

Staff Analytical Note/Note analytique du personnel 2018-36

# Modelling the Macrofinancial Effects of a House Price Correction in Canada



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## **Acknowledgements**

This note would not have been possible without the advice and analytical contributions of Olga Bilyk, Guillaume Bédard-Pagé, Gabriel Bruneau, Gino Cateau, Don Coletti, José Figue, Charles Gaa, Alejandro Garcia, Marc-André Gosselin, Siyang He, Dylan Hogg, Ivan Komarov, William Leung, Eric Luo, Guillaume Ouellet Leblanc and Virginie Traclet.

## **Abstract**

We use a suite of risk-assessment models to examine the possible impact of a hypothetical house price correction, centred in the Toronto and Vancouver areas. We also assume financial stress significantly amplifies the macroeconomic impact of the house price decline. The rates of arrears rise for households and businesses, which puts some pressure on banks. But the large banks remain resilient through the risk scenario, supported by their international diversification and their ability to replenish capital with retained earnings. As with any simulation exercise, the results are subject to significant uncertainty and depend on the specifics of the scenario being considered.

*Bank topics: Financial stability; Housing; Financial institutions*

*JEL code: E27, E37, E44, G21*

## **Résumé**

Nous utilisons un ensemble de modèles d'évaluation des risques pour examiner l'incidence possible d'une correction hypothétique des prix des logements concentrée dans les régions de Toronto et de Vancouver. Nous supposons aussi que les tensions financières amplifient considérablement les effets macroéconomiques du recul des prix. Les taux de prêts en souffrance des ménages et des entreprises augmentent, ce qui exerce une certaine pression sur les banques. Toutefois, grâce à leur diversification internationale et à leur capacité de reconstituer leurs fonds propres en augmentant leurs résultats non distribués, les grandes banques demeurent résilientes dans un tel scénario de risque. Comme dans tout exercice de simulation, les résultats comportent une grande part d'incertitude et varient selon les particularités du scénario à l'étude.

*Sujets : Stabilité financière; Logement; Institutions financières*

*Codes JEL : E27, E37, E44, G21*

## Introduction

This note illustrates the possible consequences of a hypothetical house price correction centred in the Toronto and Vancouver areas. Our scenario also assumes a sharp increase in financial stress, which amplifies the macroeconomic effects. The scenario qualitatively resembles Risk 2 in the June 2018 *Financial System Review*. We consider this to be a “tail-risk” scenario; in other words, it characterizes an event that has a low chance of occurring but has a high impact if it does. We make several simplifying assumptions to aid in exposition and modelling.

We simulate the scenario using our Framework for Risk Identification and Assessment (FRIDA).<sup>1</sup> The analysis follows four steps, corresponding to the four boxes in [Figure 1](#) and the four sections below:

1. We discuss how national house prices could evolve in the context of a housing market correction in the Toronto and Vancouver areas.
2. We model how the macroeconomic effects could be amplified as a result of increased stress to the financial system caused by the house price correction.
3. We then dig deeper into how households and businesses fare.
4. Finally, we estimate the potential impact of the deterioration in macroeconomic conditions and the associated defaults of households and businesses on large Canadian banks. The large banks remain resilient through the risk scenario.

