 | 0 | 23 | 28 | -35 |
| Corporate bonds | | | | | | |
| AAA | 0 | 0 | 0 | 20 | 25 | -32 |
| AA | 0 | 0 | 0 | 25 | 30 | -39 |
| A | 0 | 0 | 0 | 32 | 39 | -49 |
| BBB | 0 | 0 | 0 | 56 | 69 | -88 |
| BB or lower | 0 | 0 | 0 | 101 | 124 | -158 |
| unrated | 0 | 0 | 0 | 68 | 83 | -105 |
| **Exchange rates (%)** | | | | | | |
| CAN/USD | -0,6% | -0,5% | -0,7% | 4,7% | 4,0% | -3,1% |
| **Other (%)** | | | | | | |
| Hedge funds | 4,0% | 4,0% | 4,0% | -6,0% | -6,0% | 5,0% |
| Private equity | 7,0% | 7,0% | 7,0% | -10,0% | -12,0% | 9,0% |
| Infrastructure | 6,0% | 6,0% | 6,0% | -8,0% | -8,0% | 7,0% |

Source: IMF staff.

**91. Additional sensitivity tests, which assumed single-factor shocks, were utilized to complement the stress test.** The result of these sensitivity tests which are assumed to occur instantaneously was not added to the results of the adverse scenario.

- Equity: A decline in stock markets by 40 percent (20 percent for preferred shares).
- Currencies: An increase in the external value of the CAD by 10 percent.

## Methodology and Modeling Assumptions

**92. The top-down solvency stress test projected valuation changes of assets and liabilities, and the solvency coverage ratio over a 3-year horizon.** The shocks specified in the scenario were applied to the investment assets and insurance liabilities as of June 2024 and subsequently for each year of the projection horizon (i.e., June 2025 and June 2026). Haircuts in line with the adverse scenario were applied to the market value of investments. Similarly, insurance liabilities (except for segregated funds) after stress were approximated through a duration-based approach. For segregated funds, the decline in liabilities mirrored the market value loss of underlying assets. It was assumed that insurers maintain their asset allocation over the full projection horizon and re-balance it annually. Interests and dividends earned were kept unchanged. Insurance premiums, claims and expenses were assumed to change in line with the projection of consumer prices in the scenario.

**93. The main output of the FSAP stress test calculations is the effect on available capital, eligible for the coverage of the solvency capital requirement.** As the stress also affects the capital requirement, the selected components of the required capital were recalculated after stress. The capital charges for market risk and credit risk were proportionately adjusted in line with the change in exposures due to the stress. All other components of the capital requirements (i.e., for insurance risks and operational risks) were assumed unchanged, and only the diversification benefit was adjusted based on the changes in the relative weights of the components.

**94. The stress test used data of insurers' regulatory returns provided by OSFI and the AMF.** This included annual and quarterly financial returns, reporting on required capital (the Life Insurance Capital Adequacy Test and the Capital Adequacy Requirements Life Insurance, as well as the Minimum Capital Test for P&C insurers), and the Financial Condition Test.

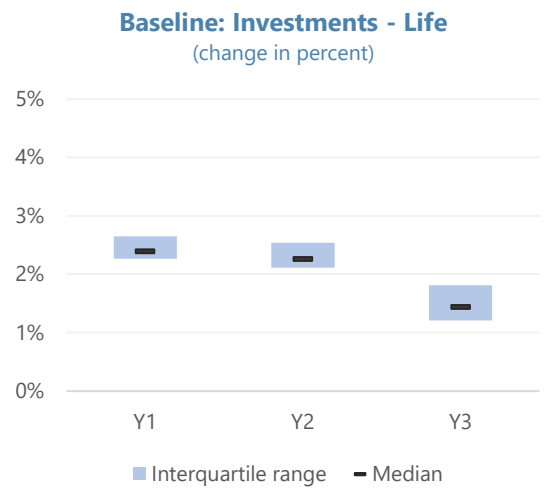
**95. Insurance stress tests, particularly when conducted as part of an FSAP, should not be seen as pass-fail exercises or as implying additional regulatory capital requirements for individual insurers—neither can they fully take into account possible management actions.** As a macrofinancial stress test, the ambition is to detect sector-wide and potentially systemic vulnerabilities. Furthermore, insurance companies have a broad range of risk-mitigating mechanisms in place which cannot be fully captured in a top-down stress test, and potential reactive management actions were not modeled in the stress test. Data granularity of the supervisory reporting does not allow for a comprehensive recognition of financial hedges, stop-loss arrangements, or financial reinsurance. In times of financial stress, insurers have several options to restore their capital adequacy or their profitability, including implementing changes in underwriting standards and in the reinsurance program or by withholding profits. An even more effective way to improve the solvency position relatively quickly is a de-risking of the balance sheet, for example, by selling equity or high-yield corporate bonds and buying sovereign bonds instead—this change in the asset allocation can significantly reduce required capital. For solo entities, there would also be a possibility of receiving capital as group support from the parent. These types of management actions were not modeled.

### Results of the Scenario Analysis

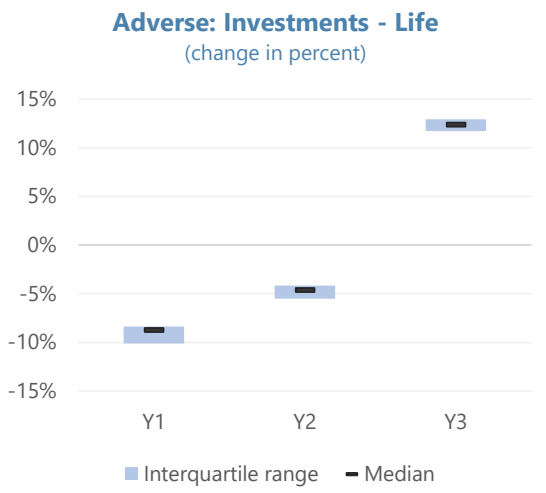
**96. The impact of the adverse scenario on the value of investments and liabilities is very significant in the life insurance sector and mainly driven by the interest rate shocks** (Figure 31). In the baseline scenario, investments assets would increase by 2 to 3 percent per year in the first two years and slightly less in year 3. At the same time, liabilities would also increase but a lower rate than investment values. In the adverse scenario, both investment values and liabilities would fluctuate considerably, with a strong decline on both sides of the balance sheet in year 1 and a reversal in year 3. In particular the strong increase in long-term interest rates results in a decline of liabilities in the first year which exceeds the reduction in asset values. Year 2 is characterized by a decline in asset prices (5 percent for the median life insurer) and an increase in liability values (3 percent).

## Figure 31. Canada: Insurance Solvency Stress Test—Valuation Changes (Life)

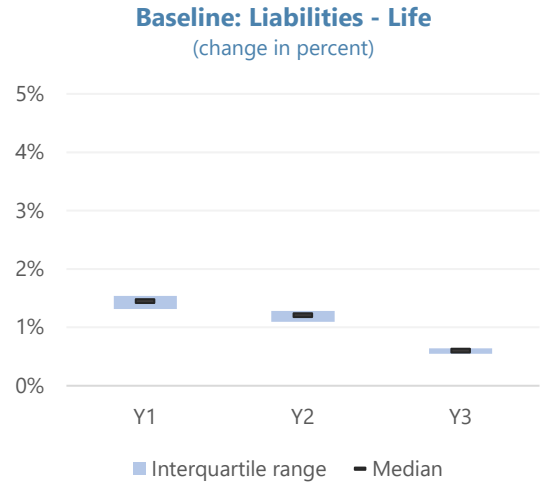
*In the baseline scenario, investment values of life insurers would mostly increase by 1 to 3 percent per year…*



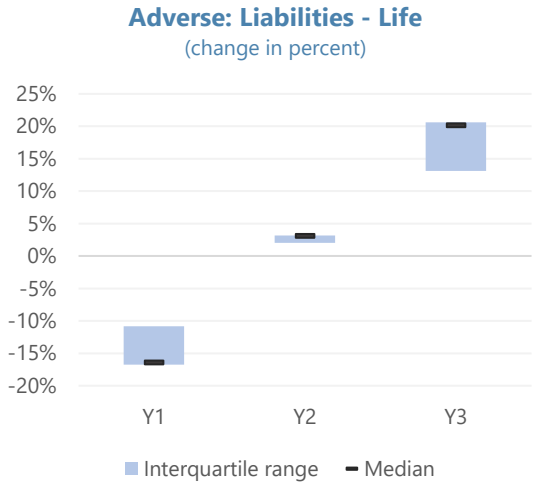

*… while in the adverse scenario, the value of investments declines significantly in year 1, followed by a further decline in year 2 and a strong recovery in year 3.*




*Liability values also increase in the baseline, but slightly less pronounced than investment values.*




*In the adverse scenario, the interest rate shocks result in large movements in the value of life insurers' liabilities, with a strong decline in the first year.*

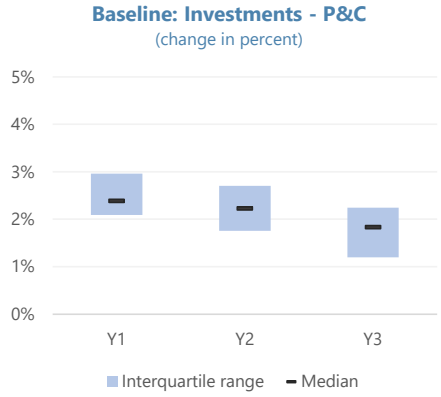



Source: IMF staff calculations based on OSFI and AMF data.

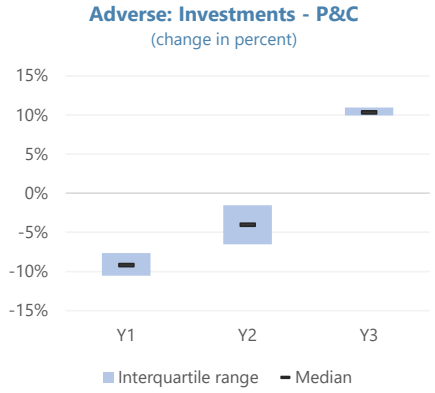
**97. P&C insurers exhibit lower sensitivities to market and credit risks, and investment values and liabilities fluctuate less than those of life insurers** (Figure 32). In the baseline scenario, valuations develop fairly similar as in the life sector. In the adverse scenario, the effect of the interest rate shocks leads to a different timing pattern of valuation changes, given shorter asset and liability maturities. Shocks are mainly seen in the investments of P&C insurers' assets with a cumulative decline of 12 percent in the first two years; meanwhile, liabilities remain largely stable (-1 percent in year 1 and +1 percent in year 2 for the median firm). In the third year, investment values rise by 10 percent, while liabilities increase by only 2 percent.

**Figure 32. Canada: Insurance Solvency Stress Test—Valuation Changes (Property and Casualty)**

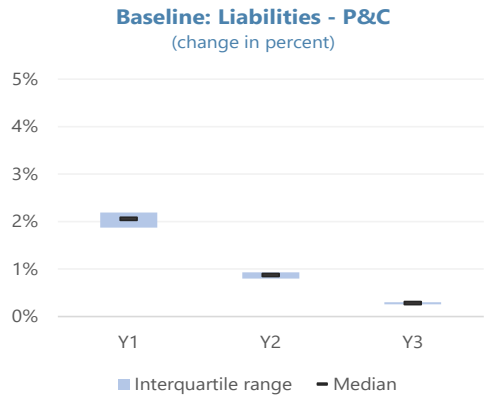
*For the median P&C insurer, the value of investment increases by around 2 percent in each year of the projection horizon.*



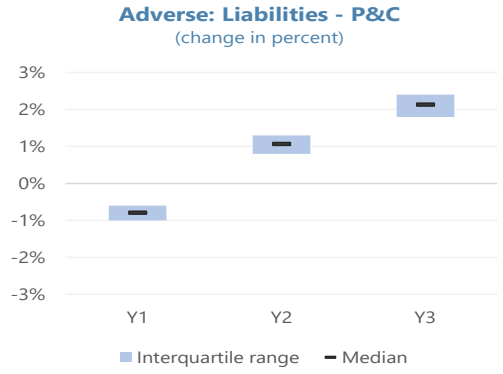

*In year 1 of the adverse scenario, investment values decline by 9 percent, followed by another 4 percent decline in year 2 and a strong recovery in year 3.*




*Liabilities increase slightly in the baseline, but with a declining trend over the three years of the projection horizon.*




*Liability values of P&C insurers fluctuate much less than those of life insurers due to shorter durations and lower interest rate sensitivity.*

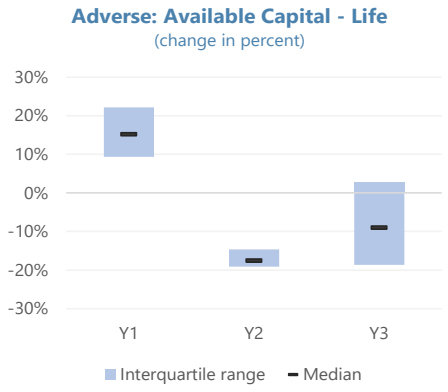



Source: IMF staff calculations based on OSFI and AMF data.

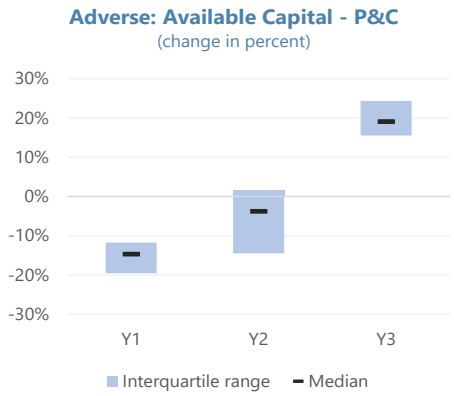
**98. The differences in asset and liability values results in pronounced changes in the available capital of insurers** (Figure 33). In the life sector, liabilities decline more than investments in year 1 as durations are longer than those of fixed-income investments. As a result, available capital increases by 15 percent for the median life insurer. This is, however, followed by a marked decline in year 2 (-18 percent) and another smaller decline in year 3 (-9 percent). In the P&C sector, available capital declines already in the first year by 15 percent. The decline in year 2 is then significantly smaller (-4 percent) than in the life sector, and also the recovery in year 3 (+19 percent) is unique to the P&C sector.

**Figure 33. Canada: Insurance Solvency Stress Test—Changes in Available Capital**

*Available capital of the median life insurer increases by 15 percent in year 1 before declining by 18 and 9 percent, respectively in years 2 and 3.*




*In the P&C sector, available capital declines by 8 and 4 percent in years 1 and 2, respectively, and increases by 19 percent in year 3.*

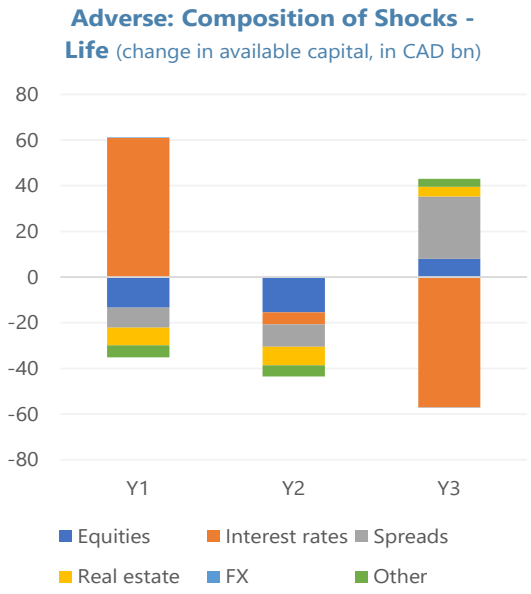



Source: IMF staff calculations based on OSFI and AMF data.

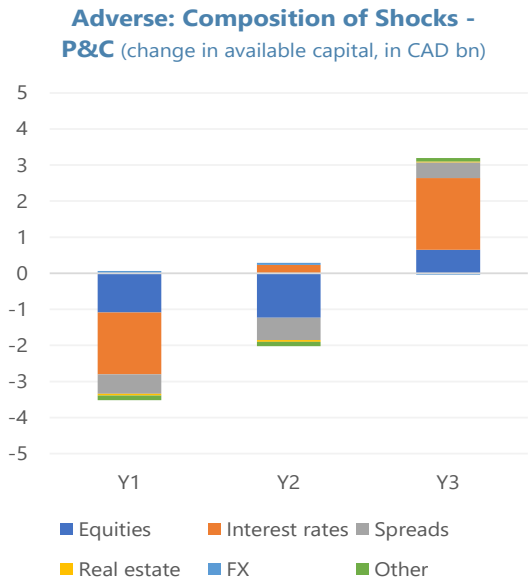
**99. In the adverse scenarios, interest rate shocks have the most pronounced impact on available capital** (Figure 34). The combined impact of the upward shock in year 1 and the downward shock in year 3 on the value of fixed-income assets and insurance liabilities is more than offsetting the remaining shocks for life insurers in those two years; year 2 instead is characterized by all shocks of the scenario having a negative impact on available capital. Other important drivers for the life sector are the shocks on equity prices and, to a lesser extent, credit spreads and real estate. In the P&C sector, interest rates have a negative impact on available capital only in year 1. The FX shock has a very small benefitting impact both in years 1 and 2. Finally, the remaining material contribution to changes in available capital stems from the equity shock.

**Figure 34. Canada: Insurance Solvency Stress Test—Contributions of Individual Shocks**

*Both in year 1 and 3, (long-term) interest rates have the largest impact on the change in available capital, with opposite effects in both years.*




*P&C insurers are less sensitive to interest rate changes, but still the impact of the interest rate shock is markable.*

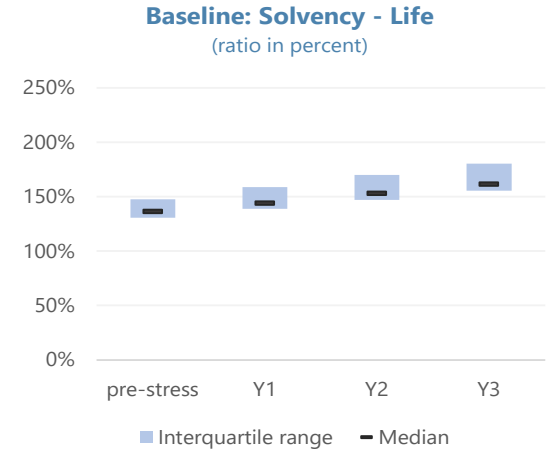



Source: IMF staff calculations based on OSFI and AMF data.

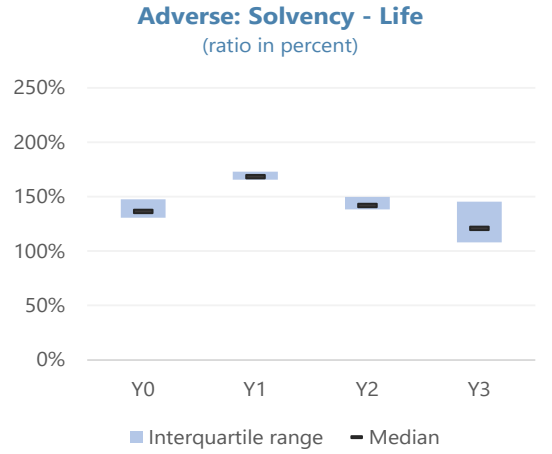
**100. Life insurers would experience some larger variations in their capital in the adverse scenario but are overall resilient with only a moderate cumulative decline of their solvency ratios** (Figure 35). The baseline scenario sees solvency ratios of life insurers increasing from 136 to 161 percent and for P&C insurers from 259 to 279 percent cumulatively over three years. In the adverse scenario, life insurers' solvency ratios initially improve—for the median firm from 136 to 168 percent in year 1. Subsequently, however, the scenario causes solvency ratios to decline, to 142 percent in the second year and to 121 percent in the third year—driven by the reversal of interest rates and higher liability values. None of the life insurers sees its solvency ratio falling below the regulatory threshold, and some insurers even remain above or close to their internal operational capital targets. The solvency ratio of the median P&C insurer initially falls from 259 to 222 percent in the first year and further to 218 percent in the following year before recovering to 237 percent in the third year.

**Figure 35. Canada: Insurance Solvency Stress Test—Solvency Ratios**

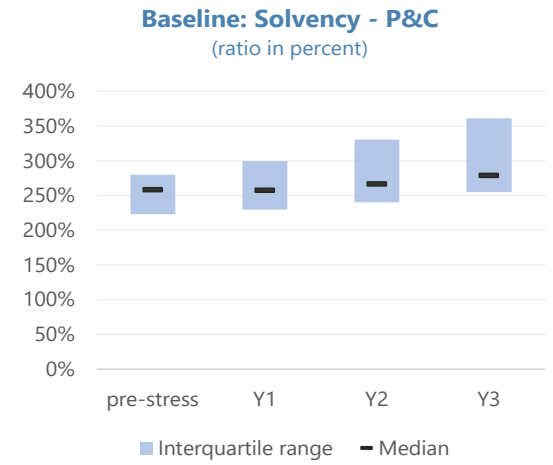
*Solvency ratios of the median life insurer increase from 136 to 161 percent over three years in the baseline scenario.*



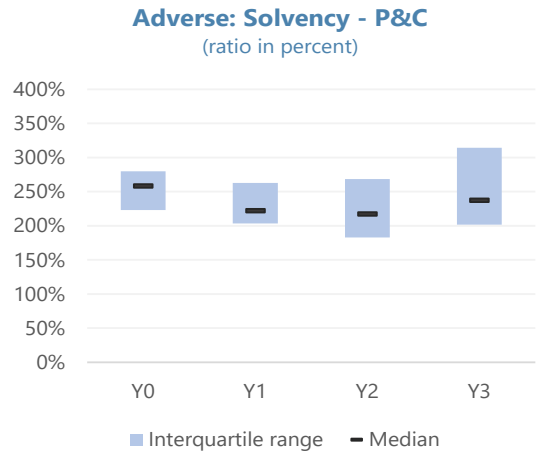

*In the adverse scenario, solvency ratios initially increase before declining in years 2 and 3; for the median life insurer, the cumulative decline amounts to 15 percentage points.*




*In the P&C sector, solvency ratios steadily increase in the baseline scenario, by 20 percentage points for the median firm.*




*Contrary to the life sector, solvency ratios in the P&C sector already decline in year 1 and recover in the third year.*




Source: IMF staff calculations based on OSFI and AMF data.

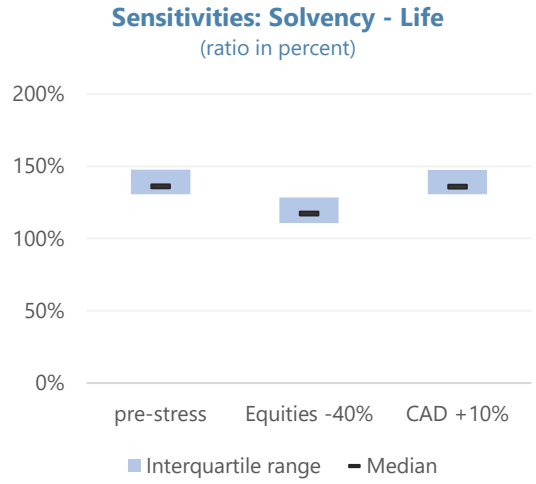
## Results of the Sensitivity Analysis

**101. The sensitivity analysis shows potential vulnerabilities related to equity exposures, while net currency exposures are rather marginal** (Figure 36). Canadian insurers hold material investments in stocks—a sharp decline in stock prices would therefore have a significant impact on the capital position. Assuming an instantaneous 40 percent decline in stock markets, solvency ratios decline by 19 and 23 percent in the life and P&C sector, respectively. Insurers aim for a close match of their currency risks on the asset and liability side and hedge accordingly where necessary. As a

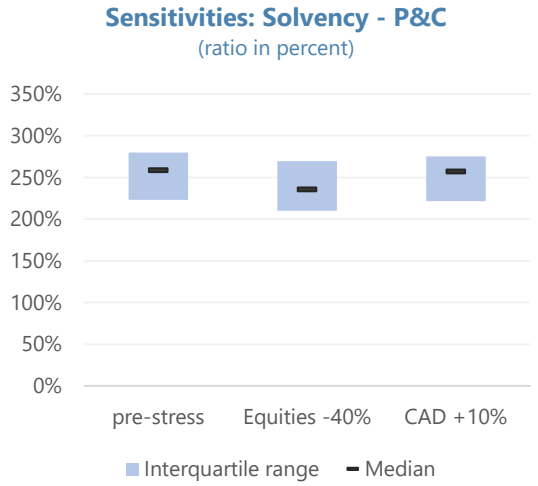
result, the impact of a 10 percent appreciation of the CAD does not have a material impact on solvency. For the median life insurer, the solvency coverage ratio would decline by less than 1 percentage point, and for the median PC insurer the decline would be 2 percentage points.