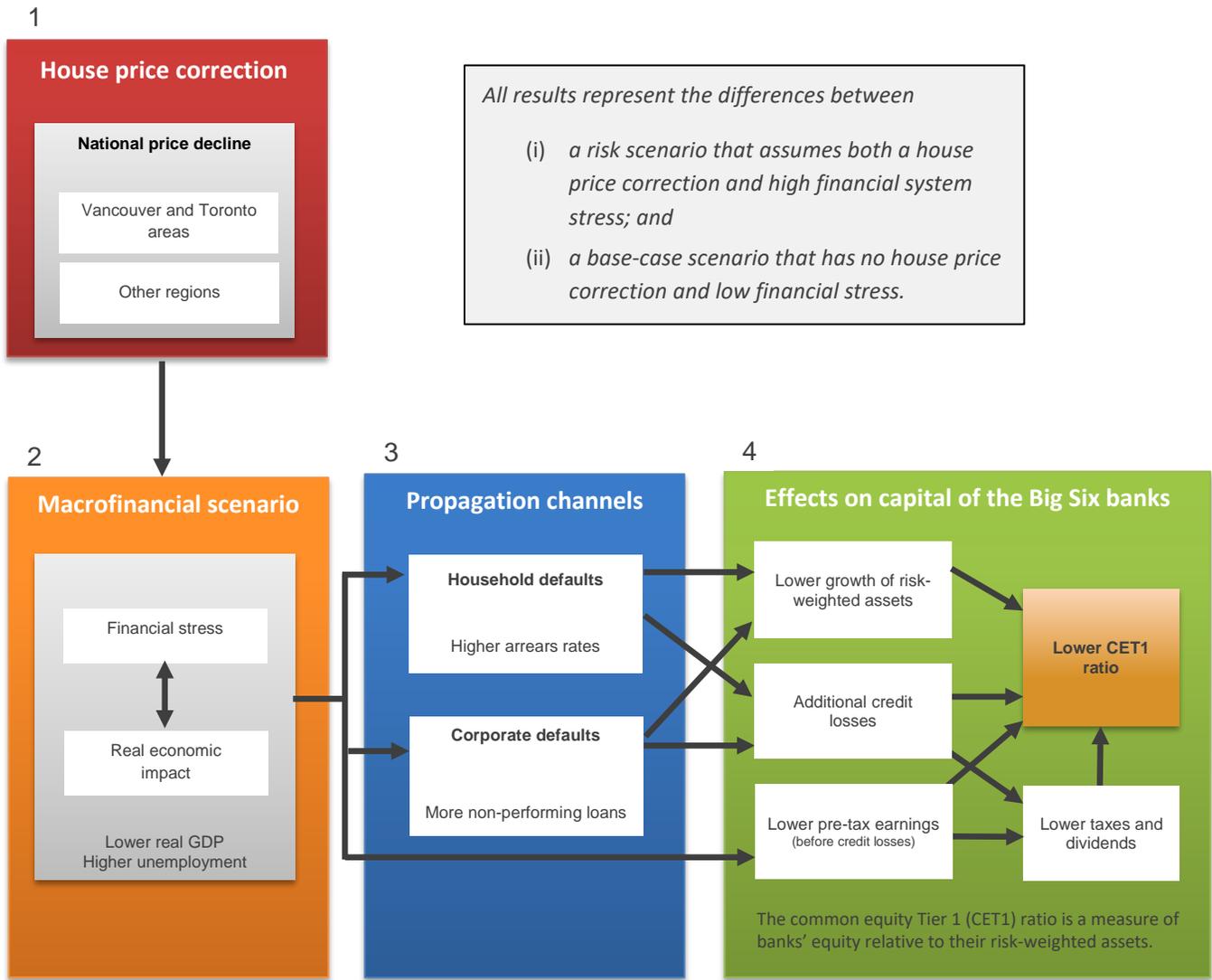
While the steps are illustrated sequentially, their effects are interrelated and simultaneous.

We present results as the differences between the risk scenario and a base case where macroeconomic variables resemble those forecast in the Bank of Canada’s *Monetary Policy Report*.

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<sup>1</sup> Details on all the models used in this note are contained in the accompanying technical report (MacDonald and Traclet 2018).

**Figure 1. Modelling the macrofinancial effects of a house price correction in Canada**



The ultimate severity of the scenario depends on several factors, including the following:

- (i) the extent of house price spillovers into the rest of the country;
- (ii) the economic environment, including the strength of the economy at the start of the scenario; and
- (iii) the resilience of the financial system, including the state of financial vulnerabilities and the ability of the financial system to withstand adverse events.

## 1. A house price correction in the Toronto and Vancouver areas

A house price correction is a key risk to the Canadian financial system. House price growth has slowed significantly in the past year, but prices in the Toronto and Vancouver areas remain 40 per cent and 55 per cent higher, respectively, than they were only three years ago. Although strong fundamentals support house prices in these markets, it is possible that the increase in prices was driven, in part, by unsustainable expectations of continued future price growth. If that were true, house price gains could reverse rapidly. Higher interest rates, changes in housing policy or movement in other factors, such as foreign demand, might trigger the adjustment.

A quick drop in house prices in the Toronto and Vancouver areas would be nationally significant on its own because these regions account for around half of housing transactions among Canada's main cities. In addition, it is possible that a house price correction in the Toronto and Vancouver areas could spill over to other regional Canadian housing markets. A key consideration is that most of the rest of Canada has not experienced exceptionally strong price growth over the past few years. Furthermore, truly localized Canadian house price cycles have typically not spilled over to other regions. For example, the 1991–97 Vancouver house price cycle, which was closely tied to developments in Asia, showed no sign of spilling over into other regional housing markets (December 2014 *Financial System Review*).<sup>2</sup>

As the starting point of our risk scenario, we consider a hypothetical decrease of 20 per cent in house prices nationwide, made up of a substantial price decline in the Toronto and Vancouver areas and a smaller decline elsewhere.<sup>3</sup> The probability of this occurring is low. We choose a large enough shock to illustrate how a tail-risk event could create stress that affects the financial system.

## 2. High financial stress could amplify macroeconomic impacts

The house price correction would have its largest effects on the Ontario and British Columbia economies, with important direct effects on residential investment; related consumption spending, such as furniture and appliances; and real estate services. The fall in house prices would also lead to negative wealth and collateral effects, which further weigh on consumption spending. There would be macroeconomic spillovers to other provincial economies through lower interprovincial trade and declining confidence nationwide.

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<sup>2</sup> Canadian historical experience suggests that a national correction in house prices would be more likely to occur if there were a significant adverse national macroeconomic shock, such as sharply higher interest rates or a broad-based recession, as in 1982 and 1991.

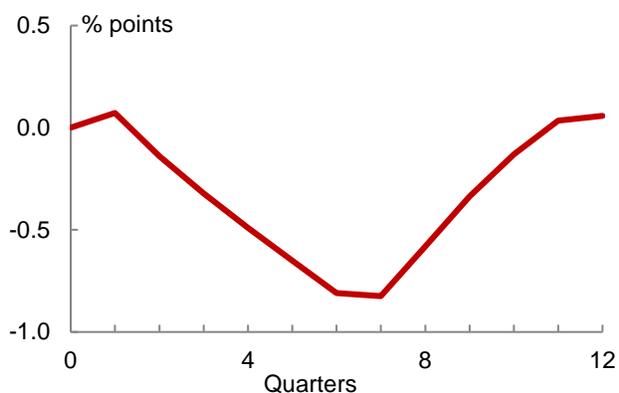
<sup>3</sup> Nationwide real house prices decline over 18 months to reach 20 per cent below the base-case trend and remain there during the rest of the three-year scenario. This is an assumption of the scenario for illustrative purposes and not a prediction. The magnitude of the house price correction in the present scenario is less severe than the nationwide nominal house price correction of 33 per cent assumed in the 2013 Canada Financial Sector Assessment Program led by the International Monetary Fund.

Macroeconomic effects are captured by the Risk Amplification Macro Model (RAMM), a component of FRIDA. To generate a severe impact that allows us to analyze challenging macrofinancial conditions, we assume that the decline in house prices and resulting deterioration in economic conditions interact with the elevated level of vulnerabilities and create high financial stress.<sup>4</sup> The concept of financial stress captures heightened volatility and sharp price corrections happening simultaneously across several markets (Duprey, Klaus and Peltonen 2017). It incorporates stress on financial assets as well as stress on the housing market and on the banking sector. When financial stress is high—even if the banking sector remains solvent—shocks to the macroeconomy can have more severe effects.

The impact of the regional house price correction is therefore amplified. RAMM includes not only the basic macroeconomic effects of a house price decline, but also the amplifying effects from decreased asset values, higher risk premiums and outsized effects on business and consumer confidence. For example, rising risk premiums put upward pressure on interest rates that is only offset by accommodative monetary policy (Figure 2). Financial stress is assumed to substantially increase the effects of the house price correction on GDP, leading economic activity in the risk scenario to fall notably below its base-case value (Figure 3).<sup>5</sup> This is not a prediction of what we expect to happen, but rather a low-probability, high-impact scenario useful for examining the resilience of the financial system to a challenging macrofinancial environment.