**Figure 36. Canada: Insurance Solvency Stress Test—Sensitivity Analysis**

*Life insurers would see their solvency ratio declining significantly if equity prices dropped, while the sensitivity to the exchange rate is marginal.*




*P&C insurers have a slightly higher sensitivity to exchange rates, but for the median firm the solvency rate would only decline by 2 percentage rates if the CAD appreciates by 10 percent.*




Source: IMF staff calculations based on OSFI and AMF data.

## Box 1. Canada: Mortgage Insurance Risk Analysis

**A top-down risk analysis was performed for the three Canadian mortgage default insurers which combined the adverse macrofinancial scenario with higher defaults on insured mortgage loans.** In this combined scenario, house prices decline by almost 25 percent in the first year of the projection horizon and probabilities of default more than double by year 2 compared to the baseline projection.

### Additional Stress Parameters for Mortgage Insurers

| | 2024 | Baseline | | | Adverse | | |
|---|---|---|---|---|---|---|---|
| | | 2025 | 2026 | 2027 | 2025 | 2026 | 2027 |
| Probablility of Default | 0,439% | 0,490% | 0,490% | 0,487% | 0,557% | 1,009% | 1,090% |
| House prices | 2,7% | 3,0% | 2,3% | 2,3% | -24,9% | 0,2% | 9,9% |

Source: IMF staff.

**Canadian mortgage insurers start from a very favorable capital position, with a pre-stress solvency ratio of 183 percent (weighted average).** At the same time, effective LTV ratios of insured loans have improved over the last years due to rising house prices: Around 63 percent of the insured volume have an LTV ratio below 70 percent and 38 percent even below 50 percent. Delinquency rates for all three mortgage insurers have been very stable between 0.1 and 0.2 percent over the last two years with a slight uptick towards end-2024. The combined ratio[1] of the sector was below 15 percent (weighted average), and returns on equity ranged from 18 to 46 percent in 2023.

**The prescribed adverse scenario would primarily have an impact on the profitability of mortgage insurers, but only in relative terms compared to the baseline.** In the adverse scenario, incurred claims would rise substantially to around CAD 290m in 2025, 520m in 2026, and 450m in 2026. This translates into combined ratios peaking at 37 percent in 2026, 25 percentage points higher than in the baseline projection. The valuation of investments is affected by the market and credit risk shocks of the adverse scenario, resulting in a decline of 7 percent in year 1. With higher underwriting losses and lower investment returns, profitability is subdued, but only one insurer would record a small operating loss in year 1 (before becoming profitable again in year 2), while the two other entities remain profitable in each year of the projection horizon. Nevertheless, in such a challenging market environment, mortgage insurers might potentially consider cutting or suspending their dividend in order to maintain their capital position.

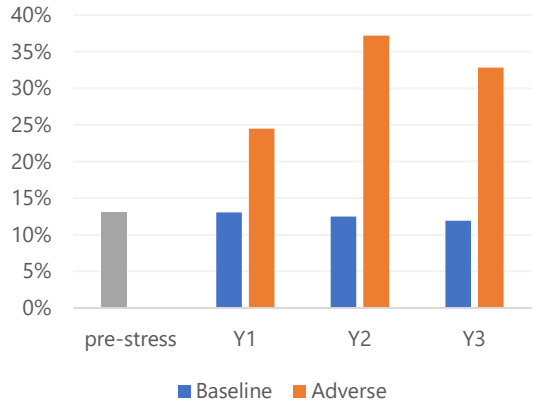
**Solvency ratios increase even in the adverse scenario albeit at significantly lower rates than in the baseline.** In the first two years of the projection horizon, available capital would increase by 19 percent in the baseline scenario and by 6 percent in the adverse scenario—this is also due to the modeling assumption that insurers would not pay out any dividends. In the adverse scenario, the solvency coverage increases to 193 percent in year 2, 21 percentage points lower than in the baseline scenario, before the gap between both scenarios narrows again in year 3 (217 percent in the adverse versus 231 percent in the baseline) when investment returns improve.

## Box 1. Canada: Mortgage Insurance Risk Analysis (concluded)

### Results of the Mortgage Insurance Risk Analysis

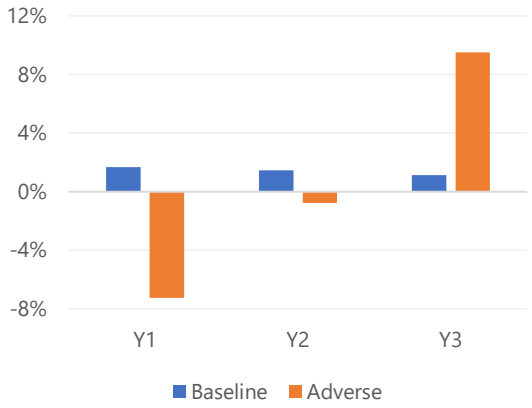
*In the adverse scenario, the combined ratio would peak at 37 percent in year 2, three times higher than in the baseline, but still indicating underwriting profits.*

**Combined Ratio**
(weighted average, in percent)



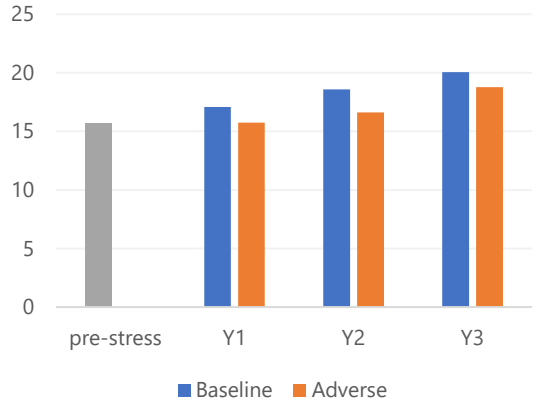

*Mortgage insurers are largely resilient to market risk shocks, but investment valuations would still decline by around 7 percent in the first year.*

**Investment Values**
(median change, in percent)



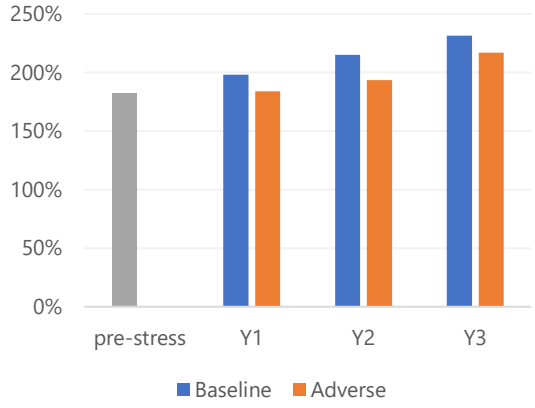

*Available capital increases even in the adverse scenario, but would be around 11 percent lower than in the baseline in year 2.*

**Available Capital**
(in CAD billions)




*Solvency ratios rise by 10 percentage points over two years in the adverse scenario, but by 32 percent in the baseline.*

**Solvency Ratio**
(weighted average, in percent)




Source: IMF staff calculations based on OSFI data and company disclosures.

[1]A measure of underwriting profitability, defined as insurance service expenses to insurance service revenue

## B. Pensions' Funding Risk Analysis

### Scope

**102. A top-down funding risk analysis covered a total of 40 DB pension plans, supervised by OSFI and FSRA.** The sample further splits into seven Ontario-chartered large public sector pension plans with average assets of CAD 84 billion. The 33 private sector pension plans, of which 20 are federally chartered and 13 chartered in Ontario, are significantly smaller than the public sector plans with average assets of CAD 8 billion and the largest plan managing CAD 31 billion (Table 9).

**Table 9. Canada: Pensions' Funding Risk Analysis—Sample**

| | | Public sector plans | Private sector plans |
|---|---|---|---|
| Sample size | | 7 | 33 |
| Assets (CAD bn) | Min | 12 | 2 |
| | Median | 32 | 6 |
| | Mean | 84 | 8 |
| | Max | 253 | 31 |

Sources: IMF staff based on company disclosures.

### Scenario

**103. The analysis used the same baseline and adverse scenario as the insurance risk analysis** (see Table 8 above). Minor adjustments were made to match the reporting granularity of pension plans as compared to the insurance sector. As an example, specific shocks for investment fund holdings were introduced which replicate the shocks for the underlying asset classes, while in the insurance sector the supervisory reporting applies a look-through principle.

### Methodology and Modelling Assumptions

**104. The top-down risk analysis projected valuation changes of assets and liabilities, and the funding ratio over a 3-year horizon.** The shocks specified in the scenario were applied to the investment assets and liabilities as of June 2024 and subsequently for each year of the projection horizon (i.e., June 2025 and June 2026). Haircuts in line with the adverse scenario were applied to the market value of investments. Similarly, liabilities after stress were approximated through a duration-based approach. For those pension plans which are hybrid, i.e., also hold assets for defined-contribution (DC) pensions, the valuation change of such DC assets was also replicated in the valuation of the underlying DC liabilities. It was furthermore assumed that pension plans maintain their asset allocation over the full projection horizon and re-balance it annually. Contributions and benefit payments were assumed to change in line with the projection of consumer prices in the scenario.

**105. The main output of the FSAP risk analysis is the effect on the funding surplus—the difference between assets and liabilities—and ultimately the funding ratio.** The valuation and calculations of the funding ratio were performed on a solvency basis which is different (and more sensitive to market shocks) to the going-concern basis. Generally, the pension sector starts from a robust funding position prior to the simulated stress, with only five plans having a funding deficit.

**106. The stress test used data of pension plans' regulatory returns provided by OSFI and FSRA.** This included annual financial statements, annual information returns, and information investment summaries, as well as the most recent actuarial valuation reports prepared by the pension plans' appointed actuary.

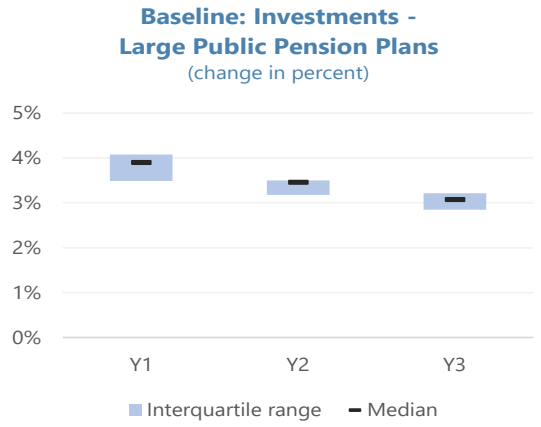
**107. Pension stress tests, particularly when conducted as part of an FSAP, should not be seen as pass-fail exercises or as implying additional funding needs for individual plans.** Neither can they fully take into account possible management actions. As a macrofinancial stress test, the ambition is to detect sector-wide and potentially systemic vulnerabilities. Furthermore, pension plans have a broad range of risk-mitigating mechanisms in place which cannot be fully captured in a top-down risk analysis, and potential reactive management actions were not modeled. Data granularity of the supervisory reporting does not allow for a comprehensive recognition of financial hedges or stop-loss arrangements. Furthermore, a funding ratio below 100 percent does not immediately trigger a requirement for the plan's sponsor to provide additional contributions and/or to cut pension benefits.

### Results of the Scenario Analysis

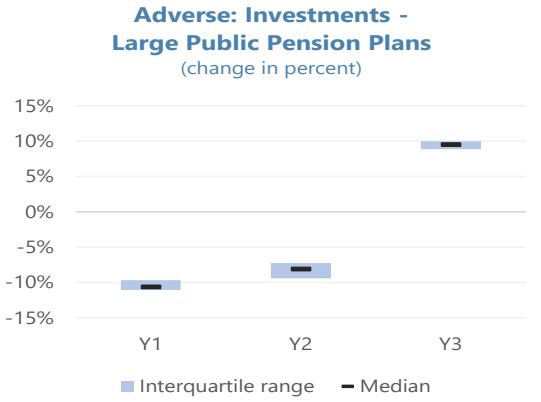
**108. Public sector pension plans would see a material impact of the adverse scenario on both their asset and liability valuations** (Figure 37). The baseline scenario produces a continuous increase in the value of investment assets, at rates between 3 and 4 percent per year for the median plan; liabilities would rise between 0.5 and 1.5 percent annually. In the adverse scenario, asset values would decline by 11 percent in the first year, but liability values decline even more (-13 percent). In the second year, assets decline once more by 9 percent, while liabilities increase by 6 percent. The recovery phase of the scenario, year 3, finally sees both assets and liabilities increasing, by 9 and 15 percent, respectively.

**Figure 37. Canada: Pension—Valuation Changes (Public Sector Plans)**

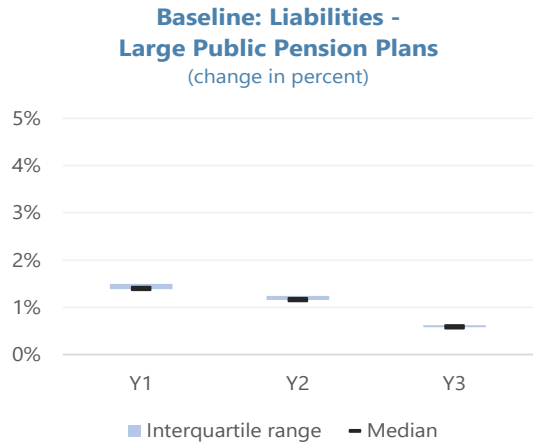
*Investment valuations would increase in the baseline scenario with 3 to 4 percent per year for the median public sector plan, though at a slightly declining pace.*



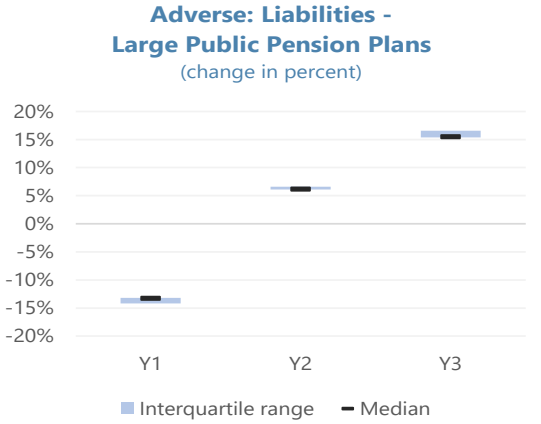

*In the adverse scenario, investment values decline substantially in years 1 and 2 (-11 and -9 percent, respectively), before strongly recovering in year 3.*




*The value of liabilities would in the baseline scenarios increase less than the value of investments, contributing to a further strengthening of the funding position.*




*Liability values decline by 13 percent in the first year for the median public sector plan, followed by increases of 6 and 15 percent in the subsequent years of the projection horizon.*

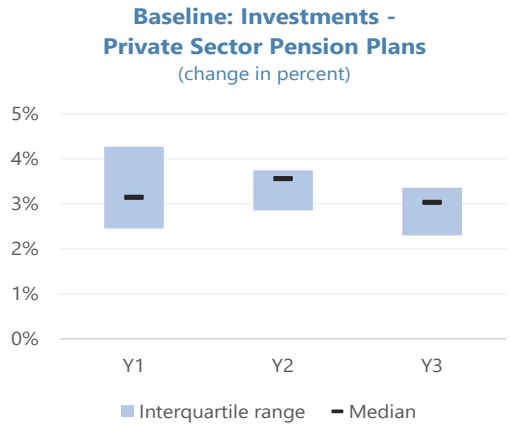



Source: IMF staff calculations based on OSFI and FSRA data.

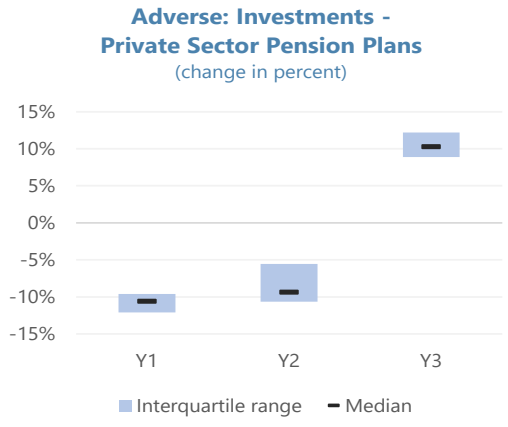
**109. Generally, valuation changes are more varied in the sample of private sector plans than among public sector plans—the directions and overall impact of the scenario are nevertheless very comparable**. The broader variation can be due to the larger sample size, but is likely more driven by the very different characteristics of the private sector plans, reflecting different states of maturity of the pension scheme, varying degrees of risk taking and accordingly differences in the asset allocation. (Figure 38).

**Figure 38. Canada: Pension—Valuation Changes (Private Sector Plans)**

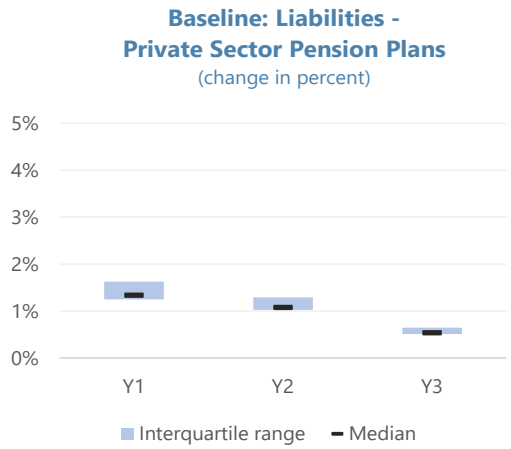
*In the first year, investment valuation changes are more varied and for the median plan slightly lower than for the median public sector pension plan.*



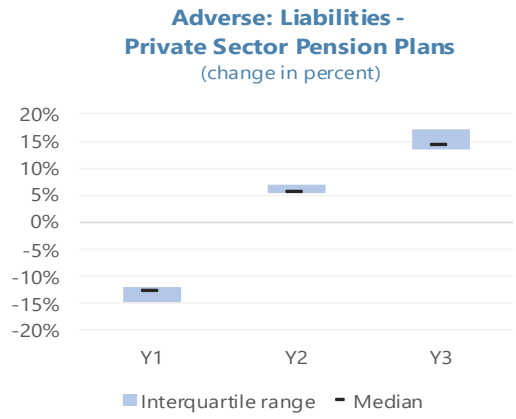

*For the median private sector plan, the changes in the value of liabilities in the adverse scenario is almost identical to what is observed for the public sector plans.*




*Liability valuations increase marginally in the baseline scenario, at similar rates as for public sector plans.*




*In the adverse scenario, liabilities are slightly less sensitive to the interest rate shocks than for public sector plans.*



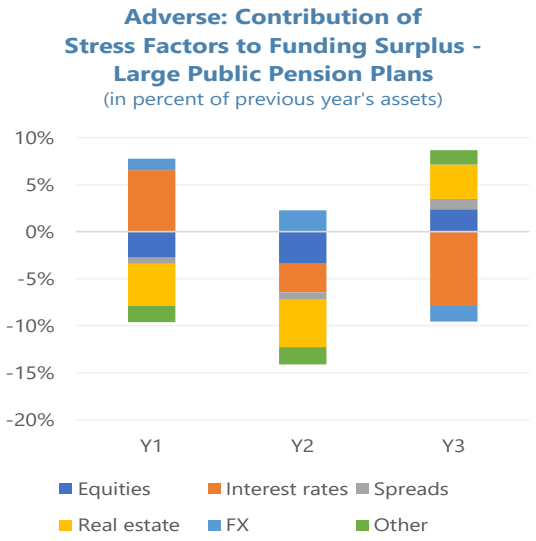

Source: IMF staff calculations based on OSFI and FSRA data.

**110. Most of the changes to the funding surplus stem from the severe interest rate shocks of the adverse scenario, which dominate especially the changes in the first and the third year.** Besides these interest rate shocks, public sector plans are materially affected through shocks to the asset classes, too. The impact of the real estate shock is even larger than the equity shock, and the category 'other' summarizes shocks to alternative assets like infrastructure and hedge funds. The depreciation of the CAD in years 1 and 2 is beneficial for Canadian pension plans which typically hold sizable net FX positions through their investments. Some differences exist between public sector plans, which tend to be more diversified, and private sector plans where more asset class concentration can be seen in parts of the sample; accordingly, the contribution of individual scenario

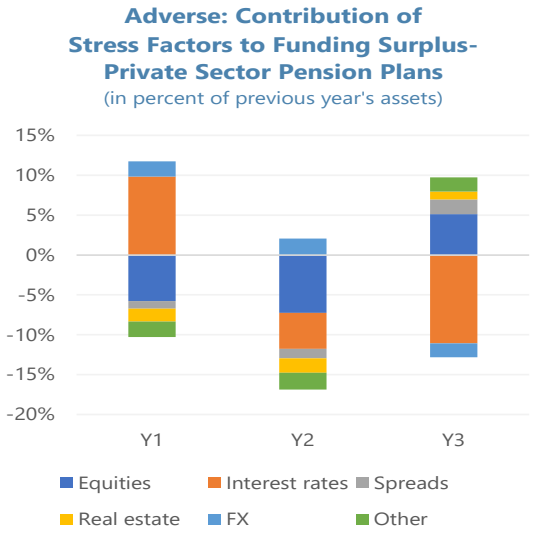
shocks to the changes in funding surplus differs—besides the interest rate shocks, the equity shock is by far the most relevant.

**Figure 39. Canada: Pension—Contribution of Individual Shocks**

*A major contributor to the change in the funding surplus is the interest rate shock, but real estate and equities also contribute significantly.*




*Among private sector plans, contributions from the equity shock are sizable, hinting at less diversification as compared to the (larger) public sector plans.*

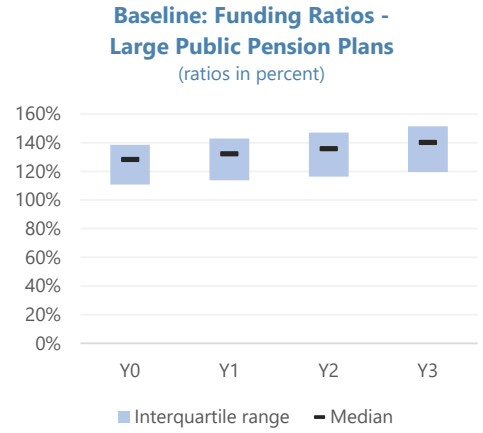



Source: IMF staff calculations based on OSFI and FSRA data.

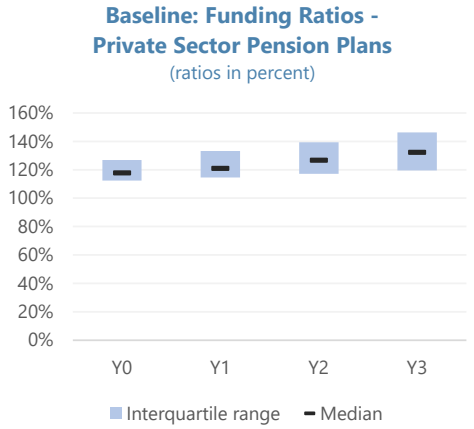
**111. Pension plans would face a deterioration of their funding ratios in the adverse scenario but remain considerably above funding levels seen prior to 2020** (Figure 40). The first year of the adverse scenario is characterized by an offset of negative and positive shock factors: While asset values decline (across all asset classes), the value of liabilities declines even more due to longer durations and higher interest rate sensitivity. As a result, the funding ratio of most public sector pension plans increases (but declines slightly for the median plan); the funding ratio of the median private pension plan increases by 4 percentage points. In the second year of the adverse scenario, funding ratios fall by 13 and 16 percentage points for the median large public sector plan and the median private sector plan, respectively. By the third year, funding ratios stabilize and increase slightly for most of the plans. Still, a bit more than a quarter of the plans would experience a funding deficit at the end of the third year (which, however, would not trigger any immediate refunding requirement).