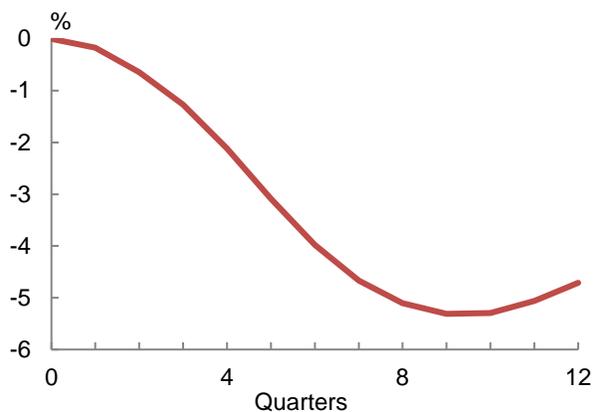
**Figure 2: Monetary easing and rising risk premiums have largely offsetting effects on mortgage rates**

Five-year mortgage rates in the risk scenario relative to the base case.



**Figure 3: We assume financial stress amplifies the decline in GDP**

GDP in the risk scenario relative to the base case.



### 3. The house price correction propagates through the household and corporate sectors

In the scenario, the proportion of households and businesses facing economic stress increases, consistent with the house price correction and resulting macroeconomic downturn. As a result, the rate of arrears in the two sectors rises. Losses from higher arrears, in turn, can put pressure on banks.

<sup>4</sup> We assume no fiscal intervention or specific bank management actions to deal with potential bank losses.

<sup>5</sup> The decline in GDP is significantly smaller than in the recession of the early 1990s and the 2008 financial crisis.

## Households

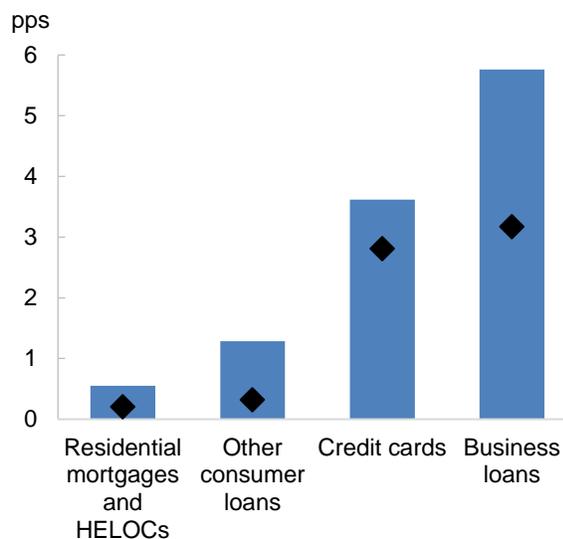
The drop in house prices reduces home equity, thus affecting the ability of households to use lines of credit or sell their house quickly to cope with financial stress. Higher unemployment and the resulting drop in household income also lead to a deterioration in the financial conditions of households. The elevated level of current household vulnerabilities amplifies these effects, leading more households to struggle to make payments on debt (Cateau, Roberts and Zhou 2015). Simulations based on the Household Risk Assessment Model (component of FRIDA) suggest that the overall arrears rate of Canadian households would be 0.6 percentage points higher than in the base case. Specifically, the increase is 0.5 percentage points for mortgage debt and 3.6 percentage points for credit cards (Figure 4). For both mortgage debt and credit cards, the change is somewhat more than what was experienced around the 2008 recession. The arrears rates, however, remain low in absolute terms.<sup>6</sup>

The decline in house prices would leave a significant fraction of indebted households with negative home equity.<sup>7</sup> The most affected would be homebuyers who entered the market close to the peak in house prices. However, for most mortgages in Canada, the lender has recourse to other household assets in case of default on a mortgage. Households in negative equity therefore have little incentive to default unless they cannot meet their mortgage payments due to a drop in their income. In our model, the main driver of arrears is the increase in unemployment that reduces households' income. The rate of arrears increases more for non-mortgage household debt in part because households tend to prioritize mortgage payments when they face financial stress.

## Businesses

Businesses would also be affected by a downturn in housing. Using our Corporate Default Model (component of FRIDA), we estimate that non-performing loans as a portion of total loans for the corporate sector increase around 6 percentage points, on average, relative to the base case (Figure 4). This increase is larger than the change in arrears for households, which is consistent with historical evidence on the effects of recessions accompanied by housing shocks. The rise in non-performing corporate loans

**Figure 4: The fraction of domestic non-performing loans increases for households and businesses**  
Risk scenario relative to the base case. Diamonds reflect the increase observed around the 2008 recession. HELOC stands for home equity line of credit.



Note: For credit cards, the increase is measured in terms of the annualized default rate rather than the non-performing loan ratio.

<sup>6</sup> Residential mortgage arrears rates stand at 0.23 per cent in June 2018. Both the level of arrears in Canada and its increase during a crisis are small compared with those witnessed in the United States. But the United States is not a useful benchmark for Canadian mortgage arrears because of the different structure of the mortgage market in Canada, including the full-recourse nature of most Canadian mortgages.

<sup>7</sup> Box 3 of the June 2016 *Financial System Review* focused on two house price correction scenarios of 15 and 25 per cent. A rough approximation to match our 20 per cent house price correction would give about 18 per cent of households with negative home equity. Approximately one third of those mortgage holders would be highly indebted households. Note, however, that this uses data until 2014. Since then, house prices and household indebtedness first increased but recently started to ease.

is mainly driven by the construction and real estate sector. In our simulation, we consider the case where the construction and real estate sector is in its worst 90<sup>th</sup> percentile.<sup>8</sup>

The deterioration in macroeconomic conditions and an increase in credit spreads would lead to a decrease in overall lending.

#### 4. Effects on banks

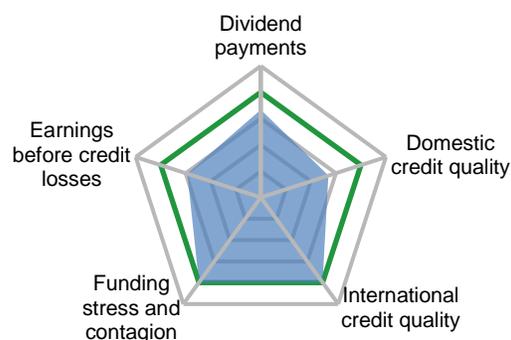
The simulated impact of the scenario on the Big Six Canadian banks is assessed using our Top-Down Solvency Assessment (TDSA) tool and the MacroFinancial Risk Assessment Framework (MFRAF), both part of FRIDA.<sup>9</sup> The TDSA tool measures the impact of the scenario on bank solvency through credit losses and income by projecting banks' balance sheets, income statements and regulatory capital ratios. MFRAF complements the TDSA tool by quantifying second-round effects, such as funding stresses and contagion, among the Big Six Canadian banks.

Figure 5 provides a qualitative overview of the first- and second-round effects on the financial health of the Big Six Canadian banks. The most important impact of the house price correction is a deterioration in the credit quality of banks' domestic loan portfolios driven by higher default rates for households and businesses. Given the domestic nature of the shock, the credit quality of the international portfolio is unaffected. The worsening in macroeconomic conditions in the scenario is also associated with slower growth in earnings and dividends.

The performance of domestic financial markets is also affected by the high-stress regime. This leads to moderate additional losses on the value of assets on banks' trading books. In the risk scenario, prices and liquidity of the domestic equity and bond markets are affected the most. However, international diversification, hedging and limited exposure of banks to equity and bond markets limits losses due to market shocks.

Finally, the results of MFRAF suggest that first-round effects through credit, income and market losses would not likely be large enough to trigger second-round effects, such as fire-sale losses driven by forced deleveraging or losses on interbank exposures due to a contagion effect. Moreover, given the significant capital buffers of banks, the model does not generate additional liquidity stress beyond a moderate increase in bank funding costs.

**Figure 5: Impact of the stress scenario on the Big Six banks**



Note: The green line corresponds to the base case and the blue area to the risk scenario. Results closer to the centre indicate higher stress.

<sup>8</sup> During the recession that started in 2008, defaults in the construction and real estate sector peaked at 10 per cent in 2010, and they were at 29 per cent in 1994.

<sup>9</sup> The Big Six Canadian banks are Bank of Montreal, Canadian Imperial Bank of Commerce, National Bank of Canada, Bank of Nova Scotia, Royal Bank of Canada and Toronto Dominion Bank.

## Earnings

Net interest income would be lower in the risk scenario than in the base case. As a result of lower interest rates and a flatter yield curve, the net interest margin earned on loans (the difference between borrowing and lending rates) would be lower in the risk scenario compared with the base case. In addition, credit growth would be weaker.