## Figure 40. Canada: Pension—Funding Ratios

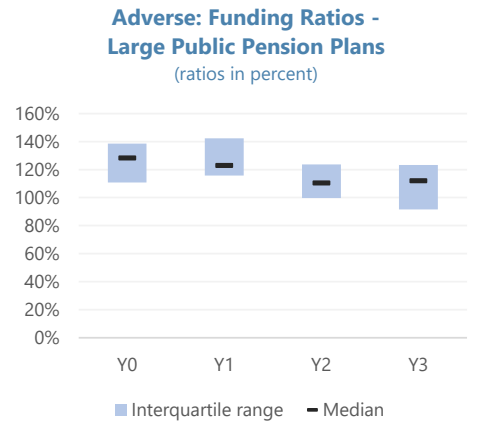
*In the baseline scenario, funding ratios of large public sector plans are expected to increase steadily—for the median plan from 128 to 140 percent in year 3.*



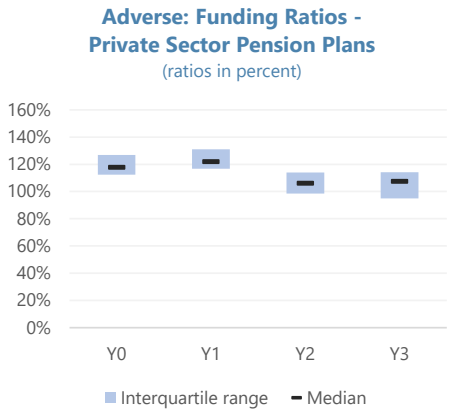

*Similarly, the median private sector pension plan would see its funding ratio increase from 118 to 132 percent over the 3-year projection horizon.*




*Funding ratios would decline slightly in the first year of the adverse scenario, and continue to decline in year 2, reaching 112 percent in year 3 for the median plan.*




*The funding ratio of the median private sector pension plan would even slightly increase in year 1 and—after a fall in year 2—reach 107 percent in the third year.*



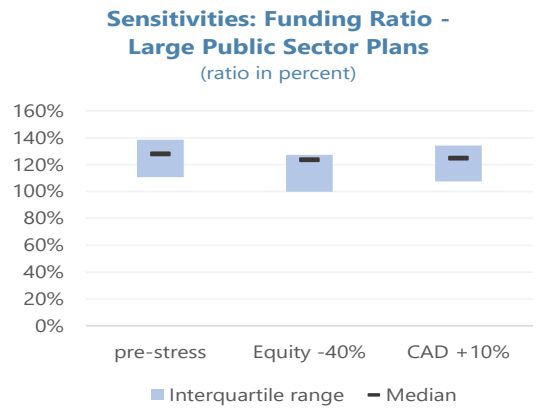

Source: IMF staff calculations based on OSFI and FSRA data.

### Results of the Sensitivity Analysis

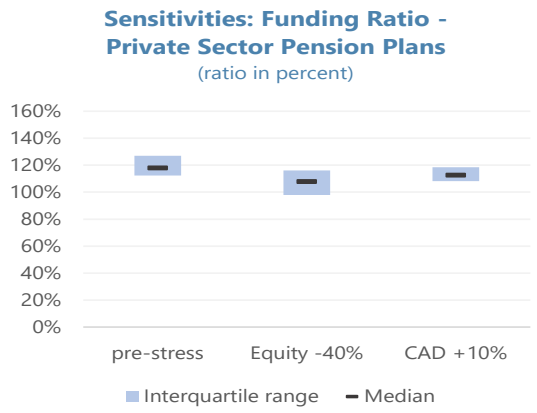
**112. The sensitivity analysis confirms the findings of the scenario analysis: Equity shocks would be more pronounced for private sector plans, and FX risks are largely contained** (Figure 41). Assuming an instantaneous 40 percent decline of equity prices would lower the funding ratios of the median public and private plan by 4 and 10 percentage points, respectively. However, even among the large public sector pension plans, a few would see a funding ratio below 100 percent. Holdings in foreign-denominated assets could potentially be a vulnerability for Canadian pension plans, but even a 10 percent appreciation of the CAD would not have a sizable impact on the funding ratios: For the median public sector pension plan, it would decline by 3 percentage points, and for the median private sector plan by 6 percentage points.

**Figure 41. Canada: Pensions Funding Risk Analysis—Sensitivity Analysis**

*For the median large public sector pension plan, the funding ratio declines by 4 percentage points if equity prices drop by 40 percent...*




*... while the shock is more pronounced for the median private sector plan with a decline of 10 percentage points.*




Source: IMF staff calculations based on OSFI and FSRA data.

## C. Insurance and Pensions Liquidity Risk Analysis

### Sample

**113. Through a bottom-up data collection, the FSAP tested the liquidity risks of pension plans and life insurers stemming from margin and collateral calls.** Nineteen pension plans were covered with total assets of around CAD 1.83 trillion, about 70 percent of the Canadian pension sector. This sub-sample includes ten public sector pension plans (including a pension fund), registered in Ontario and British Columbia, as well as one plan under joint federal-provincial supervision, and one plan overseen at the federal level by the Treasury Secretariat Board. Nine federally registered private sector pension plans, supervised by OSFI, constitute another sub-sample. Generally, the private plans are significantly smaller than those from the public sector (Table 10). Furthermore, three large life insurers supervised by OSFI were included in the analysis—their total

balance sheet assets amount to around CAD 1.70 trillion, representing about 85 percent of the total Canadian life insurance sector.

**Table 10. Canada: Insurance and Pensions Liquidity Risk Analysis—Sample**

| | | Pension funds/plans | | Life insurers |
|---|---|---|---|---|
| | | Public | Private | |
| **Sample size** | | 10 | 9 | 3 |
| **Assets** | Min | 12 | 5 | 345 |
| | Median | 139 | 13 | 432 |
| | Mean | 172 | 13 | 565 |
| | Max | 647 | 31 | 919 |

Source: IMF staff calculations based on company disclosures.

### Scenario

**114. The liquidity risk analysis focused on short-term liquidity needs triggered by higher margin and collateral needs following a sharp increase in interest rates and a depreciation of the CAD.** The calibration builds on a historic scenario, concretely the second half of September 1992, one of the most volatile episodes in fixed-income and currency markets, originating from the crisis of the European Exchange Rate Mechanism but with global repercussions. The exercise assumed a severe instantaneous and simultaneous shock to interest rates and currencies, materializing on the reference date of the exercise, 30 June 2024:

- An increase of short-term interest term rates (up to 2 years) by 150 basis points, and long-term rates (10 years and longer) by 50 basis points (applicable to interest rates in all currencies); for maturities between 2 and 10 years, interest rate shocks were interpolated;
- A depreciation of the CAD against the US dollar of 2.9 percent, and against the EUR of 4.8 percent. Accordingly, the US dollar depreciates by 1.8 percent against the EUR.

### Methodology and Modeling Assumptions

**115. The analysis compares the liquidity need for margin and collateral calls against the stock of highly liquid high-quality assets and the availability of other funding sources.** It was assumed that after the shock at t=0, the margin and collateral calls for derivatives and other off-balance sheet positions would become due according to the underlying contractual arrangements, which are typically within one day ('t+1') or two days ('t+2'). For any remaining settlement periods, 't+3 or later' was defined. Participants were asked to report:

- The stock of available liquid assets (cash, deposits, different types of assets which could be liquidated within the projection horizon of the exercise), and

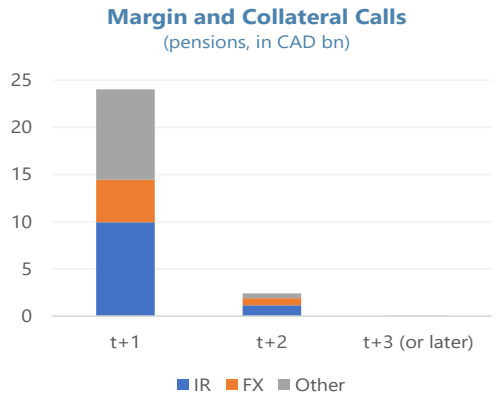
- The flow of funding sources used on each of the three days, differentiating between (i) use of cash and deposits, (ii) use of liquid assets, and (iii) financing transactions such as credit lines and repurchase agreements. It was assumed that no commercial paper could be issued.

**Results**

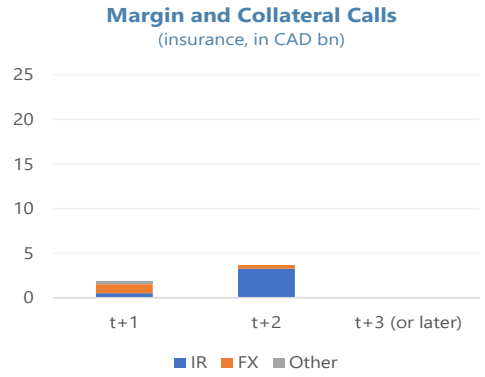
**116. Margin and collateral calls are sizable, mostly due within t+1, and stem from different types of derivatives and off-balance sheet exposures** (Figure 42). In total, the sampled entities would face margin calls of CAD 32 billion in the tested scenario—CAD 26.4 billion in the pensions sector and 5.5 billion for life insurers. Around 81 percent of the margin and collateral calls would need to be met within one day, while among life insurers, settlement periods of two days are also very common. Of the total margin calls, 47 percent stem from positions in interest rate derivatives; currency derivatives contribute 21 percent, and other off-balance sheet positions the remaining 32 percent. Life insurers would see most of the margin calls being related to interest rate derivatives.

**Figure 42. Canada: Insurance and Pensions Liquidity Risk Analysis—Amount of Margin Calls**

*In the pension sector, margin and collateral calls would amount to CAD 26.4 billion, of which 24.0 billion would be due within t+1.*




*Life insurers would face margin calls of CAD 5.5 billion of which 3.8 billion are related to interest rate derivatives and mostly due within t+2.*




Source: IMF staff calculations based on company submissions.

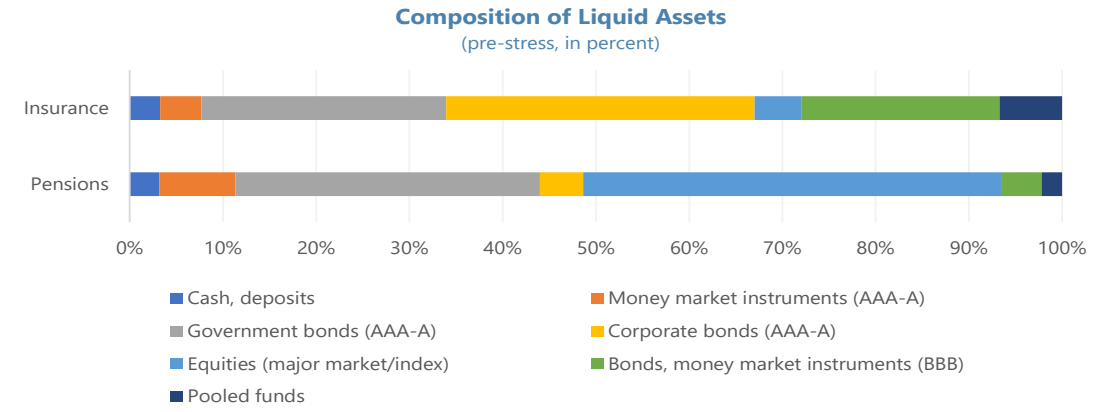
**117. Both pension plans and life insurers hold a sizable amount of their assets in liquid investments, though with different composition in the two sectors** (Figure 43). On average, the sampled pension plans hold 35 percent of their total assets in liquid investments[35]; for the three life insurers, the share of liquid investments amounts to 23 percent. There are, however, considerable differences in the composition of these liquid assets: While in the pensions sector listed equities and highly-rated government bonds dominate (with 45 and 33 percent, respectively), life insurers hold a broader mix of different types of bonds, the most relevant ones being highly-rated corporate bonds and government bonds (33 and 26 percent, respectively) as well as BBB-rated bonds and money-

[35] Liquid assets exclude securities which have been pledged as collateral.

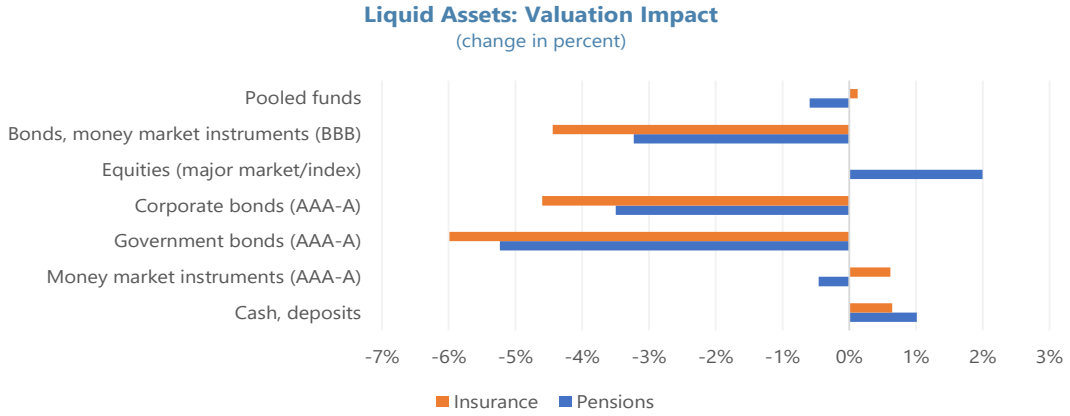
market instruments (21 percent). The value of liquid assets is sensitive to the market shocks tested in the scenario: On average, the value declines by 2.2 percent, but in some asset classes the depreciating CAD has a positive impact—equity exposures rise in value by 1.9 percent and deposits by 0.9 percent.

**Figure 43. Canada: Insurance and Pensions Liquidity Risk Analysis—Liquid Assets**

*Both sectors hold different types of liquid assets: In the pensions sector, listed equities and highly-rated government bonds dominate, while life insurers hold most highly-rated corporate bonds, government bonds as well as BBB-rated bonds and money-market instruments.*




*While overall the value of liquid assets declines in the tested scenario (through the impact of higher interest rates on bond prices), the depreciation of the CAD contributes to higher values in certain asset classes, most notably equities but also deposits.*



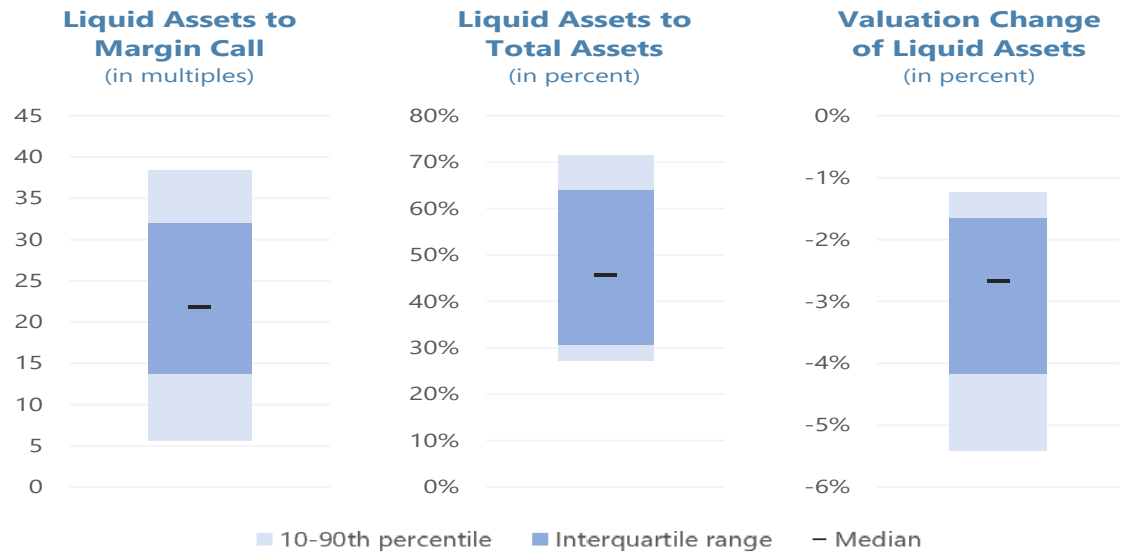

Source: IMF staff calculations based on company submissions.

**118. The sampled entities are characterized by a large heterogeneity in their holdings of liquid assets** (Figure 44). Canadian pension plans and life insurers tend to hold more illiquid assets than, for example, their European peers—such illiquid assets include private equity, private debt, real estate, infrastructure investments, and other alternative assets. As a result, the ratio of liquid assets to total assets ranges between 31 and 64 percent for half of the sample. Still, these holdings in liquid assets significantly exceed the simulated amount of margin calls, both on aggregate and for all individual entities: For half of the sample, liquid assets exceed the simulated margin calls by a factor

between 14 and 32. Depending on the asset allocation, the valuation impact of the scenario on the liquid assets is very different, and their value typically declines by between -1.7 and -4.2 percent.

**Figure 44. Canada: Insurance and Pensions Liquidity Risk Analysis—Liquid Assets (Distributions)**

*For half of the sample, liquid assets exceed the simulated margin call by a factor between 14 and 32. Liquid assets range between 31 and 64 percent of total assets for half of the sample. Also, the valuation impact of the scenario is very different, typically between -1.7 and -4.2 percent.*

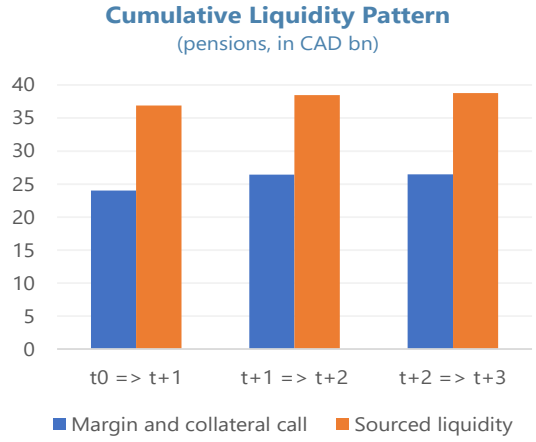



Source: IMF staff calculations based on company submissions.

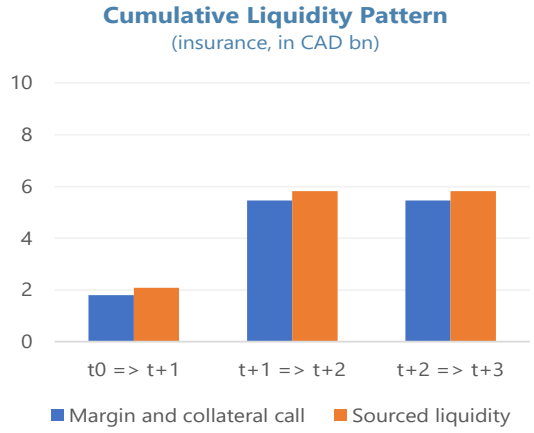
**119. Pension plans and life insurers are sufficiently liquid to meet the margin and collateral calls by using several different sources of liquidity** (Figure 45). Both sectors would, on aggregate, source liquidity which exceeds the amount due from the margin call (CAD 45 billion vs. 32 billion) likely for precautionary reasons—however, this is driven by a few entities only, and the large majority would match their sourced liquidity much closer to the needed liquidity. Among the pension plans, 55 percent of the sourced liquidity would stem from financing transactions, such as repos and credit lines. Another 31 percent would be funded through highly liquid assets (mostly through posting these instead of cash as collateral). The life insurers in the sample would rely mostly on their liquid asset holdings as a source of liquidity, contributing 91 percent, while cash and deposits would be used for the remaining amount.

**Figure 45. Canada: Insurance and Pensions Liquidity Risk Analysis—Meeting the Margin Calls**

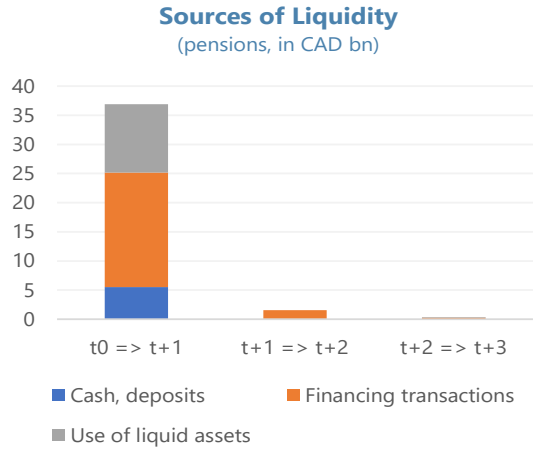
*Pension plans are sourcing CAD 39 billion to meet their margin calls. While typically most plans source exactly the margin call amount, a few indicated to source more than that, potentially as an additional buffer.*



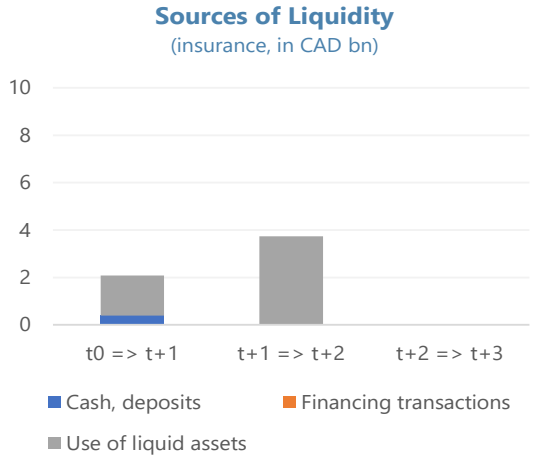

*Life insurers match their liquidity needs rather closely and in line with the different settlement dates of the margin calls.*




*Pension plans rely on financing transactions (55 percent of sourced liquidity) and liquid assets (31 percent).*




*The life insurers would mainly use their liquid assets (91 percent of sourced liquidity).*



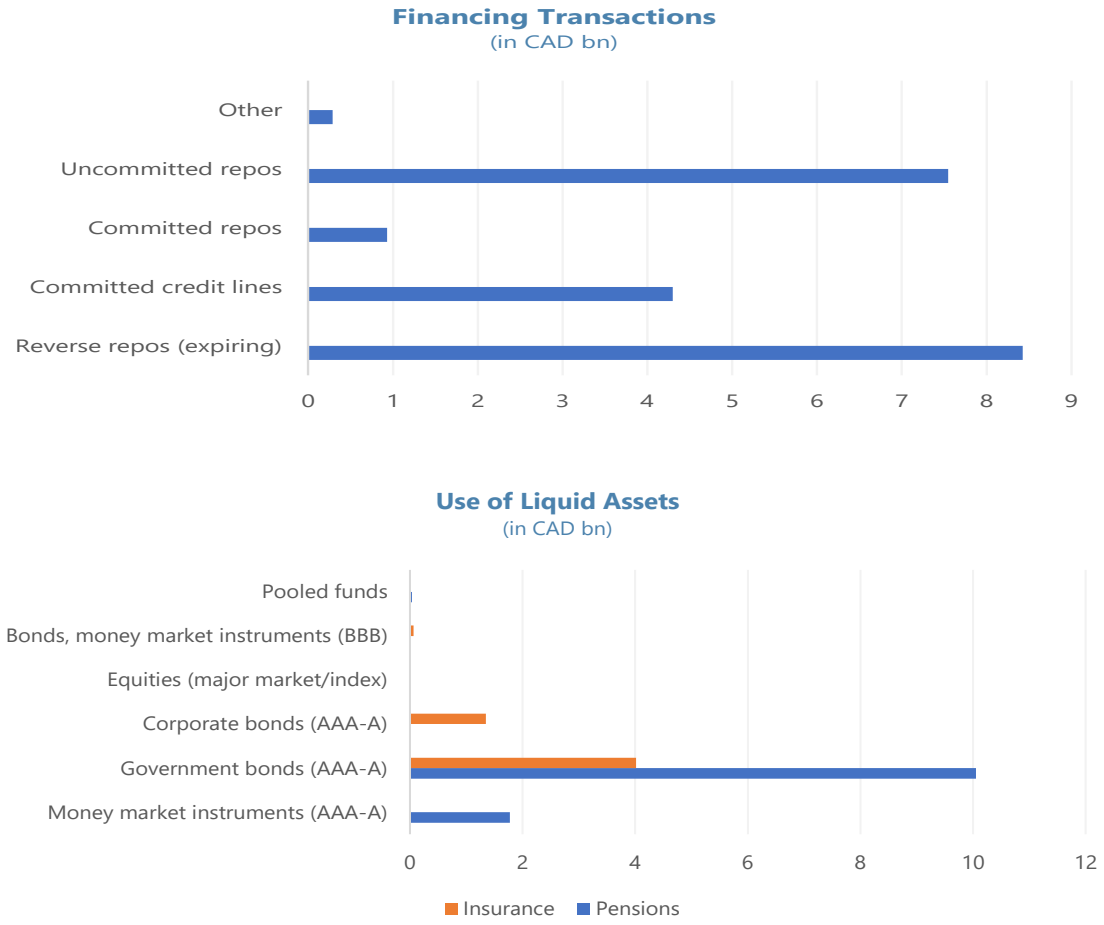

Source: IMF staff calculations based on company submissions.

**120. Repurchase agreements and credit lines are an important source for pension plans to meet short-term liquidity needs** (Figure 46). Financing transactions as a liquidity source are composed of expiring repurchase agreements (39 percent), uncommitted repos (35 percent), and committed credit lines (20 percent). When focusing on the use of liquid assets, pension plans would use almost exclusively government bonds and money-market instruments, both in the rating categories AAA to A, to meet the margin calls in the tested scenario (85 and 15 percent,

respectively). Life insurers would use a mixture of highly rated government bonds (74 percent) and corporate bonds (25 percent).

**Figure 46. Canada: Insurance and Pensions Liquidity Risk Analysis—Sources of Liquidity**

*Financing transactions, used only by the pension plans in the sample, comprise mainly expiring repos (39 percent), uncommitted repos (35 percent), and committed credit lines (20 percent). Amongst those liquid assets being used to meet margin calls, highly rated government bonds dominate (81 percent).*

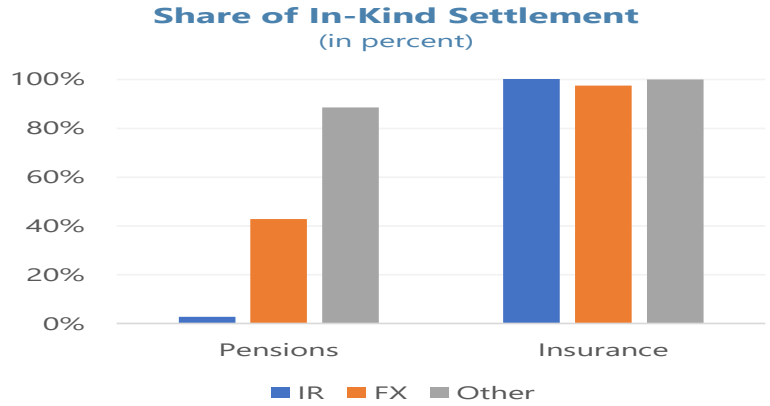



Source: IMF staff calculations based on company submissions.

**121. Liquidity risks are mitigated through a large share of margin calls which are settled in kind instead of in cash** (Figure 47). 53 percent of the aggregated margin and collateral calls can be settled in kind, through a transfer of collateral assets without the need to liquidate assets in stressed markets. However, notable differences exist across derivative types and also between pension plans and life insurers. Cash settlement has become the dominant type for interest-rate derivatives, and in-kind settlement accounts for only 28 percent; for FX derivatives and other off-balance sheet positions, the share is considerably higher (54 and 89 percent, respectively). The life insurers in the sample are able to settle almost all their margin calls in kind

**Figure 47. Canada: Insurance and Pensions Liquidity Risk Analysis—Use of In-kind Settlement**

*In the pension sector, the possibility to meet a margin call in kind differs according to the derivative type: It is almost non-existent for interest rate derivatives, but very common for other off-balance sheet positions. Among life insurers, cash settlements are a very rare case while in-kind settlement dominates.*




Source: IMF staff calculations based on company submissions.

## D. Recommendations

**122. Canada has an established regime of stress testing for insurers but would benefit from a comprehensive approach for macroprudential stress tests in this sector.** Supervisory authorities should use stress tests to also analyze systemic risks, thereby cooperating in the design of the exercise and the scenario (also in consultation with the BOC). The recent standardized climate risk exercise could serve as an example of successful cooperation. For a macroprudential stress test to be insightful, authorities should also analyze potential second-round effects, including those stemming from insurers' management actions, for example, related to investment re-allocations.

**123. In the pension sector, both OSFI and FSRA have established more robust supervision recently and are recommended to further strengthen risk analyses.** Most data in the pension sector are reported only on an annual basis. Requiring more frequent and granular data on the largest pension plans' investments, derivative holdings, as well as key metrics on liquidity and leverage is highly encouraged—allowing for top-down sensitivity testing especially in times of heightened market volatility.

**124. Monitoring of LCRs, already performed by FSRA, for the large public sector plans should be extended to other large pension plans** (including those supervised by other provincial authorities and OSFI). It could also be extended to those plans which are very active users of derivatives and other off-balance sheet transactions. A close monitoring of systemic liquidity risks (together with leverage) should also cover pension funds which fall under joint federal-provincial oversight and oversight by the Treasury Board Secretariat, respectively

# Appendix I. Financial Sector Assessment Program Risk Assessment Matrix

**Table 1. Canada: Financial Sector Assessment Program Risk Assessment Matrix**

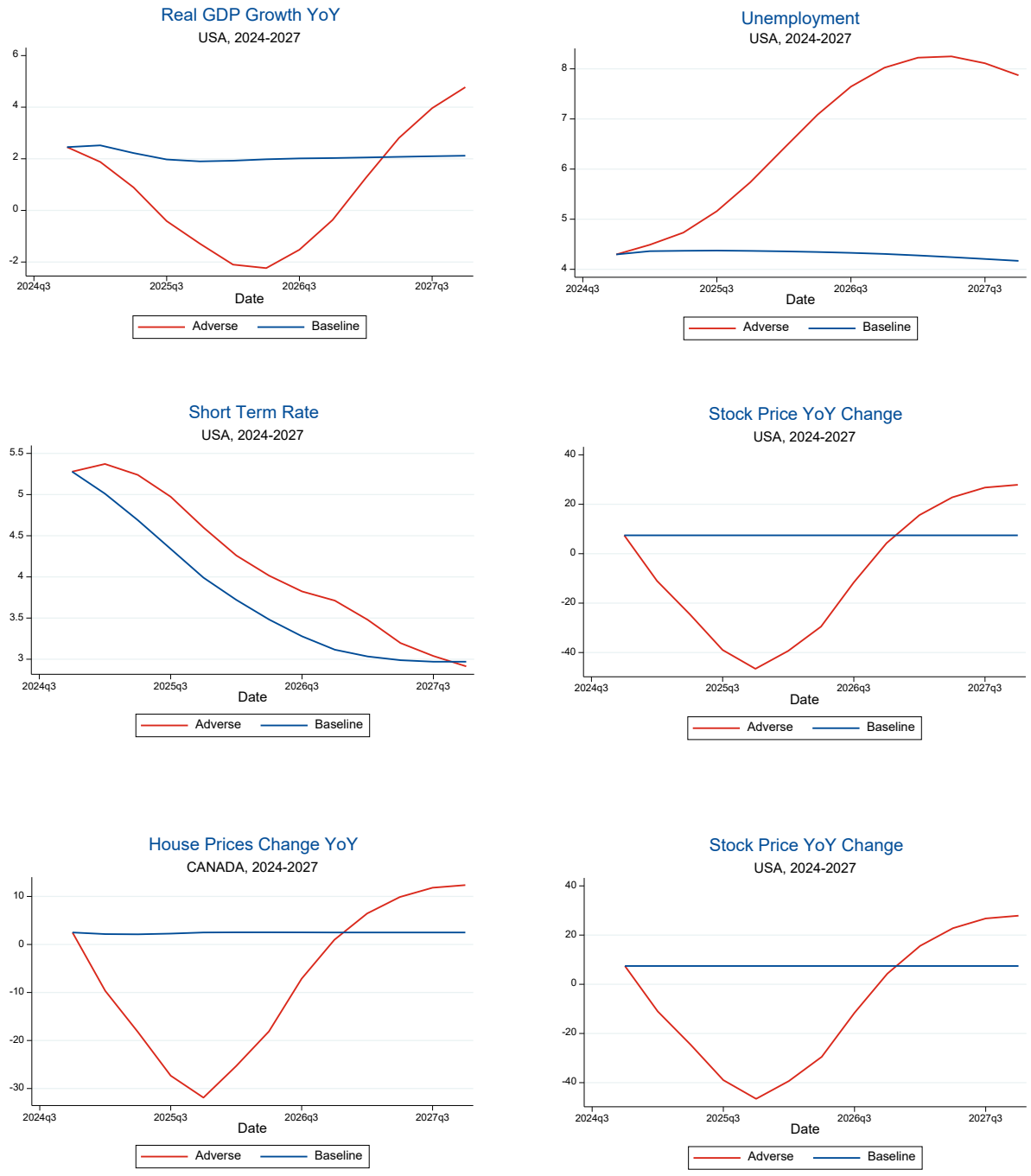
| Risk | Overall Level of Concern | |
|---|---|---|
| | Relative Likelihood | Expected Impact if Materialized |
| **Trade policy and investment shocks.** Higher trade barriers or sanctions reduce external trade, disrupt FDI and supply chains, and trigger further U.S. dollar appreciation, tighter financial conditions, and higher inflation. | **High** | • Trading partners reduce demand for Canadian exports. Domestic producers constrain supply chains and production networks, increasing inflationary pressures. Investment distortions associated with trade protectionism reduce potential growth. Negative business climate limits corporate earnings growth, employment, and economic growth, damaging asset quality. |
| **Regional conflicts.** Intensification of conflicts (e.g., in the Middle East, Ukraine, Sahel, and East Africa) or terrorism disrupt trade in energy and food, tourism, supply chains, remittances, FDI and financial flows, payment systems, and increase refugee flows. | **Medium** | • Global trade and supply-chain disruptions, together with increased uncertainty would lead to an abrupt global and domestic economic slowdown.<br>• Significant commodity price volatility and upward pressure on inflation would trigger a sharp increase in foreign and domestic interest rates.<br>• Tighter financial conditions, including through term premia and house price declines, could heighten credit risk. Higher for longer interest rates could increase unemployment and affect borrowers' ability to repay their loans.<br>• Nominal wage growth falls behind inflation rates, indicating a decrease in real wages and the ability of borrowers to service their debt. This would raise credit risk for banks and NBFIs.<br>• Valuation losses from holdings of foreign and domestic debt securities under mark-to-market accounting. |
| **Tighter financial conditions and systemic instability.** Higher-for-longer interest rates and term premia amid looser financial regulation, rising investments in cryptocurrencies, and higher trade barriers trigger asset repricing, market dislocations, | **Medium** | • Higher for longer interest rates could impact financial institutions' capital through bond valuation losses, higher credit risk and potentially lower NII (depending on relative pass-through rates to lending and funding rates). |

**Table 1. Canada: Financial Sector Assessment Program Risk Assessment Matrix (concluded)**

| | | |
|---|---|---|
| weak bank and NBFI distress, and further U.S. dollar appreciation, which widens global imbalances, worsens debt affordability, and increases capital outflow from EMDEs. | | • A U.S. dollar appreciation could rise the cost of banks' USD funding, especially if the banks have not perfectly hedged this currency risk. |
| **Deepening geoeconomic fragmentation.** Broader conflicts, inward-oriented policies, and weakened international cooperation result in a less efficient configuration of trade and FDI, supply disruptions, protectionism, policy uncertainty, technological and payments systems fragmentation, rising shipping and input costs, financial instability, a fracturing of international monetary system, and lower growth. | **High** | • Trading partners reduce demand for Canadian exports. Domestic producers constrain supply chains and production networks, increasing inflationary pressures. Investment distortions associated with trade protectionism reduce potential growth. Negative business climate limits corporate earnings growth, employment, and economic growth, damaging asset quality. |
| **Cyberthreats.** Cyberattacks on physical or digital infrastructure (including digital currency and crypto assets), technical failures, or misuse of AI technologies trigger financial and economic instability. | **High** | • Cyberattacks could disrupt payment and financial systems, posing a threat to the stability of financial institutions and their capacity to provide financial services. |
| **Climate change.** Extreme climate events driven by rising temperatures cause loss of life, damage to infrastructure, food insecurity, supply disruptions, lower growth, and financial instability. | **Medium** | • Economic damage leading to credit, liquidity, and operational risks to financial institutions. |
| **House price correction.** A significant decrease or correction in housing prices across the real estate market, triggered possibly by elevated interest rates, a slowing economy, and reduced demand. | **Medium** | • A large correction in real estate prices could damp consumption and investment (especially across leveraged households and non-diversified real estate developers), thereby increasing unemployment.<br>• Falls in house prices would widen LTV ratios and increase LGDs. |

# Appendix II. Macroeconomic Scenarios

## Figure 1. Canada: Paths U.S. Macroeconomic Variables




Sources: World Economic Outlook and Staff Calculations.

# Appendix III. Stress Testing Matrix

| Banking Sector: Solvency Test | | |
|---|---|---|
| **Domain** | | **Framework** |
| | | **Top-down by FSAP Team** |
| 1. Institutional perimeter | Institutions included | • Seven systemic deposit taking institutions (DTIs), including Desjardins and six D-SIBs: Royal Bank of Canada, Toronto-Dominion Bank, Bank of Nova Scotia, Bank of Montreal, Canadian Imperial Bank of Commerce, and National Bank of Canada. Royal Bank of Canada and Toronto-Dominion Bank are also considered global systemically important banks (G-SIBs). |
| | Market share | • The six D-SIBs represent about 93.6 percent of banking sector assets (excluding foreign bank branches).<br>• The seven systemic DTIs represent above 90.2 percent of deposit-taking institutions assets. |
| | Data and baseline date | • Data: Various sources, including the following.<br>○ OSFI: Regulatory returns and supervisory data, loan level information from the RESL dataset.<br>○ AMF: Regulatory returns and loan level information for RESL.<br>• Scope of consolidation: Global consolidated group basis. For Desjardins insurance business activities are excluded to facilitate comparability with D-SIBs.<br>• Cut-off date: end-October 2024 |
| 2. Channels of risk propagation | Methodology | • Balance-sheet based approach.<br>• Projections of key balance sheet, income statement, and capital account items conditional on scenarios<br>• Static balance sheet assumption |
| | Satellite Models for Macro-Financial linkages | • Credit Risk: A comprehensive battery of models was used.<br>○ Mortgage Loans: Household financial conditions are adjusted based on macroeconomic developments, with employment dynamics modeled to align with projected trends. Loan-level risks are assessed through iterative simulations, and PD are estimated using a BMA approach. Refer to Household Vulnerability Analysis STeM section.<br>○ Corporate Loans: Corporate stress test satellite models that link credit risk variables with macroeconomic variables were estimated using a BMA methodology.<br>• Net Interest Income: The net interest income was projected using a structural model that reflects the repricing dynamics of banks' balance sheets. Historical data on interest rates for newly originated interest-earning assets and liabilities were used to estimate the pass- |

| Banking Sector: Solvency Test | | |
|---|---|---|
| **Domain** | | **Framework** |
| | | **Top-down by FSAP Team** |
| | | through of policy rates to new lending and funding rates through econometric models.<br><br>Non-performing loans will not generate any income.<br><br>• Market risk: Valuation losses from full revaluation of sovereign securities, corporate fixed income debt securities and equity holdings were calculated using a Mark to Market (MTM) approach for fair-valued securities. Market risk is estimated as a sensitivity analysis.<br><br>• Other P&L components: Econometric models are estimated for fees and commission income and other income/expenses. |
| | Stress test horizon | • 3 years (2025–27) |
| 3. Tail shocks | Scenario analysis | Two macroeconomic scenarios:<br><br>• A baseline scenario based on the October 2024 WEO projections.<br><br>An adverse scenario that is consistent with the FSAP RAM and features deepening geoeconomic fragmentation that fuels greater protectionism and increases the use of cross-border restrictions. Deepening geopolitical fragmentation is evidenced through various channels, including international trade, restrictions on cross-border migration, limitations on foreign direct investment, and technology diffusion. Global trade is impeded by both non-tariff trade barriers and tariff barriers, including "trade wars" between some regions; particularly US-China and US-Canada. Sharp de-integration of highly integrated North American supply chains and goods and services markets leads to large deadweight losses (persistent supply shock). The disruption of established global production chains puts downward pressure on global economic growth and creates a series of temporary supply shortages, increasing inflation expectations. This prompts central banks to pause cutting interest rates (or reverse some of the recent cuts). Moreover, a slowdown in global economic growth increases unemployment and reduces commodity demand, causing oil prices to drop. Limitations on foreign direct investment and reduced technological diffusion dent innovation and lead to significant productivity decline. A reassessment of market fundamentals triggers a widespread risk-off event and asset valuation corrections. Elevated borrowing rates, higher unemployment and a reduction in household income contribute to sharp corrections in residential real estate particularly in countries with higher overvaluation estimates. CRE is also hit particularly hard. |

| Banking Sector: Solvency Test | | |
|---|---|---|
| **Domain** | | **Framework** |
| | | **Top-down by FSAP Team** |
| 4. Risks and buffers | Positions/risk factors assessed | Credit risk (provision costs)<br>• Estimated according to Basel III framework.<br>• Credit risk captures all on-balance sheet exposures at amortized cost by sector. Different paths are produced for different sectors.<br>• The starting point of credit parameters is used to project scenario conditional forward paths.<br>Sovereign risk<br>• Mark-to-market valuation of sovereign securities from shocks to interest rates and credit spreads linked to macro scenario.<br>Market risk other than sovereign risk<br>• Market risk is reflected in valuation effects of FVTPL and FVOCI positions.<br>Profits<br>• Net interest income is affected by the change in the reference rate and by the pass-through to asset-side and liability-side interest rates.<br>• Net fee and commission income and other income/expense evolve with macroeconomic conditions and banks' balance sheets. |
| | Behavioral adjustments | • Balance sheet composition remaining constant over the stress test horizon.<br>• There is no recognized interest on non-performing exposures.<br>• Maturing assets are replaced by exposures of the same type and risk.<br>• Statutory tax rates.<br>• DTIs can only accumulate capital through retained earnings.<br>• If DTIs' capital ratio falls below regulatory minimum during the stress test horizon, no prompt corrective action is assumed.<br>• Dividends are linked to DTIs' net profits. Under positive profits, and if the Capital Conservation Buffer (CCoB) is not breached, the dividend payout ratio is set at the ratio observed at the cutoff point (T0). If the CCoB is breached, restrictions on dividend distributions are aligned with the regulatory framework. |
| 5. Regulatory and market-based standards | Calibration of risk parameters | • Scenario dependent forward paths for Point-in-Time (PiT) PDs are estimated for each type of exposure.<br>• For internal ratings-based (IRB) exposures, risk weighted assets are projected on the basis of updated regulatory through-the-cycle PDs |

| Banking Sector: Solvency Test | | |
|---|---|---|
| **Domain** | | **Framework** |
| | | **Top-down by FSAP Team** |
| and parameters | | and downturn LGDs, using appropriate scaling multipliers from the PiT parameters.<br>• For standardized approach (STA) exposures, risk weighted assets are projected based on constant risk weight densities. |
| | Regulatory standards | • In the baseline, hurdles include the regulatory minimum, the CCoB, the D-SIBs surcharge and the Domestic Stability Buffer (DSB). The DSB is not required for Desjardins.<br>• In the adverse scenario, DTIs are allowed to deplete the CCoB and the DSB. Other requirements remain in place.<br>• Hurdle rates are based on common equity tier-1, tier-1, and total capital ratios. |
| 6. Reporting format for results | Output presentation | • Evolution of CET1 for the seven systemic DTIs in aggregate.<br>• Decomposition of key drivers to aggregate net profits and aggregate CET1 capital ratios, including differences between baseline scenarios and adverse scenarios.<br>• Number of DTIs and share of total assets below hurdle rates |
| **Banking Sector: Liquidity Test** | | |
| **Domain** | | **Framework** |
| | | **Top-down by FSAP Team** |
| 1. Institutional perimeter | Institutions included | • Seven systemic DTIs, including Desjardins and six D-SIBs: Royal Bank of Canada, Toronto-Dominion Bank, Bank of Nova Scotia, Bank of Montreal, Canadian Imperial Bank of Commerce, and National Bank of Canada. Royal Bank of Canada and Toronto-Dominion Bank are also considered G-SIBs. |
| | Market share | • The six D-SIBs represent about 93.6 percent of banking sector assets (excluding foreign bank branches).<br>• The seven systemic DTIs represent above 90.2 percent of deposit-taking institutions assets. |
| | Data and baseline date | • Data: Various sources, including the following.<br>○ OSFI: Regulatory returns based on the Liquidity Coverage Ratio (LCR) and Net Cumulative Cash Flow (NCCF) for the 6 D-SIBs.<br>○ AMF: Regulatory returns based on the LCR and the NCCF for Desjardins.<br>• Scope of consolidation: Global consolidated group basis.<br>• Cut-off date: end-October 2024 |

| Banking Sector: Solvency Test | | |
|---|---|---|
| **Domain** | | **Framework** |
| | | **Top-down by FSAP Team** |
| 2. Channels of risk propagation | Methodology | The exercise is based on two types of tests—LCR test and cash-flow analysis.<br>• The LCR test is in line with the standard Basel monitoring tool, featuring total liquidity and liquidity in all significant currencies (Canadian dollar, U.S. dollar, euro, British pound, and Japanese yen). A set of scenarios for LCR outflows and HQLA haircuts is used to produce stressed LCR ratios. The stress test horizon is 30 days.<br>• The cash flow analysis assesses DTIs' liquidity risk using two indicators: the cumulative net funding gap and the counterbalancing capacity. The net funding gap is defined as the difference between cash inflows and outflows in each time bucket, and it is calculated as the sum of these differences across all time buckets within a given horizon.<br>• The counterbalancing capacity refers to the cumulative value of liquid assets that DTIs can liquidate under stress at reasonable prices and is mainly composed of cash resources and securities. A liquidity shortfall arises when a DTI's counterbalancing capacity is insufficient to meet its net funding gap. |
| 3. Risks and buffers | Risks | • Funding liquidity risk is reflected in funding run-off rates.<br>• Market liquidity risk is reflected in asset haircuts, which could be influenced by market movements, potential fire sales and collateral supply considerations. |
| | Behavioral adjustments | • Liquidity from the Bank of Canada's Emergency Lending Assistance (ELA) is not considered. |
| 4. Tail shocks | Scenario analysis | • For the LCR test various scenarios are considered, with varying intensity of adverse liquidity conditions.<br>• For the cash-flow analysis, a total of 20 scenarios are considered, with a range from mild to severely adverse liquidity conditions. The cash-flow analysis considers both funding and market liquidity risks. |
| 5. Regulatory and market-based standards and parameters | Regulatory standards | • The LCR hurdle rate is set at 100 percent at the aggregate currency level (per Basel III) |
| 6. Reporting format for results | Output presentation | • Changes in the system-wide liquidity position, including important drivers for cash outflows, cash inflows, and counterbalancing capacity.<br>• Distribution of DTIs' liquidity positions.<br>• Number of institutions with LCR below 100 percent and/or negative net cash balance. |

| Banking Sector: Solvency Test | |
|---|---|
| **Domain** | **Framework** |
| | **Top-down by FSAP Team** |
| | • Amount of liquidity shortfalls. |
| **Interconnectedness and Contagion Analysis** | |
| Institutions involved | • Confidential interbank exposure data: six D-SIBs and aggregate data for the remaining banks (if available).<br>• Publicly available cross-sectoral and cross-border data: Statistics Canada's financial accounts on a from-whom-to-whom basis. |
| Data and starting position | • Supervisory data: 2024: Q2 (or most recently available). |
| Methodology | • Contagion and interconnectedness Network Analysis: EVS Model, 2010. |
| Risks | • Credit and funding losses related to bilateral exposures, and fire-sale of assets following sizeable withdrawals of deposits.<br>• Cross-border exposures (data permitting). |
| Buffers | • Institution's own capital and liquidity buffers, sector's aggregate capital buffers. |
| Size of shocks | • Default of institutions. |
| Output/Presentation | • Network charts: Economy-wide and inter-financial network based on the exposures.<br>• Entity-level contagion/vulnerability/amplification indices. |
| **Household Sector Vulnerability Analysis** | |
| Objective | • Assess the overall indebtedness in the household sector under FSAP baseline and adverse scenario. Project mortgage PD as input of banking sector stress test. |
| Data | • Vulnerabilities and PD will be assessed using OSFI mortgage loan-level RESL data, September 2023 version, supplemented by the most recent aggregated statistics from Statistics Canada.<br>• Bank-level historical mortgage PD path shared by BOC. |
| Methodology | • The mortgage PD projection follows a two-stage approach, integrating a structural simulation with a Bayesian econometric framework to assess risks under baseline and adverse scenarios.<br>• Stage 1 - Structural Simulation: (1) Baseline Initialization: Update household financial variables to reflect end-2024 conditions based on the realized macroeconomic conditions. (2) Employment Status Simulation: Use a bootstrap approach to model employment evolution, aligning with projected unemployment trends. (3) Income and debt Metrics Update: Adjust income based on employment status and wage growth, feeding into DSR. (4) Aggregation: Repeat the stochastic process across iterations, aggregating results into a debt-weighted PD estimate for projection horizon. |