Non-interest income would also be weaker in the risk scenario. Slower balance sheet growth limits the growth of fees earned on deposit accounts and loan balances. Moreover, the weaker economic activity and domestic stock market performance reduce income earned from investment banking and wealth management clients.

Cumulative earnings over the three-year simulation would be 14 per cent lower in the risk scenario compared with the base case. But the Big Six Canadian banks would continue to have substantial earnings through the risk scenario. This is due in large part to banks' international diversification, which allows them to generate normal earnings from the United States and other international exposures that are unaffected in our risk scenario. In recent years, about one-third of the earnings of the Big Six banks has been from international business segments.

## Credit losses

The average credit losses suffered by banks would be \$24 billion higher in the risk scenario compared with the base case.<sup>10</sup> Nevertheless, the average loss rate in the risk scenario remains lower than the loss rate observed during the 2008 recession.<sup>11</sup>

The additional losses in the risk scenario relative to the base case are driven primarily by losses on business and consumer loans. The proportion of losses in these portfolios is larger than their share of the loan book (Figure 6). This is consistent with observations from historical stress periods and the typically higher capital requirements for these exposures.

For the business loan portfolio, a large share of the additional losses in the risk scenario is due to elevated default rates in the construction and real estate sector. For consumer loans, including credit cards, additional losses are due to both higher default rates and higher losses on defaulted exposures because these loans are mostly unsecured.

In comparison, the additional losses incurred on residential mortgages and home equity lines of credit are small relative to the size of these portfolios. Although default rates for mortgages would be higher in the risk scenario relative to historical experience, they would remain low in absolute terms. Moreover, nearly half of mortgages held by banks are protected by mortgage default insurance.

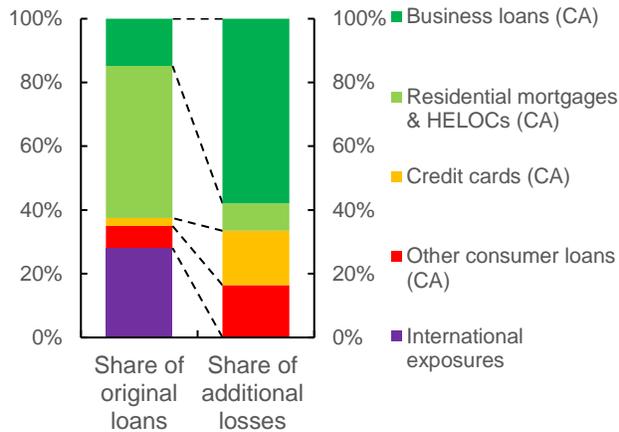
To help quantify the uncertainty around our estimate of average credit losses and highlight more extreme outcomes, the models in FRIDA generate a distribution of potential credit losses (Figure 7). This distribution is right-skewed, which means that more extreme outcomes could occur. A 90 per cent confidence interval for the increase in combined credit losses of the Big Six Canadian banks in the risk scenario relative to the base case is between \$18 billion and \$30 billion.

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<sup>10</sup> The projected credit loss rates are calculated using the default rates implied by the non-performing loans in the household and corporate sectors multiplied by the expected losses on defaulted exposure, which are calibrated using regulatory data and expert judgment.

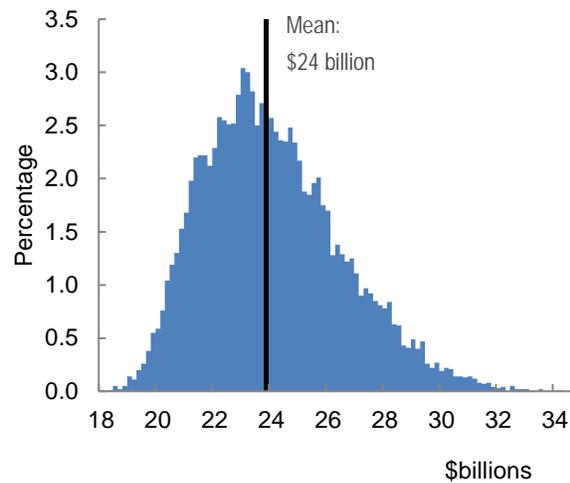
<sup>11</sup> Compared with the 2008 recession, more defaults are concentrated in sectors where expected losses on defaulted exposures are lower.