| | |
|---|---|
| | • Stage 2 – BMA Approach: (1) DSR Anchoring: Aligns projected debt service ratios with end-2024 aggregate statistics from Statistics Canada. (2) Econometric Estimation: Uses a by-bank panel BMA framework to refine PD projections by systematically selecting the most relevant macro-financial predictors.FSAP Systematic Risk workstream also collaborates with Bank of Canada to refine HRAM scenario and leverage its access to household survey data, credit bureau records and tax survey data that FSAP team does not have access obtain estimates BOC's PD path as reference. |
| **Corporate Sector Vulnerability Analysis** | |
| Objective | • Quantify the share of financially weak NFCs and assess the resilience of the corporate sector.<br>• Project PD at both aggregate and industry level as input of banking sector stress test. |
| Data | • Firm-level balance sheet, income statement and credit data from Moody's Orbis and Moody's KMV EDF.<br>• Statistics Canada National Balance Sheet Account for aggregate NFC vulnerability indicator construction.<br>• Overall and industry-level historical corporate PD shared by BOC. |
| Methodology | • Use most recent aggregate statistics from Statistics Canada NBSA for headline corporate sector vulnerability indicators (debt-to-asset ratio, cash-to-debt ratio, debt-to-equity ratio) to assess overall NFC resilience.<br>• Analyze NFC balance sheets by integrating Moody's Orbis firm-level financial data and Moody's KMV 1-year EDF, focusing on leverage (various debt-to-asset measures, equity-to-asset), profitability (EBIT Ratio, ROA, ROE), and liquidity (current ratio, interest coverage ratio, cash buffer) at both aggregate and by firm-size. Identify financially weak firms based on debt-servicing capacity and examine trends in firms-at-risk and debt-at-risk.<br>• Conduct firm-level fixed effects regressions to analyze PD drivers, following the IMF Japan FSAP (2024) approach, and compare aggregate and sectoral results.<br>• Project PDs using historical corporate PDs provided by BOC and macroeconomic scenarios, applying BMA methods from Gross and Población (2019) at both aggregate and industry levels.<br>• Incorporate the most recent trends from FactSet on publicly traded NFCs provided by authorities to complement FSAP assessment based on Moody's Orbis.<br>• Address SME data limitations by using supplementary information provided by authorities, given the lack of aggregate or firm-level SME data to inform vulnerabilities quantitatively with FSAP accessibility. |

| Pension Funds: Solvency Stress Test | | |
|---|---|---|
| | | **Top-down** |
| 1. Institutional perimeter | Number of institutions | 7 Public sector pension plans (Ontario)<br>33 Private sector single-employer and multi-employer pension plans (federal, Ontario) |
| | Market share | ~35 percent, based on assets |
| | Data | Statutory returns |
| | Reference date | June 30, 2024 |
| 2. Channels of risk propagation | Methodology | • Investment assets: market value changes of assets after price shocks<br>• Liabilities: valuation change due to interest rate shock<br>• Impact on net assets (difference between stressed assets and liabilities) and funding ratios |
| | Time horizon | 3 years |
| 3. Scenario analysis | Tail shocks | Adverse scenario: aligned with the macrofinancial scenario, but with more granularity on market and interest rate risks, for example:<br>• Canadian stocks: -17.3 percent (year 1), -18.1 percent (year 2), +14.3 percent (year 3)<br>• Canadian commercial real estate: -14.0 percent (year 1) -5.4 percent (year 2), +7.9 percent (year 3)<br>• Canadian short-term risk-free interest rates: -33 bps (year 1), -80 bps (year 2), -22 bps (year 3)<br>• Canadian short-term risk-free interest rates: +114 bps (year 1), -53 bps (year 2), -133 bps (year 3)<br>• Canadian sovereign bond spreads: +25 bps (year 1), +30 bps (year 2), -39 bps (year 3)<br>• Corporate bond spreads: between +20 bps for AAA-rated and +101 bps for BB and lower (year 1), between +25 bps for AAA-rated and +124 bps for BB and lower (year 2), between -32 bps for AAA-rated and -158 bps for BB and lower (year 3)<br>• Canadian dollar (external value): -4.7 percent (year 1), -4.0 percent (year 2), +3.1 percent (year 3) |
| | Sensitivity analysis | Instantaneous market risk shocks<br>• Stock price decline: -40 percent for ordinary shares, -20 percent for preferred shares<br>• CAD appreciation: +10 percent |

| | | |
|---|---|---|
| 4. Risk factors assessed | | • Market risks (equity, property, FX, alternative assets)<br>• Interest rate risks<br>• Credit risks (sovereign and corporate bond spreads) |
| 5. Regulatory/accounting standards | | Canadian Accounting Standards for Pension Plans (ASPP) |
| 6. Reporting formats for results | Output presentation | • Change in values of assets and liabilities<br>• Funding ratios<br>• Contribution of individual shocks |
| **Pension Funds: Liquidity Risk** | | |
| | | **Bottom-up** |
| 7. Institutional Perimeter | Number of institutions | 10 Public sector pension plans (Ontario, British Columbia, federal, jointly federal-provincial)<br>9 Private sector single-employer pension plans (federal) |
| | Market Share | ~70 percent, based on assets |
| | Data | Data collection from participating pension plans |
| | Reference Date | 30 June 2024 |
| 8. Channels of Risk propagation | Methodology | Combination of interest rate and FX shocks leading to margin calls on pension plans' derivative and other off-balance sheet positions |
| | Time horizon | Up to three days |
| 9. Scenario Analysis | Tail shocks | Instantaneous increase of interest rates (short-term +150 basis points, long-term +50 basis points; for all currencies) and a CAD depreciation (-2.9 percent against USD, and -4.8 percent against EUR) |
| 10. Risk factors assessed | | Short-term liquidity risks |
| 11. Regulatory/accounting standards | | Canadian ASPP |
| 12. Reporting Formats for results | Output presentation | • Amount of margin call (per day)<br>• Share of margin calls which could be met in kind<br>• Liquid assets<br>• Sources of liquidity to meet margin calls |
| **Insurers Solvency Stress Test** | | |
| | | **Top-down** |
| 1. Institutional Perimeter | Number of institutions | ~9 life insurers<br>~17 P&C insurers |

| | | |
|---|---|---|
| | | 3 mortgage insurers |
| | Market Share | Life: ~94 percent, based on balance sheet assets<br>P&C: ~57 percent, based on gross premiums<br>Mortgage: 100 percent, based on gross premiums |
| | Consolidation level | Unconsolidated |
| | Data | Statutory returns |
| | Reference Date | June 30, 2024 |
| 2. Channels of Risk propagation | Methodology | • Investment assets: market value changes of assets after price shocks;<br>• Liabilities: valuation change due to interest rate shock;<br>• Impact on available capital (net assets as the difference between stressed assets and liabilities).<br>• For mortgage insurers: higher claims through heightened defaults on insured mortgage loans |
| | Time horizon | 3 years |
| 3. Scenario Analysis | Tail shocks | Adverse scenario: aligned with the macrofinancial scenario, but with more granularity on market and interest rate risks, for example:<br>• Canadian stocks: -17.3 percent (year 1), -18.1 percent (year 2), +14.3 percent (year 3)<br>• Canadian commercial real estate: -14.0 percent (year 1) -15.4 percent (year 2), +7.9 percent (year 3)<br>• Canadian short-term risk-free interest rates: -33 bps (year 1), -80 bps (year 2), -22 bps (year 3)<br>• Canadian short-term risk-free interest rates: +114 bps (year 1), -53 bps (year 2), -133 bps (year 3)<br>• Canadian sovereign bond spreads: +25 bps (year 1), +30 bps (year 2), -39 bps (year 3)<br>• Corporate bond spreads: between +20 bps for AAA-rated and +101 bps for BB and lower (year 1), between +25 bps for AAA-rated and +124 bps for BB and lower (year 2), between -32 bps for AAA-rated and -158 bps for BB and lower (year 3)<br>• Canadian dollar (external value): -4.7 percent (year 1), -4.0 percent (year 2), +3.1 percent (year 3) |
| 4. Sensitivity analysis | | Instantaneous market risk shocks |

| | | |
|---|---|---|
| | | • Stock price decline: -40 percent for ordinary shares, -20 percent for preferred shares<br>• CAD appreciation: +10 percent |
| 5. Risk factors assessed | | • Market risks (equity, property, FX, alternative assets)<br>• Interest rate risks<br>• Credit risks (sovereign and corporate bond spreads)<br>• For mortgage insurers: credit risks from underwriting business |
| 6. Regulatory/accounting standards | | IFRS 17 |
| 7. Reporting Formats for results | Output presentation | • Change in valuation of assets and liabilities<br>• Solvency ratios;<br>• Aggregated capital shortfall (where applicable);<br>• Dispersion across companies;<br>• Contribution of individual shocks. |
| **Insurers: Liquidity Stress Test** | | |
| | | **Bottom-up** |
| 1. Institutional perimeter | Number of institutions | 3 life insurers |
| | Market share | Life: ~85 percent, based on balance sheet assets |
| | Consolidation level | Unconsolidated |
| | Data | Data collection from participating life insurers |
| | Reference date | June 30, 2024 |
| 2. Channels of risk propagation | Methodology | Combination of interest rate and FX shocks leading to margin calls on insurers' derivative and other off-balance sheet positions |
| | Time horizon | Up to three days |
| 3. Scenario analysis | Tail shocks | • Instantaneous increase of interest rates (short-term +150 basis points, long-term +50 basis points; for all currencies) and a CAD depreciation (-2.9 percent against USD, and -4.8 percent against EUR) |
| 4. Risk factors assessed | | Short-term liquidity risks |
| 5. Regulatory/accounting standards | | IFRS 17 |
| 6. Reporting Formats for results | Output presentation | • Amount of margin call (per day) |

| | | |
|---|---|---|
| | | • Share of margin calls which could be met in kind<br>• Liquid assets<br>• Sources of liquidity to meet margin calls |
| Source: IMF staff. | | |

# Appendix IV. Structural Model for Interest Income

**1. All formulas in the following apply at the DTI-segment level; the notation omits this for brevity.**

The model requires two inputs:

- A repricing ladder at T0, given by the value of exposures in each repricing bucket [$k$,$k$+1] (i.e., exposures with time-to-repricing between $k$ and $k$+1 years), denoted as $E_0^{[k,k+1]}$. The corresponding fraction of total exposures in that bucket is denoted as $\theta_0^{[k,k+1]}$. This is summarized in the following table:

| Repricing Buckets | Value of Exposures | Share of Exposures |
|---|---|---|
| **[0;1] yrs** | $E_0^{[0,1]}$ | $\theta_0^{[0,1]} = E_0^{[0,1]}/E_0$ |
| **[1;2] yrs** | $E_0^{[1,2]}$ | $\theta_0^{[1,2]} = E_0^{[1,2]}/E_0$ |
| **[2;3] yrs** | $E_0^{[2,3]}$ | $\theta_0^{[2,3]} = E_0^{[2,3]}/E_0$ |
| **[3;4] yrs** | $E_0^{[3,4]}$ | $\theta_0^{[3,4]} = E_0^{[3,4]}/E_0$ |

**2. Any exposure with time-to-repricing larger than three years can be allocated to the [3;4] year bucket.** This is without loss of generality because those exposures will not reprice within the three-year stress-testing window.

- Scenario-specific projections for the interest rate on new originations, denoted as $i_t^{NO}$.

The model calculations are conducted in three steps.

**Step 1: Simulate the exposures originated/repriced in each bucket and period**

**3. The model simulates the "law of motion" of exposures across buckets. Consider, for example, the value of exposures in bucket $[k-1,k]$ at the end of year-1.** The exposures in that bucket will correspond either to exposures that at end of year-0 were in bucket $[k, k+1]$ (so one year later they have moved to the bucket with 1-year lower time-to-repricing), or to exposures that have been newly issued/repriced during year-1. The corresponding equation for this is:

$$(1)\quad E_t^{[k-1,k]} = E_{t-1}^{[k,k+1]} + I_t^{[k-1,k]} \; for\; k = 1,2,3$$

Where $I_t^{[k-1,k]}$ are the newly issued/repriced loans in bucket $[k-1,k]$ during year-$t$. In order to pin down the value of $I_t^{[k-1,k]}$, the key assumption is that the shares of exposures across buckets are constant over time. That is,

$$(2)\quad \theta_t^{[k,k+1]} = \theta_0^{[k,k+1]} \; for\; all\; t,k$$

This assumption is consistent with the static balance sheet used throughout the stress test.

**Step 2: Simulate the average interest rate for each bucket and period**

**4. Denote as $i_{t-1}^{[k,k+1]}$ the average interest rate of the exposures that at end of year-($t-1$) were in bucket $[k, k+1]$.** This interest rate can be calculated recursively. From equation (1), $E_t^{[k-1,k]}$ is the sum of the exposures that were in bucket $[k, k+1]$ at end of year-($t-1$) and the newly issued/repriced exposures $I_t^{[k-1,k]}$. Then, it must be that the average interest rate of $E_t^{[k-1,k]}$ is an exposure-weighted average of the respective interest rates of these two terms. That is:

$$(3) \quad i_t^{[k-1,k]} = \delta t i_{t-1}^{[k,k+1]} + (1-\delta t) i_t^{NO} \quad \text{where } \delta_t = \frac{E_{t-1}^{[k,k+1]}}{E_t^{[k-1,k]}}$$

The recursive definition in equation (3) requires an initial condition, $i_0^{[k-1,k]}$. The assumption is that the initial interest rate in all buckets is equal to the average interest rate of the portfolio at T0.

**Step 3: Calculate the interest income**

**5. Consider first the case without NPEs; the interest income is $\widetilde{II}_t$:**

$$(4) \quad \widetilde{II}_t = \sum_{k=1}^{3} i_{t-1}^{[k,k+1]} E_{t-1}^{[k,k+1]} + \frac{1}{2} i_{t-1}^{[0,1]} E_{t-1}^{[0,1]} + \frac{1}{2} i_t^{NO} \left( \sum_{k=0}^{3} I_t^{[k,k+1]} \right)$$

The first term of equation (4) is the interest income from the exposures that at the end of year-($t-1$) had at least 1 year left until repricing, so they earn their "old" interest rate throughout all of year-$t$ (where "old" refers to the same interest rate they had at the end of year-($t-1$)). The second term is the income from the exposures that at the end of year-($t-1$) had less than 1 year left until repricing. The assumption is that these exposures reprice in the midpoint of the year, so they earn the old interest rate for half the year. The last term is the interest income from newly issued/repriced loans, which are assumed to enter the portfolio in the midpoint of the year, so they earn the new interest rate for half the year.

# Appendix V. Liquidity Coverage Ratio-Based Test Scenarios

## Table 1. Canada: Haircuts and Run-off Rates

| | Haircuts | | |
|---|---|---|---|
| | **Regulatory Haircut** | **Haircut 1** | **Haicut 2** |
| **1. Stock of high quality liquid assets (HQLA)** | | | |
| **1.1. Level 1 assets** | | | |
| Coins and banknotes | 1.00 | 1.00 | 1.00 |
| Total central bank reserves; of which: | | | |
| part of central bank reserves that can be drawn in times of stress | 1.00 | 1.00 | 1.00 |
| part of central bank reserves that cannot be drawn in times of stress | | | |
| Securities with a 0% risk weight: | | | |
| issued by sovereigns | 1.00 | 0.95 | 0.90 |
| guaranteed by sovereigns | 1.00 | 0.95 | 0.90 |
| issued or guaranteed by central banks | 1.00 | 0.95 | 0.90 |
| issued or guaranteed by PSEs | 1.00 | 0.95 | 0.90 |
| issued or guaranteed by BIS, IMF, ECB and European Community, or MDBs | 1.00 | 1.00 | 1.00 |
| For non-0% risk-weighted sovereigns: | | | |
| sovereign or central bank debt securities issued in domestic currencies by the sovereign or central bank in the country in which the liquidity risk is being taken or in the bank's home country | 1.00 | 0.95 | 0.90 |
| domestic sovereign or central bank debt securities issued in foreign currencies, up to the amount of the bank's stressed net cash outflows in that specific foreign currency stemming from the bank's operations in the jurisdiction where the bank's liquidity risk is being taken | 1.00 | 0.95 | 0.90 |
| **Total stock of Level 1 assets** | | | |
| Adjustment to stock of Level 1 assets | | | |
| Adjusted amount of Level 1 assets | | | |
| **1.2. Level 2A assets** | | | |
| Securities with a 20% risk weight: | | | |
| issued by sovereigns | 0.85 | 0.80 | 0.75 |
| guaranteed by sovereigns | 0.85 | 0.80 | 0.75 |
| issued or guaranteed by central banks | 0.85 | 0.80 | 0.75 |
| issued or guaranteed by PSEs | 0.85 | 0.80 | 0.75 |
| issued or guaranteed by MDBs | 0.85 | 0.80 | 0.75 |
| Non-financial corporate bonds, rated AA- or better | 0.85 | 0.75 | 0.65 |
| Covered bonds, not self-issued, rated AA- or better | 0.85 | 0.75 | 0.65 |
| **Total stock of Level 2A assets** | | | |
| Adjustment to stock of Level 2A assets | | | |
| Adjusted amount of Level 2A assets | 0.85 | 0.85 | 0.85 |
| **1.3. Level 2B assets** | | | |
| Residential mortgage-backed securities (RMBS), rated AA or better | 0.75 | 0.65 | 0.55 |
| Non-financial corporate bonds, rated BBB- to A+ | 0.50 | 0.40 | 0.30 |
| Non-financial common equity shares | 0.50 | 0.40 | 0.30 |
| Sovereign or central bank debt securities, rated BBB- to BBB+ | 0.50 | 0.40 | 0.30 |
| **Total stock of Level 2B RMBS assets** | 0.75 | 0.70 | 0.60 |
| Adjustment to stock of Level 2B RMBS assets | | | |
| Adjusted amount of Level 2B RMBS assets | 0.75 | 0.65 | 0.55 |
| **Total stock of Level 2B non-RMBS assets** | | | |
| Adjustment to stock of Level 2B non-RMBS assets | | | |
| Adjusted amount of Level 2B non-RMBS assets | 0.50 | 0.50 | 0.50 |
| Adjusted amount of Level 2B (RMBS and non-RMBS) assets | | | |

## Table 1. Canada: Haircuts and Run-off Rates (continued)

| | Run-off Rates | | | |
|---|---|---|---|---|
| | Regulatory | Retail | Wholesale | Combined |
| **2. Net cash outflows** | | | | |
| **2.1. Cash outflows** | | | | |
| **2.1.1. Retail deposit run-off** | | | | |
| Total retail deposits; of which: | | | | |
| Stable deposits; of which: | | | | |
| Insured deposits; of which: | | | | |
| in transactional accounts; of which: | | | | |
| eligible for a 3% run-off rate; of which: | | | | |
| are in Canada | 0.03 | 0.10 | 0.03 | 0.10 |
| are not in Canada | 0.03 | 0.10 | 0.03 | 0.10 |
| eligible for a 5% run-off rate | 0.05 | 0.10 | 0.05 | 0.10 |
| in non-transactional accounts with established relationships that make deposit withdrawal highly unlikely; of which: | | | | |
| eligible for a 3% run-off rate; of which: | | | | |
| are in Canada | 0.03 | 0.10 | 0.03 | 0.10 |
| are not in Canada | 0.03 | 0.10 | 0.03 | 0.10 |
| eligible for a 5% run-off rate | 0.05 | 0.10 | 0.05 | 0.10 |
| Less stable deposits; of which: | | | | |
| Insured deposits in non-transactional and no established relationship accounts | 0.10 | 0.20 | 0.10 | 0.20 |
| Insured deposits received from funds and trusts where the balance is controlled by underlying retail customer | 0.10 | 0.20 | 0.10 | 0.20 |
| Uninsured deposits | 0.10 | 0.20 | 0.10 | 0.20 |
| Deposits denominated in a foreign currency | 0.10 | 0.20 | 0.10 | 0.20 |
| Rate sensitive deposits directly managed by the client - established relationship or deposit in a transactional account | 0.10 | 0.20 | 0.10 | 0.20 |
| Rate sensitive deposits directly managed by the client - no established relationship and not in a transactional account | 0.20 | 0.35 | 0.20 | 0.35 |
| Term deposits managed by an unaffiliated third-party - cashable or maturing in the next 30 days | 0.30 | 0.50 | 0.30 | 0.50 |
| Demand deposits managed by an unaffiliated third-party | 0.40 | 0.65 | 0.40 | 0.65 |
| Less stable retail deposits subject to host jurisdiction requirements | | | | |
| Term deposits with a remaining maturity of >30 days | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total retail deposits run-off** | | | | |
| **2.1.2. Unsecured wholesale funding run-off** | | | | |
| Total unsecured wholesale funding | | | | |
| Total funding provided by small business customers; of which: | | | | |
| Stable deposits; of which: | | | | |
| Insured deposits; of which: | | | | |
| in transactional accounts; of which: | | | | |
| eligible for a 3% run-off rate; of which: | | | | |
| are in Canada | 0.03 | 0.03 | 0.15 | 0.15 |
| are not in Canada | 0.03 | 0.03 | 0.15 | 0.15 |
| eligible for a 5% run-off rate | 0.05 | 0.05 | 0.15 | 0.15 |
| in non-transactional accounts with established relationships that make deposit withdrawal highly unlikely; of which: | | | | |
| eligible for a 3% run-off rate; of which: | | | | |
| are in Canada | 0.03 | 0.03 | 0.15 | 0.15 |
| are not in Canada | 0.03 | 0.03 | 0.15 | 0.15 |
| eligible for a 5% run-off rate | 0.05 | 0.05 | 0.15 | 0.15 |
| Less stable deposits; of which: | | | | |
| in non-transactional and non-relationship accounts | 0.10 | 0.10 | 0.30 | 0.30 |
| Insured deposits received from funds and trusts where the balance is controlled by underlying retail customer | 0.10 | 0.10 | 0.30 | 0.30 |
| Uninsured deposits | 0.10 | 0.10 | 0.30 | 0.30 |
| Deposits denominated in a foreign currency | 0.10 | 0.10 | 0.30 | 0.30 |
| Rate sensitive deposits directly managed by the client - established relationship or deposit in a transactional account | 0.10 | 0.10 | 0.30 | 0.30 |
| Rate sensitive deposits directly managed by the client - no established relationship and not in a transactional account | 0.20 | 0.20 | 0.35 | 0.35 |
| Term deposits managed by an unaffiliated third-party cashable or maturing in the next 30 days | 0.30 | 0.30 | 0.50 | 0.50 |
| Demand deposits managed by unaffiliated third-party | 0.40 | 0.40 | 0.65 | 0.65 |

## Table 1. Canada: Haircuts and Run-off Rates (continued)

| | Regulatory | Retail | Wholesale | Combined |
|---|---|---|---|---|
| Less stable small business deposits subject to host jurisdiction requirements | | | | |
| Term deposits with a remaining maturity of >30 days | 0.00 | 0.00 | 0.00 | 0 |
| Total operational deposits; of which: | | | | |
| provided by non-financial corporates | | | | |
| insured, with a 3% run-off rate | 0.03 | 0.03 | 0.15 | 0.15 |
| insured, with a 5% run-off rate | 0.05 | 0.03 | 0.20 | 0.20 |
| uninsured | 0.25 | 0.25 | 0.40 | 0.40 |
| provided by sovereigns, central banks, PSEs and MDBs | | | | |
| insured, with a 3% run-off rate | 0.03 | 0.03 | 0.15 | 0.15 |
| insured, with a 5% run-off rate | 0.05 | 0.03 | 0.20 | 0.20 |
| uninsured | 0.25 | 0.25 | 0.40 | 0.40 |
| provided by banks | | | | |
| insured, with a 3% run-off rate | 0.03 | 0.03 | 0.15 | 0.15 |
| insured, with a 5% run-off rate | 0.05 | 0.03 | 0.20 | 0.20 |
| uninsured | 0.25 | 0.25 | 0.40 | 0.40 |
| provided by other financial institutions and other legal entities | | | | |
| insured, with a 3% run-off rate | 0.03 | 0.03 | 0.15 | 0.15 |
| insured, with a 5% run-off rate | 0.05 | 0.03 | 0.20 | 0.20 |
| uninsured | 0.25 | 0.25 | 0.45 | 0.45 |
| Total non-operational deposits; of which | | | | |
| provided by non-financial corporates; of which: | | | | |
| where entire amount is fully covered by an effective deposit insurance scheme | 0.20 | 0.20 | 0.40 | 0.40 |
| where entire amount is not fully covered by an effective deposit insurance scheme | 0.40 | 0.40 | 0.60 | 0.60 |
| provided by sovereigns, central banks, PSEs and MDBs; of which: | | | | |
| where entire amount is fully covered by an effective deposit insurance scheme | 0.20 | 0.20 | 0.40 | 0.40 |
| where entire amount is not fully covered by an effective deposit insurance scheme | 0.40 | 0.40 | 0.60 | 0.60 |
| provided by other banks | 1.00 | 1.00 | 1.00 | 1.00 |
| provided by other financial institutions and other legal entities | 1.00 | 1.00 | 1.00 | 1.00 |
| Unsecured debt issuance | 1.00 | 1.00 | 1.00 | 1.00 |
| Additional balances required to be installed in central bank reserves | 1.00 | 1.00 | 1.00 | 1.00 |
| **Total unsecured wholesale funding run-off** | | | | |
| **2.1.3. Secured funding run-off** | | | | |
| | | | | |
| Transactions maturing ≤ 30 days conducted with the bank's domestic central bank; of which: | | | | |
| Backed by Level 1 assets; of which: | | | | |
| Transactions involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions not involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Backed by Level 2A assets; of which: | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions not involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Backed by Level 2B RMBS assets; of which: | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions not involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Backed by Level 2B non-RMBS assets; of which: | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions not involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Backed by other assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions maturing ≤ 30 days not conducted with the bank's domestic central bank and backed by Level 1 assets; of which: | | | | |
| Transactions involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions not involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions maturing ≤ 30 days not conducted with the bank's domestic central bank and backed by Level 2A assets; of which: | | | | |
| Transactions involving eligible liquid assets | 0.15 | 0.15 | 0.15 | 0.15 |
| Transactions not involving eligible liquid assets | 0.15 | 0.15 | 0.15 | 0.15 |
| Transactions maturing ≤ 30 days not conducted with the bank's domestic central bank and backed by Level 2B non-RMBS assets; of which: | | | | |
| Transactions involving eligible liquid assets | 0.25 | 0.25 | 0.25 | 0.25 |
| Transactions not involving eligible liquid assets | 0.25 | 0.25 | 0.25 | 0.25 |

## Table 1. Canada: Haircuts and Run-off Rates (continued)

| | Regulatory | Retail | Wholesale | Combined |
|---|---|---|---|---|
| Transactions maturing ≤ 30 days not conducted with the bank's domestic central bank and backed by Level 2B non-RMBS assets; of which: | | | | |
| Counterparties are domestic sovereigns, MDBs or domestic PSEs with a 20% risk weight; of which: | | | | |
| Transactions involving eligible liquid assets | 0.25 | 0.25 | 0.25 | 0.25 |
| Transactions not involving eligible liquid assets | 0.25 | 0.25 | 0.25 | 0.25 |
| Counterparties are not domestic sovereigns, MDBs or domestic PSEs with a 20% risk weight; of which: | | | | |
| Transactions involving eligible liquid assets | 0.50 | 0.50 | 0.50 | 0.50 |
| Transactions not involving eligible liquid assets | 0.50 | 0.50 | 0.50 | 0.50 |
| Transactions maturing ≤ 30 days not conducted with the bank's domestic central bank and backed by other assets (non-HQLA); of which: | | | | |
| Counterparties are domestic sovereigns, MDBs or domestic PSEs with a 20% risk weight | 0.25 | 0.25 | 0.25 | 0.25 |
| Counterparties are not domestic sovereigns, MDBs or domestic PSEs with a 20% risk weight | 1.00 | 1.00 | 1.00 | 1.00 |
| **Total secured wholesale funding run-off** | | | | |
| **2.1.4. Additional requirements** | | | | |
| | | | | |
| Derivatives cash outflow | 1.00 | 1.00 | 1.00 | 1.00 |
| Increased liquidity needs related to downgrade triggers in derivatives and other financing transactions | 1.00 | 1.00 | 1.00 | 1.00 |
| Increased liquidity needs related to the potential for valuation changes on posted collateral securing derivative and other transactions: | | | | |
| Cash and Level 1 assets | 0.00 | 0.00 | 0.00 | 0.00 |
| For other collateral (ie all non-Level 1 collateral) | 0.20 | 0.20 | 0.20 | 0.20 |
| Increased liquidity needs related to excess non-segregated collateral held by the bank that could contractually be called at any time by the counterparty | 1.00 | 1.00 | 1.00 | 1.00 |
| Increased liquidity needs related to contractually required collateral on transactions for which the counterparty has not yet demanded the collateral be posted | 1.00 | 1.00 | 1.00 | 1.00 |
| Increased liquidity needs related to contracts that allow collateral substitution to non-HQLA assets | 1.00 | 1.00 | 1.00 | 1.00 |
| Increased liquidity needs related to market valuation changes on derivative or other transactions | 1.00 | 1.00 | 1.00 | 1.00 |
| Loss of funding on ABS and other structured financing instruments issued by the bank, excluding covered bonds | 1.00 | 1.00 | 1.00 | 1.00 |
| Loss of funding on covered bonds issued by the bank | 1.00 | 1.00 | 1.00 | 1.00 |
| Loss of funding on ABCP, conduits, SIVs and other such financing activities; of which: | | | | |
| debt maturing ≤ 30 days | 1.00 | 1.00 | 1.00 | 1.00 |
| with embedded options in financing arrangements | 1.00 | 1.00 | 1.00 | 1.00 |
| other potential loss of such funding | 1.00 | 1.00 | 1.00 | 1.00 |
| Undrawn committed credit and liquidity facilities to retail and small business customers | 0.05 | 0.05 | 0.05 | 0.05 |
| Undrawn committed credit facilities to | | | | |
| non-financial corporates | 0.10 | 0.10 | 0.25 | 0.25 |
| sovereigns, central banks, PSEs and MDBs | 0.10 | 0.10 | 0.10 | 0.10 |
| Undrawn committed liquidity facilities to | | | | |
| non-financial corporates | 0.30 | 0.30 | 0.50 | 0.50 |
| sovereigns, central banks, PSEs and MDBs | 0.30 | 0.30 | 0.30 | 0.30 |
| Undrawn committed credit and liquidity facilities provided to banks subject to prudential supervision | 0.40 | 0.40 | 0.40 | 0.40 |
| Undrawn committed credit facilities provided to other Fis | 0.40 | 0.40 | 0.40 | 0.40 |
| Undrawn committed liquidity facilities provided to other Fis | 1.00 | 1.00 | 1.00 | 1.00 |
| Undrawn committed credit and liquidity facilities to other legal entities | 1.00 | 1.00 | 1.00 | 1.00 |
| | | | | |
| **Other contractual obligations to extend funds to** | | | | |
| financial institutions | 1.00 | 1.00 | 1.00 | 1.00 |
| retail clients | | | | |
| small business customers | | | | |
| non-financial corporates | | | | |
| other clients | | | | |
| retail, small business customers, non-financials and other clients | 1.00 | 1.00 | 1.00 | 1.00 |
| **Total contractual obligations to extend funds in excess of 50% roll-over assumption** | | | | |

## Table 1. Canada: Haircuts and Run-off Rates (continued)

| | Regulatory | Retail | Wholesale | Combined |
|---|---|---|---|---|
| **Other contingent funding obligations** | | | | |
| Non-contractual obligations related to potential liquidity draws from joint ventures or minority investments in entities | 1.00 | 1.00 | 1.00 | 1.00 |
| Unconditionally revocable "uncommitted" credit and liquidity facilities provided to retail and small business customers | 0.02 | 0.05 | 0.02 | 0.05 |
| Unconditionally revocable "uncommitted" credit and liquidity facilities provided to all other customers | 0.05 | 0.05 | 0.10 | 0.10 |
| Trade finance-related obligations (including guarantees and letters of credit) | 0.03 | 0.03 | 0.03 | 0.03 |
| Guarantees and letters of credit unrelated to trade finance obligations | 0.05 | 0.10 | 0.05 | 0.10 |
| Non-contractual obligations: | | | | |
| Debt-buy back requests (incl related conduits) | 0.00 | 0.00 | 0.00 | 0.00 |
| Structured products | 0.05 | 0.05 | 0.05 | 0.05 |
| Managed funds | 0.00 | 0.00 | 0.00 | 0.00 |
| Other non-contractual obligations | 0.05 | 0.05 | 0.05 | 0.05 |
| Outstanding debt securities with remaining maturity > 30 days | 0.00 | 0.00 | 0.00 | 0.00 |
| Non contractual obligations where customer short positions are covered by other customers' collateral | 0.50 | 0.75 | 0.50 | 0.75 |
| Bank outright short positions covered by a collateralised securities financing transaction | 0.00 | 0.00 | 0.00 | 0.00 |
| Other contractual cash outflows (including those related to unsecured collateral borrowings and uncovered short positions) | 1.00 | 1.00 | 1.00 | 1.00 |
| **Total run-off on other contingent funding obligations** | | | | |
| **2.1.5. Total cash outflows** | | | | |
| Total cash outlfows | | | | |
| **2.2. Cash inflows** | | | | |
| Is reporting institution an indirect clearer that is not a subsidiary of an OSFI or provincially-regulated direct clearer? | | | | |
| **2.2.1. Secured lending including reverse repo and securities borrowing** | | | | |
| Reverse repo and other secured lending or securities borrowing transactions maturing ≤ 30 days | | | | |
| Of which collateral is not re-used (ie is not rehypothecated) to cover the reporting institution's outright short positions | | | | |
| Transactions backed by Level 1 assets; of which: | | | | |
| Transactions involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions not involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions backed by Level 2A assets; of which: | | | | |
| Transactions involving eligible liquid assets | 0.15 | 0.15 | 0.15 | 0.15 |
| Transactions not involving eligible liquid assets | 0.15 | 0.15 | 0.15 | 0.15 |
| Transactions backed by Level 2B RMBS assets; of which: | | | | |
| Transactions involving eligible liquid assets | 0.25 | 0.25 | 0.25 | 0.25 |
| Transactions not involving eligible liquid assets | 0.25 | 0.25 | 0.25 | 0.25 |
| Transactions backed by Level 2B non-RMBS assets; of which: | | | | |
| Transactions involving eligible liquid assets | 0.50 | 0.50 | 0.50 | 0.50 |
| Transactions not involving eligible liquid assets | 0.50 | 0.50 | 0.50 | 0.50 |
| Margin lending backed by non-Level 1 or non-Level 2 collateral | 0.50 | 0.50 | 0.50 | 0.50 |
| Transactions backed by other collateral | 1.00 | 1.00 | 1.00 | 1.00 |
| Of which collateral is re-used (ie is rehypothecated) in transactions to cover the reporting insitution's outright short positions | | | | |
| Transactions backed by Level 1 assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions backed by Level 2A assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions backed by Level 2B RMBS assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions backed by Level 2B non-RMBS assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Margin lending backed by non-Level 1 or non-Level 2 collateral | 0.00 | 0.00 | 0.00 | 0.00 |
| Transactions backed by other collateral | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total inflows on reverse repo and securities borrowing transactions** | | | | |
| **2.2.2. Other inflows by counterparty** | | | | |
| Contractual inflows due in ≤ 30 days from fully performing loans, not reported as secured lending, from: | | | | |
| Retail customers | 0.50 | 0.50 | 0.50 | 0.50 |
| Small business customers | 0.50 | 0.50 | 0.50 | 0.50 |
| Non-financial corporates | 0.50 | 0.50 | 0.50 | 0.50 |
| Central banks | 1.00 | 1.00 | 1.00 | 1.00 |

## Table 1. Canada: Haircuts and Run-off Rates (continued)

| | Regulatory | Retail | Wholesale | Combined |
|---|---|---|---|---|
| Financial institutions, of which | | | | |
| operational deposits related to clearing activities placed by indirect clearers with an OSFI or provincially-regulated direct clearer | 0.25 | 0.25 | 0.25 | 0.25 |
| other operational deposits | 0.00 | 0.00 | 0.00 | 0.00 |
| all payments on other loans and deposits due in ≤ 30 days | 1.00 | 1.00 | 1.00 | 1.00 |
| Other entities | 0.50 | 0.50 | 0.50 | 0.50 |
| **Total of other inflows by counterparty** | | | | |
| **2.2.3. Other cash inflows** | | | | |
| Other cash inflows | | | | |
| Derivatives cash inflow | 1.00 | 1.00 | 1.00 | 1.00 |
| Contractual inflows from securities maturing ≤ 30 days, not included anywhere above | 1.00 | 1.00 | 1.00 | 1.00 |
| Other contractual cash inflows | 1.00 | 1.00 | 1.00 | 1.00 |
| **Total of other cash inflows** | | | | |
| **2.2.4. Total cash inflows** | | | | |
| Total cash inflows before applying the cap | | | | |
| Cap on cash inflows | 0.75 | 0.75 | 0.75 | 0.75 |
| Total cash inflows after applying the cap | | | | |
| **3. Collateral swaps** | | | | |
| Collateral swaps maturing ≤ 30 days: | | | | |
| Of which the borrowed assets are not re-used (ie are not rehypothecated) to cover short positions | | | | |
| Level 1 assets are lent and Level 1 assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Not involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Level 1 assets are lent and Level 2A assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | | | | |
| Not involving eligible liquid assets | | | | |
| Level 1 assets are lent and Level 2B RMBS assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | | | | |
| Not involving eligible liquid assets | | | | |
| Level 1 assets are lent and Level 2B non-RMBS assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | | | | |
| Not involving eligible liquid assets | | | | |
| Level 1 assets are lent and other assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | | | | |
| Not involving eligible liquid assets | | | | |
| Level 2A assets are lent and Level 1 assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | 0.15 | 0.15 | 0.15 | 0.15 |
| Not involving eligible liquid assets | 0.15 | 0.15 | 0.15 | 0.15 |
| Level 2A assets are lent and Level 2A assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Not involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Level 2A assets are lent and Level 2B RMBS assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | | | | |
| Not involving eligible liquid assets | | | | |
| Level 2A assets are lent and Level 2B non-RMBS assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | | | | |
| Not involving eligible liquid assets | | | | |
| Level 2A assets are lent and other assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | | | | |
| Not involving eligible liquid assets | | | | |
| Level 2B RMBS assets are lent and Level 1 assets are borrowed; of which: | | | | |

## Table 1. Canada: Haircuts and Run-off Rates (concluded)

| | Regulatory | Retail | Wholesale | Combined |
|---|---|---|---|---|
| Involving eligible liquid assets | 0.25 | 0.25 | 0.25 | 0.25 |
| Not involving eligible liquid assets | 0.25 | 0.25 | 0.25 | 0.25 |
| Level 2B RMBS assets are lent and Level 2A assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | 0.10 | 0.10 | 0.10 | 0.10 |
| Not involving eligible liquid assets | 0.10 | 0.10 | 0.10 | 0.10 |
| Level 2B RMBS assets are lent and Level 2B RMBS assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Not involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Involving eligible liquid assets | 0.50 | 0.50 | 0.50 | 0.50 |
| Not involving eligible liquid assets | 0.50 | 0.50 | 0.50 | 0.50 |
| Level 2B non-RMBS assets are lent and Level 2A assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | 0.35 | 0.35 | 0.35 | 0.35 |
| Not involving eligible liquid assets | 0.35 | 0.35 | 0.35 | 0.35 |
| Level 2B non-RMBS assets are lent and Level 2B RMBS assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | 0.25 | 0.25 | 0.25 | 0.25 |
| Not involving eligible liquid assets | 0.25 | 0.25 | 0.25 | 0.25 |
| Level 2B non-RMBS assets are lent and Level 2B non-RMBS assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Not involving eligible liquid assets | 0.00 | 0.00 | 0.00 | 0.00 |
| Involving eligible liquid assets | 1.00 | 1.00 | 1.00 | 1.00 |
| Not involving eligible liquid assets | 1.00 | 1.00 | 1.00 | 1.00 |
| Other assets are lent and Level 2A assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | 0.85 | 0.85 | 0.85 | 0.85 |
| Not involving eligible liquid assets | 0.85 | 0.85 | 0.85 | 0.85 |
| Other assets are lent and Level 2B RMBS assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | 0.75 | 0.75 | 0.75 | 0.75 |
| Not involving eligible liquid assets | 0.75 | 0.75 | 0.75 | 0.75 |
| Other assets are lent and Level 2B non-RMBS assets are borrowed; of which: | | | | |
| Involving eligible liquid assets | 0.50 | 0.50 | 0.50 | 0.50 |
| Not involving eligible liquid assets | 0.50 | 0.50 | 0.50 | 0.50 |
| Other assets are lent and other assets are borrowed | 0.00 | 0.00 | 0.00 | 0.00 |
| Of which the borrowed assets are re-used (ie are rehypothecated) in transactions to cover short positions | | | | |
| Level 1 assets are lent and Level 1 assets are borrowed | 0.00 | 0.00 | 0.00 | 0.00 |
| Level 2A assets are lent and Level 1 assets are borrowed | 0.15 | 0.15 | 0.15 | 0.15 |
| Level 2A assets are lent and Level 2A assets are borrowed | 0.00 | 0.00 | 0.00 | 0.00 |
| Level 2A assets are lent and Level 2B RMBS assets are borrowed | | | | |
| Level 2A assets are lent and Level 2B non-RMBS assets are borrowed | | | | |
| Level 2A assets are lent and other assets are borrowed | | | | |
| Level 2B RMBS assets are lent and Level 1 assets are borrowed | 0.25 | 0.25 | 0.25 | 0.25 |
| Level 2B RMBS assets are lent and Level 2A assets are borrowed | 0.10 | 0.10 | 0.10 | 0.10 |
| Level 2B RMBS assets are lent and Level 2B RMBS assets are borrowed | 0.00 | 0.00 | 0.00 | 0.00 |
| Level 2B RMBS assets are lent and Level 2B non-RMBS assets are borrowed | | | | |
| Level 2B RMBS assets are lent and other assets are borrowed | | | | |
| Level 2B non-RMBS assets are lent and Level 1 assets are borrowed | 0.50 | 0.50 | 0.50 | 0.50 |
| Level 2B non-RMBS assets are lent and Level 2A assets are borrowed | 0.35 | 0.35 | 0.35 | 0.35 |
| Level 2B non-RMBS assets are lent and Level 2B RMBS assets are borrowed | 0.25 | 0.25 | 0.25 | 0.25 |
| Level 2B non-RMBS assets are lent and Level 2B non-RMBS assets are borrowed | 0.00 | 0.00 | 0.00 | 0.00 |
| Level 2B non-RMBS assets are lent and other assets are borrowed | | | | |
| Other assets are lent and Level 1 assets are borrowed | 1.00 | 1.00 | 1.00 | 1.00 |
| Other assets are lent and Level 2A assets are borrowed | 0.85 | 0.85 | 0.85 | 0.85 |
| Other assets are lent and Level 2B RMBS assets are borrowed | 0.75 | 0.75 | 0.75 | 0.75 |
| Other assets are lent and Level 2B non-RMBS assets are borrowed | 0.50 | 0.50 | 0.50 | 0.50 |
| Other assets are lent and other assets are borrowed | 0.00 | 0.00 | 0.00 | 0.00 |

Sources: OSFI, AMF, and IMF staff calculations.

# Appendix VI. Cash Flow Analysis Scenarios

## Table 1. Canada: Run-off Rates

| | Run-off Rates | | | |
|---|---|---|---|---|
| | Mild Scenario | | Severe Scenario | |
| | Weeks 1-4 | Month 2-12 | Weeks 1-4 | Month 2-12 |
| **Deposits** | | | | |
| **Retail and Small Business (RSB) Demand / Notice Deposits** | | | | |
| RSB Type 1 insured, stable demand deposits | 0.25% | 0.75% | 1.00% | 2.00% |
| RSB Type 2 insured, stable demand deposits | 0.75% | 0.75% | 1.75% | 2.50% |
| RSB Insured, less stable demand deposits | 1.00% | 1.50% | 2.00% | 3.50% |
| RSB managed by an unaffiliated third-party, demand deposits | 3.50% | 5.00% | 8.00% | 12.00% |
| RSB Uninsured demand deposits | 1.00% | 1.50% | 2.00% | 3.75% |
| RSB Rate sensitive deposits directly managed by the client - established relationship or deposit in a transactional account | 1.00% | 1.50% | 2.00% | 3.75% |
| RSB Rate sensitive deposits directly managed by the client - no established relationship and not in a transactional account | 2.00% | 1.50% | 4.00% | 4.00% |
| **Retail and Small Business Term Deposits** | | | | |
| **RSB Cashable Term Deposits** | | | | |
| RSB Type 1 insured, stable, cashable term deposit | 0.25% | 0.75% | 1.00% | 2.00% |
| RSB Type 1 insured, less stable, cashable term deposit | 1.00% | 1.50% | 2.00% | 3.50% |
| RSB Type 2 insured, stable, cashable term deposit | 0.75% | 0.75% | 1.75% | 2.50% |
| RSB Type 2 insured, less stable, cashable term deposit | 1.00% | 1.50% | 2.00% | 3.50% |
| RSB Uninsured cashable term deposit | 1.00% | 1.75% | 2.00% | 3.75% |
| RSB managed by an unaffiliated third-party, cashable term deposit | 1.75% | 3.50% | 5.50% | 8.50% |
| **RSB Fixed Term Deposits - Type 1, insured, stable** | | | | |
| RSB Type 1 insured, stable, fixed term (30-day) deposit | 0.25% | 0.50% | 0.75% | 1.50% |
| RSB Type 1 insured, stable, fixed term (60-day) deposit | 0.25% | 0.50% | 0.75% | 1.50% |
| RSB Type 1 insured, stable, fixed term (90-day) deposit | 0.25% | 0.50% | 0.75% | 1.50% |
| RSB Type 1 insured, stable, fixed term (180-day) deposit | 0.25% | 0.50% | 0.75% | 1.50% |
| RSB Type 1 insured, stable, fixed term (1 year) deposit | 0.25% | 0.50% | 0.75% | 1.50% |
| RSB Type 1 insured, stable, fixed term (>1 year) deposit | 0.25% | 0.50% | 0.75% | 1.50% |
| **RSB Fixed Term Deposits - Type 1, insured, less stable** | | | | |
| RSB Type 1 insured, less stable, fixed term (30-day) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| RSB Type 1 insured, less stable, fixed term (60-day) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| RSB Type 1 insured, less stable, fixed term (90-day) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| RSB Type 1 insured, less stable, fixed term (180-day) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| RSB Type 1 insured, less stable, fixed term (1 year) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| RSB Type 1 insured, less stable, fixed term (>1 year) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| **RSB Fixed Term Deposits - Type 2, insured, stable** | | | | |
| RSB Type 2 insured, stable, fixed term (30-day) deposit | 0.50% | 0.50% | 1.25% | 1.50% |
| RSB Type 2 insured, stable, fixed term (60-day) deposit | 0.50% | 0.50% | 1.25% | 1.50% |
| RSB Type 2 insured, stable, fixed term (90-day) deposit | 0.50% | 0.50% | 1.25% | 1.50% |
| RSB Type 2 insured, stable, fixed term (180-day) deposit | 0.50% | 0.50% | 1.25% | 1.50% |
| RSB Type 2 insured, stable, fixed term (1 year) deposit | 0.50% | 0.50% | 1.25% | 1.50% |
| RSB Type 2 insured, stable, fixed term (>1 year) deposit | 0.50% | 0.50% | 1.25% | 1.50% |
| **RSB Fixed Term Deposits - Type 2, insured, less stable** | | | | |
| RSB Type 2 insured, less stable, fixed term (30-day) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| RSB Type 2 insured, less stable, fixed term (60-day) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| RSB Type 2 insured, less stable, fixed term (90-day) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| RSB Type 2 insured, less stable, fixed term (180-day) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| RSB Type 2 insured, less stable, fixed term (1 year) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| RSB Type 2 insured, less stable, fixed term (>1 year) deposit | 0.50% | 0.75% | 1.75% | 3.50% |
| **RSB Fixed Term Deposits - Uninsured** | | | | |
| RSB Uninsured, fixed term (30-day) deposit | 0.75% | 1.50% | 1.75% | 4.50% |
| RSB Uninsured, fixed term (60-day) deposit | 0.75% | 1.50% | 1.75% | 4.50% |
| RSB Uninsured, fixed term (90-day) deposit | 0.75% | 1.50% | 1.75% | 4.50% |
| RSB Uninsured, fixed term (180-day) deposit | 0.75% | 1.50% | 1.75% | 4.50% |
| RSB Uninsured, fixed term (1 year) deposit | 0.75% | 1.50% | 1.75% | 4.50% |
| RSB Uninsured, fixed term (>1 year) deposit | 0.75% | 1.50% | 1.75% | 4.50% |
| **RSB Fixed Term Deposits - managed by an Unaffiliated third-party sourced** | | | | |
| RSB managed by an Unaffiliated third-party sourced, fixed term (30-day) deposit | 1.75% | 3.50% | 5.50% | 8.50% |
| RSB managed by an Unaffiliated third-party sourced, fixed term (60-day) deposit | 1.75% | 3.50% | 5.50% | 8.50% |
| RSB managed by an Unaffiliated third-party sourced, fixed term (90-day) deposit | 1.75% | 3.50% | 5.50% | 8.50% |
| RSB managed by an Unaffiliated third-party sourced, fixed term (180-day) deposit | 1.75% | 3.50% | 5.50% | 8.50% |
| RSB managed by an Unaffiliated third-party sourced, fixed term (1 year) deposit | 1.75% | 3.50% | 5.50% | 8.50% |
| RSB managed by an Unaffiliated third-party sourced, fixed term (>1 year) deposit | 1.75% | 3.50% | 5.50% | 8.50% |

## Table 1. Canada: Run-off Rates (concluded)

| | Run-off Rates | | | |
|---|---|---|---|---|
| | Mild Scenario | | Severe Scenario | |
| **Commercial, Corporate and Wholesale Deposits** | | | | |
| CommCorp and Wholesale Demand/Notice Deposits (Original Term ≤30 Days) - Operational | | | | |
| Insured, within approved jurisdiction | 0.75% | 3.00% | 3.50% | 7.00% |
| Insured, outside of approved jurisdiction | 1.25% | 3.25% | 3.75% | 7.50% |
| Not Insured | 2.50% | 3.25% | 4.00% | 7.50% |
| CommCorp and Wholesale Demand/Notice Deposits (Original Term ≤30 Days) - Non-Operational | | | | |
| Insured (FI) | 7.50% | | 25.00% | |
| Uninsured (FI) | 12.50% | | 25.00% | |
| Insured (Corp, Sovereigns, central banks, PSE, MDB) | 3.00% | 5.50% | 7.00% | 8.50% |
| Uninsured (Corp, Sovereigns, central banks, PSE, MDB) | 3.00% | 12.00% | 6.00% | 15.50% |
| CommCorp and Wholesale Notice Deposits, where withdrawal notification has been provided - | | | | |
| CommCorp and Wholesale Notice, where withdrawal notification has been provided | 100.00% | 100.00% | 100.00% | 100.00% |
| CommCorp and Wholesale Notice Deposits (original term >30 days) - Operational & Non-Operational | | | | |
| CommCorp Notice | 20.00% | 20.00% | 50.00% | 50.00% |
| Wholesale Notice (Sovereigns, central banks, PSE, MDB) | 20.00% | 20.00% | 50.00% | 50.00% |
| Wholesale Notice (All other counterparties, including other FIs and other legal entities) | 100.00% | 100.00% | 100.00% | 100.00% |
| CommCorp and Wholesale Term Deposits | | | | |
| CommCorp Non-Operational Term | 20.00% | 20.00% | 50.00% | 50.00% |
| Wholesale Term (Sovereigns, central banks, PSE, MDB) | 20.00% | 20.00% | 50.00% | 50.00% |
| Wholesale Term (All other counterparties, including other FIs and other legal entities) | 100.00% | 100.00% | 100.00% | 100.00% |

Source: IMF staff calculations.

## Table 2. Canada: Haircuts

| Securities | Haircut | |
|---|---|---|
| | Mild | Severe |
| **Government Securities** | | |
| High Rated Government Securities | | |
| Sovereign & Central Bank Government Securities (High rated) | 0.5% | 20.0% |
| State, Provincial & Agency Government Securities (High rated) | 1.5% | 40.0% |
| State Municipal Government Securities (High rated) | 5.0% | 60.0% |
| Supranational and Multilateral Development Bank Government Securities (High rated) | 5.0% | 32.0% |
| Medium Rated Government Securities | | |
| Sovereign & Central Bank Government Securities (Medium rated) | 10.0% | 30.0% |
| State, Provincial & Agency Government Securities (Medium rated) | 13.0% | 100.0% |
| State Municipal Government Securities (Medium rated) | 20.0% | 100.0% |
| Supranational and Multilateral Development Bank Government Securities (Medium rated) | 10.0% | 100.0% |
| Low/Not Rated Government Securities | | |
| Sovereign & Central Bank Government Securities (Low/not rated) | 40.0% | 100.0% |
| State, Provincial & Agency Government Securities (Low/not rated) | 100.0% | 100.0% |
| State Municipal Government Securities (Low/not rated) | 100.0% | 100.0% |
| Supranational and Multilateral Development Bank Government Securities (Low/not rated) | 100.0% | 100.0% |
| **Mortgage Backed Securities (MBS)** | | |
| Agency MBS | | |
| Agency MBS (High rated) | 4.0% | 15.0% |
| Agency MBS (Medium rated) | 100.0% | 100.0% |
| Agency MBS (Low/not rated) | 100.0% | 100.0% |
| Non-Agency Commercial MBS (CMBS) | | |
| Non-Agency CMBS (High rated) | 20.0% | 100.0% |
| Non-Agency CMBS Medium rated) | 100.0% | 100.0% |
| Non-Agency CMBS (Low/not rated) | 100.0% | 100.0% |
| Non-Agency Residential MBS (RMBS) | | |
| Non-Agency RMBS (High rated) | 20.0% | 100.0% |
| Non-Agency RMBS (Medium rated) | 100.0% | 100.0% |
| Non-Agency RMBS (Low/not rated) | 100.0% | 100.0% |
| **Corporate Bonds and Paper** | | |
| Non-FI Issued Corporate Bonds and Paper (High rated) | | |
| Non-FI issued unsecured bonds and paper (High rated) | 5.0% | 60.0% |
| Non-FI issued covered bonds (High rated) | 5.0% | 40.0% |
| FI Issued Corporate Bonds and Paper (High rated) | | |
| FI issued unsecured bonds and paper (High rated) | 9.0% | 80.0% |
| FI issued covered bonds (High rated) | 9.0% | 70.0% |
| FI issued jumbo covered bonds (High rated) | 10.0% | 100.0% |
| Non-FI Issued Corporate Bonds and Paper (Medium rated) | | |
| Non-FI issued unsecured bonds and paper (Medium rated) | 10.0% | 70.0% |
| Non-FI issued covered bonds (Medium rated) | 10.0% | 50.0% |
| FI Issued Corporate Bonds and Paper (Medium rated) | | |
| FI issued unsecured bonds and paper (Medium rated) | 11.0% | 100.0% |
| FI issued covered bonds (Medium rated) | 11.0% | 80.0% |
| FI issued jumbo covered bonds (Medium rated) | 40.0% | 100.0% |
| Non-FI Issued Corporate Bonds and Paper (Low/not rated) | | |
| Non-FI issued unsecured bonds and paper (Low/not rated) | 60.0% | 100.0% |
| Non-FI issued covered bonds (Low/not rated) | 40.0% | 100.0% |
| FI Issued Corporate Bonds and Paper (Low/not rated) | | |
| FI issued unsecured bonds and paper (Low/not rated) | 100.0% | 100.0% |
| FI issued covered bonds (Low/not rated) | 60.0% | 100.0% |
| FI issued jumbo covered bonds (Low/not rated) | 60.0% | 100.0% |

## Table 2. Canada: Haircuts (concluded)

| | Haircut | |
|---|---|---|
| **Securities** | **Mild** | **Severe** |
| **Asset Backed Securities (ABS) and Asset Backed Commercial Paper (ABCP)** | | |
| Non-FI Issued ABS and ABCP (High rated) | | |
| Non-FI Issued ABS (High rated) | 10.0% | 100.0% |
| Non-FI Issued ABCP (High rated) | 7.5% | 40.0% |
| FI Issued ABS and ABCP (High rated) | | |
| FI Issued ABS (High rated) | 2.0% | 100.0% |
| FI Issued ABCP (High rated) | 7.5% | 80.0% |
| Non-FI Issued ABS and ABCP (Medium rated) | | |
| Non-FI Issued ABS (Medium rated) | 40.0% | 100.0% |
| Non-FI Issued ABCP (Medium rated) | 40.0% | 100.0% |
| FI Issued ABS and ABCP (Medium rated) | | |
| FI Issued ABS (Medium rated) | 60.0% | 100.0% |
| FI Issued ABCP (Medium rated) | 60.0% | 100.0% |
| Non-FI Issued ABS and ABCP (Low/not rated) | | |
| Non-FI Issued ABS (Low/not rated) | 70.0% | 100.0% |
| Non-FI Issued ABCP (Low/not rated) | 70.0% | 100.0% |
| FI Issued ABS and ABCP (Low/not rated) | | |
| FI Issued ABS (Low/not rated) | 100.0% | 100.0% |
| FI Issued ABCP (Low/not rated) | 100.0% | 100.0% |
| **Bank's Own Securities - Not Eliminated** | | |
| Bank's own debt not eliminated | 100.0% | 100.0% |
| Bank's own equity not eliminated | 100.0% | 100.0% |

Source: OSFI and IMF staff calculations.

## Table 3. Canada: Draws on Commitments

| | Draws on Commitments | |
|---|---|---|
| **Off-Balance Sheet Items** | **Mild** | **Severe** |
| **Commitments** | | |
| **Undrawn amounts related to credit and liquidity facilities to retail and small business customers** | | |
| HELOCs | 2.00% | 10.00% |
| Credit Cards; of which to transactors | 0.00% | 4.00% |
| Credit Cards; of which to non-transactors | 1.00% | 5.00% |
| Other lines of credit; of which transactors | 0.00% | 4.00% |
| Other lines of credit; of which uncommitted to non-transactors | 1.00% | 5.00% |
| Other lines of credit; of which committed to non-transactors | 2.50% | 7.50% |
| Other; of which uncommitted | 1.00% | 5.00% |
| Other; of which committed | 2.50% | 7.50% |
| **Undrawn amounts related to committed credit facilities to other customers** | | |
| Committed credit facilities to non-financial corporates; of which: NIG; no operational relationship | 7.50% | 22.50% |
| Committed credit facilities to non-financial corporates; of which: IG; no operational relationship | 7.50% | 22.50% |
| Committed credit facilities to non-financial corporates; of which: NIG; existing operational relationship | 2.50% | 7.50% |
| Committed credit facilities to non-financial corporates; of which: IG; existing operational relationship | 2.50% | 7.50% |
| Committed credit facilities to sovereigns, central banks, PSEs and MDBs | 5.00% | 15.00% |
| Committed credit facilities to banks subject to prudential supervision | 20.00% | 60.00% |
| Committed credit facilities to other financial institutions | 20.00% | 60.00% |
| Committed credit facilities to other legal entities | 100.00% | 100.00% |
| **Undrawn amounts related to committed credit facilities to commercial clients** | | |
| Committed credit facilities to commercial clients; no operational relationship | 5.00% | 15.00% |
| Committed credit facilities to commercial clients; existing operational relationship | 2.50% | 7.50% |
| **Undrawn amounts related to uncommitted credit facilities to other customers** | | |
| Uncommitted credit facilities to non-financial corporates | 2.50% | 7.50% |
| Uncommitted credit facilities to sovereigns, central banks, PSEs and MDBs | 2.50% | 7.50% |
| Uncommitted credit facilities to banks subject to prudential supervision | 2.50% | 7.50% |
| Uncommitted credit facilities to other financial institutions | 2.50% | 7.50% |
| Uncommitted credit facilities to other legal entities | 2.50% | 7.50% |
| **Undrawn amounts related to liquidity facilities to ABCPs** | | |
| Committed liquidity facilities to ABCPs - Maturing Balance | 100.00% | 100.00% |
| Committed liquidity facilities to Unissued ABCPs (reported recognizing notice periods) | 100.00% | 100.00% |
| **Undrawn amounts related to liquidity facilities to other customers** | | |
| Committed liquidity facilities to non-financial corporate clients | 15.00% | 45.00% |
| Committed liquidity facilities to sovereigns, central banks, PSEs and MDBs | 15.00% | 45.00% |
| Committed liquidity facilities to banks subject to prudential supervision | 20.00% | 60.00% |
| Committed liquidity facilities to other financial institutions | 100.00% | 100.00% |
| Committed liquidity facilities to VIEs | 100.00% | 100.00% |
| Committed liquidity facilities to other legal entities | 100.00% | 100.00% |
| Uncommitted liquidity facilities | 4.00% | 15.00% |
| **Contingent funding obligations** | | |
| Trade finance-related obligations (including guarantees and letters of credit) | 1.50% | 4.50% |
| Guarantees and letters of credit unrelated to trade finance obligations | 2.50% | 7.50% |
| **Funding guarantees** | | |
| Funding guarantees to subsidiaries | 100.00% | 100.00% |

Source: OSFI and IMF staff calculations.

# Appendix VII. Household Analysis Methodology

**1. This appendix outlines the methodology employed for processing and filtering OSFI loan-level data, as well as the simulation approach used to project PD under FSAP overarching macroeconomic scenarios.** The methodology aligns recent FSAP practices, as in Integrated Dynamic Household Balance Sheet Model (Gross and Población, 2017; Gross et al. 2022), but tailored to OSFI RESL loan-level data structure and variable availability of FSAP team.

## A. Data Processing and Filtering

**2. The dataset used in this analysis is drawn from the September 2023 version of the RESL database, covering a total of 9.1 million loan observations across multiple loan types.** To ensure a focused analysis on household mortgage debt, the dataset was filtered to retain only mortgage-related loans, including standalone mortgage loans and mortgage components within combined loan plan (CLP). This filtering process resulted in a final sample of 2.8 million mortgage loan observations, forming the basis for subsequent analysis.

**3. Employment status was an important criterion for this analysis, as it plays a central role in determining borrowers' ability to service debt and highly correlates with historical mortgage arrear rates.**

- We include the primary sample that includes borrowers employed on a full-time salaried basis, which comprises 48 percent of the dataset. We also include individuals engaged in part-time, hourly, seasonal, contract-based, and self-employed work, as well as those unemployed at the time of origination, were included, bringing the total sample coverage to 59.1 percent.[1]

- Certain categories were excluded due to their limited reliance on wage-based income or their distinctive financial characteristics. Specifically, homemakers (0.2 percent), investors (0.2 percent), and students (0.1 percent) were removed from the sample, while individuals categorized as "Other" (34.5 percent) were also excluded due to the uncertain heterogeneous nature of this group for our modeling purpose.

- Retirees and pensioners, representing 6.1 percent of the dataset, were initially excluded but later tested as robustness checks to assess borrowing and repayment dynamics among older cohorts.

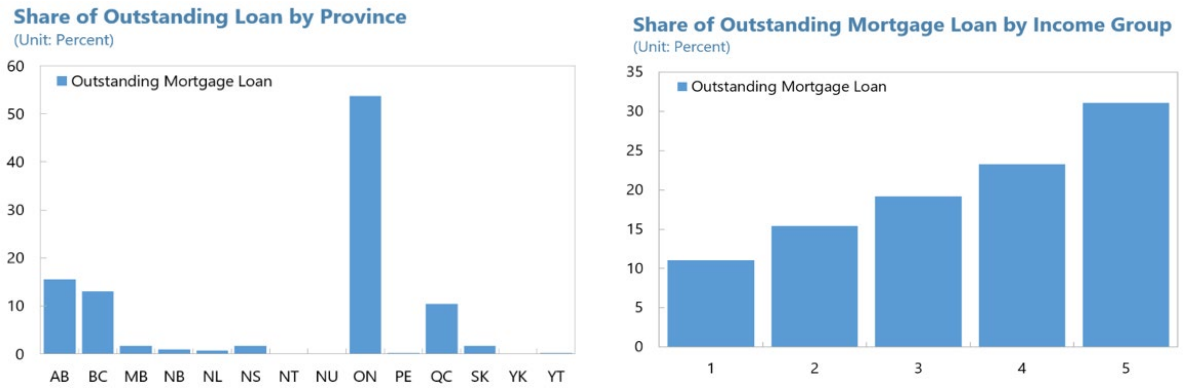
**4. Filtering based on property tenure type was also necessary to ensure consistency in the analysis.**

- The sample was restricted to mortgages secured by freehold and condominium/strata properties, which together accounted for 95.3 percent of the dataset.

[1] We do not differentiate the income process among subcategories of “employed” status.

- Life lease properties, representing 0.18 percent of observations, were excluded due to their distinct financing arrangements that differ from standard mortgage lending practices.
- Similarly, loans associated with properties categorized as "Other" (4.5 percent) were excluded due to inconsistencies in tenure structure.
- Observations related to cooperative housing were negligible and thus not included in the analysis.

**Figure 1. Canada: Summary Statistics of Outstanding Loan Distribution**




Sources: OSFI, RESL, and IMF staff calculations.

5. **Geographically, the dataset reflects the distribution of mortgage lending in Canada, with the majority of loans concentrated in Ontario (53.7 percent), followed by Alberta (15.6 percent), British Columbia (13.1 percent), and Quebec (10.4 percent)** (Figure 1). To ensure data consistency and reliability, a structured data cleaning process was implemented.

- Observations with missing or implausible values for key loan characteristics at origination were removed. Specifically, loans with missing or negative interest rates, qualifying income, property values, days past due, or current authorized amounts were excluded from the sample.
- Loans with combined LTV ratios outside the range of (0,2) were removed to prevent distortions in leverage calculations to allow for high-LTV lending or cash-out refinancing.
- Similarly, total debt service (TDS) and gross debt service (GDS) ratios at the qualifying interest rate at origination were constrained within the range of (0,1) to ensure that affordability metrics remained within plausible bounds.

## B. Adjustment and Bring Forward Loan at-Origination Variables

6. **Further adjustments were made to standardize reported payment and income values across borrowers and bring forward the variables measured at origination to the dataset cutoff period to be consistent across variables relevant in our modeling process.**

- Loan payments were annualized based on the reported payment frequency, ensuring consistency across weekly, biweekly, accelerated biweekly, monthly, and semi-monthly payment structures.

- Borrower income values were adjusted based on employment status and loan origination date to bring it to end-2023. As only cross-sectional data is available, assumptions are made to employment status remain the same from origination to end-2023, while we introduce stochasticity to bring forward all loan-level information to 2024 calibrated to the realized macro variables.

7. **For employed borrowers, qualifying income was projected forward using wage growth trends to account for changes in income over time.** For unemployed borrowers, income was adjusted forward using CPI growth, approximating potential changes in unemployment benefits. Borrower's income at time $t$ is as follows with adjustment:

$$Y_i(t) = Y_i(t_0) \times \prod_{\tau=t_0}^{t} (1 + g_w(\tau))$$

where $t_0$ is the loan origination date, $g_w(\tau)$ refers to wage growth for employed and CPI growth for unemployed, and $i$ represents loan-level observation. These adjustments ensured that income figures remained reflective of real economic conditions over time.

## C. Simulation Process

8. **With above prepared data, we employ a stochastic, loan-level simulation framework to assess household vulnerabilities under baseline and adverse macroeconomic scenarios over the period 2025–27, with 2024 serving as the base year.** The macroeconomic assumptions underpinning the simulations align with the overarching FSAP scenario path, incorporating projections for wage growth, unemployment rate dynamics, interest rate changes, and housing price fluctuations. These macroeconomic variables drive the evolution of borrower income, debt service burdens, and loan performance over time. Loan characteristics play a central role in determining borrowers' exposure to interest rate and payment shocks.[2]

**Bootstrap steps are as follows**[3]:

1) Initialize borrower status including employment status, income and DSR at t=0 where RESL data ends according to earlier steps.

[2] The simulation differentiates between fixed-rate and variable-rate mortgages, as well as distinguishing between variable-rate loans with variable payments and those with fixed payments.

[3] Alternative projections of PD using micro-simulations across various specifications—including debt service, income, employment status, loan-to-value (LTV), and debt-to-income ratios—were explored but proved ineffective due to the absence of financial savings stock data, a key determinant of default risk following unemployment. These data and methodological constraints were discussed with authorities during the FSAP mission, and results were interpreted accordingly and with caveats.

2) Iterate for each simulation for employment status:

- At the loan-level, we introduce idiosyncratic uncertainty via a uniform random draw $\xi_i \sim U(0,1)$.

  Employment status for each borrower is assigned probabilistically to ensure that employment transitions align with the aggregate unemployment rate trajectory in each economic scenario. Employment transitions are then assigned as follows:

$$E_i(t) = \begin{cases} 1, & \text{if } \xi_i > U(t) \\ 0, & \text{otherwise} \end{cases}$$

  where $U(t)$ represents the projected unemployment rate at time t, which is updated based on macroeconomic projections for each year.

3) Update income: Individual borrower income $Y_i(t)$ evolves conditional on employment status.

- For employed borrowers, income grows according to projected wage growth $g_w(t)$.

$$Y_i(t) = Y_i(t-1) \cdot (1 + g_w(t))$$

- For unemployed borrowers, income declines to a fraction of prior income, approximated by the OECD-reported Canadian replacement rate λ, which captures the percentage of prior wages received as unemployment benefits.[4]

- Transitions between employment states impact income as follows:

$$Y_i(t) = Y_i(t-1) \cdot \lambda$$

  i. If an employed borrower in $t-1$ becomes unemployed in $t$, their income is adjusted downward using λ.

  ii. If an unemployed borrower in $t-1$ gains employment in $t$, their income is restored by λ, assuming re-employment at prior earnings levels.

  iii. If a borrower remains in the same employment state, income evolves based on macroeconomic wage growth. Recalculate mortgage payments $P_i(t)$. using loan renewal timing and projected interest rates.

4) Compute updated DSR and LTV ratio:

- For each loan in each year, the DSR is computed based on both stochastic and scenario-specific parameters. Specifically, DSR is calculated as the ratio of annualized debt payments to annual

[4] We calibrate replacement rate using the benefits in unemployment, share of previous income as of 2023, which is derived from OECD statistics calculated as the average of the replacement rate after two months (64 percent) and after one year (22 percent).

income, accounting for variations in payment structures and macroeconomic conditions as below:

$$DSR^{s}_{i,j,t} = \frac{Payment^{s}_{annualized,i,j,t}}{Income^{s}_{annual,i,j,t}}$$

where $i$ represents each loan record, $j$ represents stochastic variation across simulations, and $s$ represents scenario-specific variations (baseline vs. adverse) in year $t$.

- The LTV is similarly computed by dividing the outstanding loan balance by the estimated property value under the given scenario as below:

$$LTV^{s}_{i,t} = \frac{OutstandingLoan^{s}_{i,t}}{PropertyValue^{s}_{i,t}}$$

5) Run 1,000 stochastic simulations per period per scenario.

6) Repeat for each year for projection horizon under both baseline and adverse macroeconomic scenarios.

7) Compute and aggregate expected DSR distribution across all simulations and across loans.

## D. Bayesian Model Averaging Step for Probability of Default Projection

**9. A by-bank panel version of the BMA framework was employed to enhance robustness in variable selection and account for cross-sectional heterogeneity.** The estimation excludes the pandemic period (2020: Q1–2021: Q2) to mitigate distortions from temporary policy interventions and economic volatility. The model is anchored to the 2024: Q4 DSR from Statistics Canada, incorporating projected DSR changes for 2025–27 from the structural approach as key inputs for the econometric analysis.

**10. The model space is restricted to a maximum of three right-hand-side variables per equation, ensuring parsimony and interpretability.** The predictor pool comprises 24 variables, resulting in an implied model space of 12,950 equations, balancing flexibility and computational feasibility. The BMA methodology follows Gross and Población (2019, JFSR), which has been widely applied in FSAPs and euro area-wide stress testing at the ECB, ensuring methodological consistency with international financial stability assessments.

**Table 1. Canada: Mortgage Bayesian Model Averaging Specification**

| No. | Variable | Transformation | Constraints |
|---|---|---|---|
| 1 | Real GDP | YoY | -1 |
| 2 | Real GDP | QoQ | -1 |
| 3 | CPI | YoY | 1 |
| 4 | CPI | QoQ | 1 |
| 5 | Short-term Rate | Level | 1 |
| 6 | Short-term Rate | 1st Diff | 1 |
| 7 | Short-term Rate | 4th Diff | 1 |
| 8 | Long-term Rate | Level | 1 |
| 9 | Long-term Rate | 1st Diff | 1 |
| 10 | Long-term Rate | 4th Diff | 1 |
| 11 | Unemployment Rate | Level | 1 |
| 12 | Unemployment Rate | 1st Diff | 1 |
| 13 | Unemployment Rate | 4th Diff | 1 |
| 14 | Wage | YoY | -1 |
| 15 | Wage | QoQ | -1 |
| 16 | Debt Service Ratio | Level | 1 |
| 17 | Debt Service Ratio | 1st Diff | 1 |
| 18 | Debt Service Ratio | 4th Diff | 1 |
| 19 | U.S. Real GDP Growth | Level | -1 |
| 20 | U.S. Short-term Rate | Level | 1 |
| 21 | U.S. Long-term Rate | Level | 1 |
| 22 | U.S. Unemployment Rate | Level | 1 |
| 23 | U.S. Unemployment Rate | 1st Diff | 1 |
| 24 | U.S. Unemployment Rate | 4th Diff | 1 |

Sources: BoC, Haver, Statistics Canada, OSFI, RESL, and IMF staff calculations.

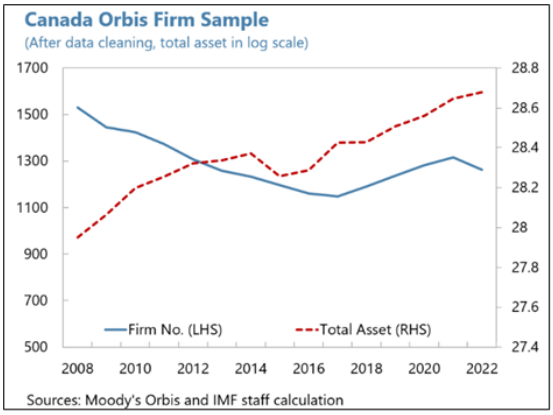
# Appendix VIII. Corporate Analysis Methodology

**1. The analysis of corporate sector vulnerabilities is based on firm-level data from Moody's Orbis and Moody's KMV 1-year EDF. The approach consists of two steps.** First, a firm fixed-effects panel econometric model is estimated to identify key drivers of corporate PD. Second, a BMA framework is used to project corporate PD, both at aggregate and at sector level, using macroeconomic variables and historical NFC PD path provided by authorities.

## A. Firm-Level Data Processing and Cleaning

**2. The firm-level dataset is constructed from Moody's Orbis (updated through 2022), with data cleaning procedures following Kalemli-Ozcan et al. (2015).** The dataset is filtered to avoid double-counting, with firms included at the highest level of consolidation. The following filters are applied:

- Exclusion of financial sector firms.
- Positive values for total assets, cash, liabilities, debt, sales, and employment to ensure economic relevance.
- Only firms with valid financial statements are retained.




The final dataset includes 1,262 firms as of 2022, with total assets of $2.932 trillion USD, covering approximately 41 percent of total NFC assets in Canada ($7.196 trillion USD, Statistics Canada). Public firms account for 93 percent of the sample each year on average.

## B. Descriptive Stats and Industry Dynamics from the Cleaned Dataset

**3. The composition of corporate assets highlights the capital-intensive nature of real estate, utilities, and mining, which together account for a significant share of total firm assets in Canada**. These industries dominate asset-heavy sectors, reflecting their structural importance in the economy.

**4. The distribution of firms by industry shows that manufacturing (30.6 percent) constitutes the largest share, followed by other industries (20.9 percent) and mining (18.6 percent).** However, when measured by total assets, the largest industries are real estate (19.7 percent), manufacturing (19.3 percent), utilities (12.4 percent), mining (10.7 percent), transportation (9.1 percent), and information and communication (7.3 percent).

**5. Sectoral asset distribution has shifted significantly over time. Between 2008 and 2022, the real estate sector's share of total corporate assets increased by 17.4 percentage points,**

**while the mining sector experienced a decline of 9.7 percentage points.** These trends underscore the evolving structure of corporate asset allocation and potential changes in sectoral credit risks.

## C. Firm-Level Panel Econometric Model

**6. The firm-level analysis employs a fixed-effects panel regression model to assess corporate PD drivers, using Moody's KMV 1-year EDF as the dependent variable as follows.** The model is estimated using publicly listed firms only, as Canadian SMEs are highly underrepresented in the Orbis dataset.

$$\text{logit}(\text{EDF})_{i,t} = \beta_1 \text{Leverage}_{i,t} + \beta_2 \text{ICR}_{i,t} + \beta_3 \text{EBITR}_{i,t} + \beta_4 \text{Cash Buffer}_{i,t} + \sum_{j=1}^{J} \beta_{4+j} (\text{Cash Buffer} \times X_j)_{i,t} + \alpha_i + \epsilon_{i,t}$$

**7. The explanatory variables are chosen to align with the stock- and flow-oriented Merton model framework. Specifically, the model includes:**

- Leverage, defined as debt-to-asset ratio where debt = 0.5*long term debt + short term debt.[1] We also use five different leverage measures with debt, asset, equity metrics for robustness to explore the capital structure impact.
- ICR, defined as EBIT over interest expense, capturing firms' ability to service debt (expected negative relationship).
- EBIT Ratio, measured as EBIT over total assets, providing insight into firms' profitability (expected negative relationship).
- Cash Buffer, calculated as cash holdings over short-term debt, indicating firms' liquidity risk (expected negative relationship).
- Cash Buffer Interactions include interaction terms with different financial health indicators $X_j$, such as ICR, EBITR, and ROA**,** tested in various model specifications.
- $\alpha_i$ represents firm-fixed effects, controlling for time-invariant firm characteristics.
- $\gamma_t$ represents year-fixed effects, included as a robustness check to control for time-varying macroeconomic conditions. While not essential in a firm-level model, we use it to compare results across specifications and assess the stability of estimated relationships.
- $\varepsilon_{i,t}$ is the error term.

[1] This leverage metric is referred as leverage with risk weights in regression result tables.

The regression is estimated using both raw-level and standardized variables. Standardization involves unit-specific demeaning, followed by global standard deviation normalization to ensure coefficient comparability across firms in the panel model.

## D. Comparing Regression Results of International Monetary Fund and Bank of Canada Measures

**8. The regression results using the BOC measures broadly align with the IMF measures, confirming that cash buffers and their interaction with profitability remain the most significant drivers of default risk across industries.** The results also reinforce sectoral heterogeneity, with leverage being a key risk factor in capital-intensive sectors such as real estate, construction, and manufacturing, while liquidity constraints play a more critical role in trade and services. However, differences emerge in the magnitude and significance of certain coefficients across specifications, particularly in the role of leverage and profitability measures, which appear more pronounced in some sectors under the BOC measure. In particular, the impact of leverage is stronger in construction and manufacturing, while the effects of cash buffers and profitability interactions vary slightly across industries. These variations suggest that different methodological approaches can influence the estimated sensitivities of financial risk drivers, though the overarching conclusions on the sector-specific nature of financial vulnerabilities and the critical role of liquidity buffers remain robust across specifications.

**Table 1. Canada: Firm-Level Regression Results**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Variables | Logit(EDF) | | | | | | | |
| Leverage | 0.0274 | 0.0268 | 0.00966 | 0.00861 | 0.0166 | 0.018 | -0.00539 | -0.00474 |
| | (0.022) | (0.020) | (0.019) | (0.017) | (0.016) | (0.015) | (0.012) | (0.012) |
| ICR | 0.00626 | 0.00845 | 0.00655 | 0.00874 | 0.0158 | 0.0191 | 0.0164 | 0.0197 |
| | (0.016) | (0.014) | (0.016) | (0.014) | (0.019) | (0.016) | (0.019) | (0.016) |
| EBITR | -0.00613 | -0.0633 | -0.241 | -0.306 | -0.133 | -0.162 | -0.498* | -0.539 |
| | (0.257) | (0.277) | (0.299) | (0.314) | (0.242) | (0.285) | (0.299) | (0.343) |
| Cash Buffer | -0.404*** | -0.407*** | -0.403*** | -0.406*** | -0.416*** | -0.418*** | -0.415*** | -0.417*** |
| | (0.075) | (0.080) | (0.075) | (0.080) | (0.077) | (0.081) | (0.077) | (0.081) |
| ICR * Cash Buffer | -0.0181 | -0.0246 | -0.0187 | -0.0252 | -0.0522 | -0.0607 | -0.0544 | -0.063 |
| | (0.018) | (0.017) | (0.018) | (0.017) | (0.070) | (0.072) | (0.070) | (0.071) |
| EBITR * Cash Buffer | -0.0713 | -0.076 | -0.0655 | -0.07 | -0.0642 | -0.0673 | -0.0559 | -0.0587 |
| | (0.068) | (0.070) | (0.069) | (0.071) | (0.062) | (0.066) | (0.062) | (0.066) |
| ROA * Cash Buffer | 0.112*** | 0.119*** | 0.111*** | 0.118*** | 0.118*** | 0.129*** | 0.118*** | 0.128*** |
| | (0.022) | (0.022) | (0.023) | (0.022) | (0.019) | (0.018) | (0.019) | (0.018) |
| Constant | 0.0145*** | 0.0405 | 0.0122*** | 0.0377 | -0.00800** | 0.0496 | -0.0126*** | 0.0449 |
| | (0.004) | (0.066) | (0.004) | (0.066) | (0.004) | (0.062) | (0.004) | (0.062) |
| Year FE | No | Yes | No | Yes | No | Yes | No | Yes |
| COVID Period Excluded | No | No | No | No | Yes | Yes | Yes | Yes |
| Leverage Metrics with Risk | Yes | Yes | No | No | Yes | Yes | No | No |
| Observations | 9102 | 9102 | 9102 | 9102 | 7718 | 7718 | 7718 | 7718 |
| R-squared | 0.025 | 0.081 | 0.025 | 0.081 | 0.027 | 0.081 | 0.027 | 0.081 |
| Number of Firm FE | 1529 | 1529 | 1529 | 1529 | 1481 | 1481 | 1481 | 1481 |

Sources: Moody's Orbis and IMF staff calculations.
Note: Standard errors in parenthesis, *p <0.10, **p<0.05, ***p<0.001.

## Table 2. Canada: Firm-Level Regression Results, by Industry

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Logit(EDF) | | | | | | | |
| Variables | Construction | | Information & Com. | | Manufacturing | | Mining | | Professional Services | | Real Estate | | Trade | |
| Leverage | 0.402 | 0.314 | 0.305*** | 0.366*** | 0.255*** | 0.252** | 0.0261* | 0.0180* | 0.548 | 0.659 | 3.421** | 3.628*** | 1.616* | 1.649** |
| | (0.361) | (0.370) | (0.105) | (0.136) | (0.097) | (0.101) | (0.015) | (0.010) | (0.431) | (0.546) | (1.361) | (1.106) | (0.813) | (0.796) |
| ICR | 0.25 | -0.971 | -0.0238 | -0.00453 | 0.0196 | 0.018 | -0.0206 | 0.0144 | -0.0763 | -0.0099 | -7.942 | -6.318 | 0.0143 | 0.00746 |
| | (0.830) | (0.915) | (0.129) | (0.082) | (0.022) | (0.022) | (0.038) | (0.025) | (0.122) | (0.144) | (6.187) | (5.981) | (0.265) | (0.232) |
| EBITR | 0.581 | -0.472 | 0.433** | 0.225 | -0.962 | -1.065* | 0.325 | 0.239 | -0.0335 | -0.106 | 2.474 | 0.934 | 0.693 | 1.421 |
| | (3.875) | (4.632) | (0.205) | (0.254) | (0.623) | (0.638) | (0.261) | (0.196) | (0.512) | (0.619) | (3.101) | (2.737) | (3.868) | (3.849) |
| Cash Buffer | -1.516* | -1.474 | -1.254*** | -1.085*** | -0.530*** | -0.563*** | -0.388* | -0.309** | -0.257 | -0.314 | -0.0574 | 0.0422 | -2.015** | -2.161** |
| | (0.833) | (1.076) | (0.345) | (0.322) | (0.105) | (0.107) | (0.209) | (0.138) | (0.156) | (0.194) | (0.094) | (0.080) | (0.887) | (0.889) |
| ICR * Cash Buffer | -6.146*** | -5.212* | 0.141 | 0.212 | -0.0178 | -0.0225 | 0.162 | -0.121 | 0.241* | 0.111 | 26.68 | 22.2 | 2.936* | 4.034** |
| | (1.606) | (2.651) | (0.778) | (0.506) | (0.020) | (0.020) | (0.196) | (0.135) | (0.125) | (0.136) | (21.100) | (20.140) | (1.682) | (1.537) |
| EBITR * Cash Buffer | 2.462 | 2.81 | 0.141 | -0.102 | -0.137 | -0.152 | -1.520*** | -0.924** | -0.311 | -0.298 | 2.564*** | 1.897* | -1.361 | -1.979 |
| | (1.996) | (2.485) | (0.406) | (0.465) | (0.099) | (0.098) | (0.442) | (0.375) | (0.218) | (0.267) | (0.903) | (0.976) | (1.230) | (1.205) |
| ROA * Cash Buffer | 1.184 | 1.057 | 0.111 | 0.549 | 0.108*** | 0.116*** | 3.143*** | 1.896** | 0.423** | 0.323 | -10.28*** | -7.399* | 1.695 | 1.524 |
| | (1.424) | (1.693) | (0.543) | (0.660) | (0.029) | (0.029) | (1.096) | (0.919) | (0.185) | (0.211) | (3.726) | (4.240) | (1.184) | (1.145) |
| Constant | -0.463*** | -0.340* | 0.0232 | 0.821*** | -0.00157 | 0.111 | 0.0531*** | -0.890*** | 0.0605*** | 0.257 | 0.00836*** | 0.761*** | -0.0443*** | 0.0351 |
| | (0.117) | (0.172) | (0.023) | (0.265) | (0.004) | (0.098) | (0.014) | (0.161) | (0.014) | (0.425) | (0.002) | (0.200) | (0.007) | (0.343) |
| Year FE | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Leverage with Risk Weight | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 130 | 130 | 959 | 959 | 3284 | 3284 | 1763 | 1763 | 315 | 315 | 505 | 505 | 466 | 466 |
| R-squared | 0.173 | 0.423 | 0.062 | 0.214 | 0.05 | 0.104 | 0.025 | 0.309 | 0.048 | 0.134 | 0.123 | 0.338 | 0.087 | 0.194 |
| Number of Firm FE | 16 | 16 | 188 | 188 | 556 | 556 | 352 | 352 | 60 | 60 | 63 | 63 | 77 | 77 |

Sources: Moody's Orbis and IMF staff calculations.

## Table 3. Canada: Firm-Level Regression Results (Bank of Canada Measures)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Variables | | | | Logit(EDF) | | | | |
| Leverage | 0.145*** | 0.142*** | 0.176*** | 0.174*** | 0.143*** | 0.144*** | 0.169*** | 0.172*** |
| | (0.053) | (0.052) | (0.058) | (0.057) | (0.050) | (0.051) | (0.052) | (0.053) |
| ICR | -0.00692 | -0.0113 | -0.00584 | -0.0107 | 0.0105 | 0.00383 | 0.0112 | 0.00431 |
| | (0.017) | (0.015) | (0.017) | (0.015) | (0.019) | (0.018) | (0.019) | (0.018) |
| EBITR | -0.247*** | -0.233*** | -0.232*** | -0.219*** | -0.296*** | -0.292*** | -0.275*** | -0.272*** |
| | (0.073) | (0.073) | (0.076) | (0.076) | (0.075) | (0.077) | (0.078) | (0.079) |
| Cash Buffer | -0.294*** | -0.300*** | -0.283*** | -0.290*** | -0.303*** | -0.306*** | -0.294*** | -0.298*** |
| | (0.064) | (0.070) | (0.064) | (0.070) | (0.064) | (0.068) | (0.064) | (0.069) |
| ICR * Cash Buffer | -0.00697 | -0.0116 | -0.00928 | -0.0137 | -0.0352 | -0.0352 | -0.0366 | -0.0365 |
| | (0.057) | (0.056) | (0.056) | (0.054) | (0.073) | (0.074) | (0.073) | (0.073) |
| EBITR * Cash Buffer | 0.133 | 0.114 | 0.119 | 0.0991 | 0.0985 | 0.0848 | 0.0783 | 0.0626 |
| | (0.129) | (0.129) | (0.132) | (0.132) | (0.113) | (0.116) | (0.115) | (0.118) |
| ROA * Cash Buffer | 0.0137 | 0.024 | 0.0153 | 0.0254 | 0.0715*** | 0.0798*** | 0.0725*** | 0.0807*** |
| | (0.058) | (0.058) | (0.057) | (0.057) | (0.010) | (0.010) | (0.010) | (0.010) |
| Constant | 0.0206*** | 0.0496 | 0.0199*** | 0.0563 | -0.00296 | 0.051 | -0.0022 | 0.0566 |
| | (0.002) | (0.065) | (0.002) | (0.064) | (0.002) | (0.060) | (0.002) | (0.060) |
| Year FE | No | Yes | No | Yes | No | Yes | No | Yes |
| COVID Period Excluded | No | No | No | No | Yes | Yes | Yes | Yes |
| Leverage Metrics with Risk | Yes | Yes | No | No | Yes | Yes | No | No |
| Observations | 7598 | 7598 | 7598 | 7598 | 6505 | 6505 | 6505 | 6505 |
| R-squared | 0.065 | 0.129 | 0.076 | 0.139 | 0.069 | 0.132 | 0.078 | 0.14 |
| Number of Firm FE | 1282 | 1282 | 1282 | 1282 | 1230 | 1230 | 1230 | 1230 |

Sources: Moody's Orbis and IMF staff calculations.

**Table 4. Canada: Firm-Level Regression Results, by Industry (Bank of Canada Measures)**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Logit(EDF) | | | | | | | |
| Variables | Construction | | Information & Com. | | Manufacturing | | Mining | | Professional Services | | Real Estate | | Trade | |
| Leverage | 0.513** | 0.418** | 0.281* | 0.294** | 0.297*** | 0.304*** | 0.123*** | 0.0763*** | 0.457** | 0.706*** | 0.501*** | 0.509*** | 0.312* | 0.320* |
| | (0.193) | (0.187) | (0.150) | (0.137) | (0.086) | (0.088) | (0.032) | (0.026) | (0.206) | (0.224) | (0.157) | (0.130) | (0.173) | (0.171) |
| ICR | -6.447 | -3.708 | -0.0561 | -0.0978 | -0.029 | -0.0317 | -0.0556*** | -0.0154 | 0.146 | 0.0899 | -0.837 | 0.625 | -0.271** | -0.199* |
| | (3.980) | (3.283) | (0.104) | (0.099) | (0.035) | (0.038) | (0.021) | (0.017) | (0.193) | (0.261) | (3.880) | (3.330) | (0.104) | (0.118) |
| EBITR | -0.0328 | -0.0634 | -0.047 | -0.0995 | -0.0649 | -0.0576 | -0.531*** | -0.338*** | -0.495*** | -0.396** | -1.482** | -1.552** | 0.0201 | 0.0359 |
| | (0.469) | (0.400) | (0.206) | (0.195) | (0.068) | (0.065) | (0.100) | (0.068) | (0.178) | (0.174) | (0.727) | (0.698) | (0.096) | (0.097) |
| Cash Buffer | -2.009 | -1.688 | -0.902** | -0.740** | -0.430*** | -0.456*** | -0.269 | -0.204* | 0.0283 | 0.000125 | -0.224* | -0.142 | -1.494** | -1.588** |
| | (1.571) | (1.718) | (0.359) | (0.295) | (0.096) | (0.097) | (0.167) | (0.115) | (0.149) | (0.172) | (0.127) | (0.157) | (0.728) | (0.726) |
| ICR * Cash Buffer | 98.36* | 34.19 | 0.221 | 0.32 | 0.00882 | 0.00243 | 0.364** | 0.078 | -0.086 | -0.103 | -17 | -19.65 | 2.662*** | 3.031*** |
| | (52.220) | (55.500) | (0.393) | (0.368) | (0.059) | (0.055) | (0.165) | (0.149) | (0.115) | (0.141) | (13.990) | (12.230) | (0.852) | (0.927) |
| EBITR * Cash Buffer | -12.5 | 0.608 | 0.12 | -0.0881 | -0.0875 | -0.129 | -0.58 | -0.352 | 0.676* | 0.4 | 7.390** | 6.883** | -1.847 | -2.504 |
| | (10.150) | (10.520) | (0.730) | (0.637) | (0.174) | (0.171) | (0.580) | (0.457) | (0.348) | (0.392) | (2.934) | (2.857) | (1.513) | (1.625) |
| ROA * Cash Buffer | 26.24 | 3.23 | 0.905 | 0.969 | 0.0535* | 0.0619** | 1.269 | 0.694 | 0.551*** | 0.525** | -7.759*** | -5.543** | 1.162 | 1.065 |
| | (35.230) | (34.470) | (0.667) | (0.747) | (0.030) | (0.029) | (0.901) | (0.738) | (0.177) | (0.230) | (2.377) | (2.664) | (0.719) | (0.698) |
| Constant | -1.315 | -0.382 | -0.0121** | 0.787*** | -0.00579* | 0.137 | 0.0941*** | -0.797*** | 0.0429*** | 0.451 | 0.0215** | 0.449*** | -0.0269*** | 0.0526 |
| | (1.473) | (1.519) | (0.006) | (0.264) | (0.003) | (0.099) | (0.010) | (0.161) | (0.008) | (0.401) | (0.011) | (0.143) | (0.006) | (0.334) |
| Year FE | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Leverage with Risk Weight | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 114 | 114 | 673 | 673 | 2784 | 2784 | 1559 | 1559 | 216 | 216 | 363 | 363 | 415 | 415 |
| R-squared | 0.157 | 0.431 | 0.046 | 0.295 | 0.091 | 0.149 | 0.105 | 0.35 | 0.172 | 0.352 | 0.219 | 0.384 | 0.091 | 0.2 |
| Number of Firm FE | 14 | 14 | 133 | 133 | 471 | 471 | 315 | 315 | 44 | 44 | 49 | 49 | 70 | 70 |

Sources: Moody's Orbis and IMF staff calculations.

## E. Corporate Probability of Default Projection Using Bayesian Model Averaging

**9. To project corporate PD, a time-series BMA approach is employed, following Gross and Población (2019, JFSR).** This methodology has been widely adopted in FSAPs and by European central banks for financial stability monitoring. The BMA framework allows for a probabilistic selection of relevant macroeconomic predictors, accounting for model uncertainty.

**10. The left-hand side (LHS) variable consists of aggregate and industry-level PD estimates provided by national authorities.** The right-hand side (RHS) comprises a set of 23 macroeconomic indicators, with a maximum of five variables included in each estimated model. To mitigate distortions from extreme economic conditions, the pandemic period (2020: Q1–2021: Q2) is excluded from estimation.

**11. The methodology explores 44,551 possible model specifications, allowing for robust predictor selection across different specifications.** Industry-level PD projections are also generated to assess sectoral vulnerabilities.

## Table 5. Canada: Corporate Bayesian Model Averaging Specifications

| No. | Variable | Transformation | Constraints |
|---|---|---|---|
| 1 | Real GDP | YoY | -1 |
| 2 | Real GDP | QoQ | -1 |
| 3 | CPI | YoY | 1 |
| 4 | CPI | QoQ | 1 |
| 5 | Short-term Rate | Level | 1 |
| 6 | Short-term Rate | 1st Diff | 1 |
| 7 | Short-term Rate | 4th Diff | 1 |
| 8 | Long-term Rate | Level | 1 |
| 9 | Long-term Rate | 1st Diff | 1 |
| 10 | Long-term Rate | 4th Diff | 1 |
| 11 | Unemployment Rate | Level | 1 |
| 12 | Unemployment Rate | 1st Diff | 1 |
| 13 | Unemployment Rate | 4th Diff | 1 |
| 14 | Stock Price | YoY | -1 |
| 15 | Stock Price | QoQ | -1 |
| 16 | Corporate Spread | Level | 1 |
| 17 | FX | Level | 1 |
| 18 | FX | YoY | 1 |
| 19 | FX | QoQ | 1 |
| 20 | U.S. Real GDP Growth | Level | -1 |
| 21 | U.S. Short-term Rate | Level | 1 |
| 22 | U.S. Long-term Rate | Level | 1 |
| 23 | U.S. Unemployment Rate | 4th Diff | 1 |

Sources: BOC, Haver, Statistics Canada, and IMF staff calculations.