**Figure 6: Additional credit losses in the risk scenario arise mostly from business and consumer loans**



Note: HELOC stands for Home Equity Line of Credit.

**Figure 7: Total credit losses could be larger**  
Distribution of credit losses (before taxes) in the risk scenario relative to the base case



## Capital ratios

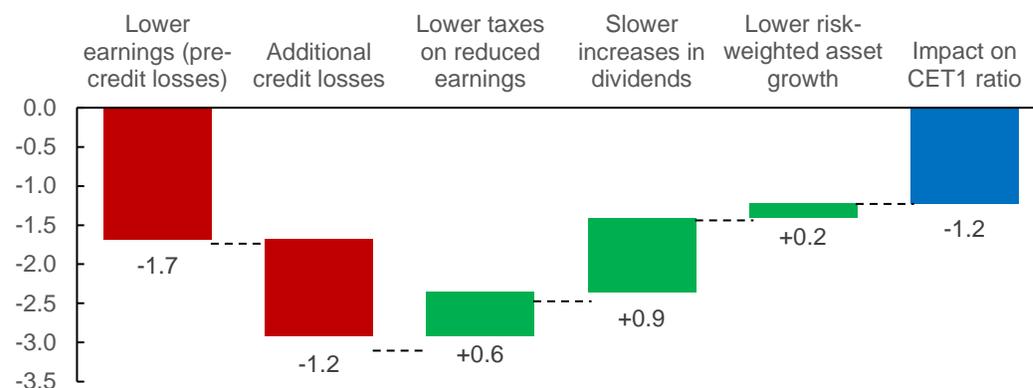
The average capital ratio of the Big Six Canadian banks is 1.2 percentage points lower in the risk scenario relative to the base case. Figure 8 provides a summary of the impact of the risk scenario on the various components that contribute to bank capital. Notably, the lower amount of taxes paid on reduced earnings and a slower rate of increase in bank dividends<sup>12</sup> help offset the impact of decreased earnings and increased credit losses relative to the base case.

For the purpose of quantitative risk assessment, the difference in capital between the risk scenario and the base case is most useful in understanding overall effects. But to assess bank resilience, it is also useful to consider the evolution of absolute capital ratios. In both the base case and the risk scenario, capital grows in absolute terms due to the continued positive income and moderate credit losses. Bank capital ratios would therefore remain above regulatory requirements.

<sup>12</sup> In the TDSA, banks are assumed to target a specific dividend payout ratio (the ratio of dividends to earnings) when earnings are rising. This is calibrated on the historical behaviour of each bank. In addition, the tool does not allow for banks to deploy capital into acquisitions or share repurchases. This assumption can lead to rising capital ratios due to rising retained earnings.

**Figure 8: The impact of the risk scenario on the average CET1 ratio is moderated by lower taxes and slower dividend increases**

CET1 impact of the risk scenario relative to the base case, as a percentage of initial risk-weighted assets. The impact is decomposed into negative (red bars) or positive (green bars) contributions.



Note: CET1 stands for Common Equity Tier 1 capital

## Discussion

The hypothetical, low-probability house price correction scenario considered here is not expected to threaten the overall resilience of the Big Six Canadian banks. Losses are not large enough to trigger funding withdrawals or asset fire sales. Banks' resilience through the risk scenario is supported by their international diversification and their ability to replenish capital with retained earnings.

Still, procyclical behaviour in the financial system could amplify macroeconomic effects, even though financial system resilience is not threatened. Smaller financial institutions that focus on uninsured mortgage lending may be forced to take corrective actions and reduce their supply of lending. To deal with higher losses and reduced earnings, larger banks may adjust their lending behaviour by tightening lending requirements. Financial market volatility is likely to contribute to higher risk premiums.

The overall effects on the financial system depend on the scenario being considered. The outcomes would likely be more severe

- (i) in the case of a larger house price correction;
- (ii) if the correction were accompanied by other shocks, leading to a broader and deeper economic recession in Canada (e.g., Risk 1 of the June 2018 *Financial System Review*); or
- (iii) if international shocks reduced the benefits of international diversification for the banks (e.g., Risk 3 of the June 2018 *Financial System Review*).

In addition, our analysis assumes that bank creditors are well-informed and forward-looking, so that the healthy capital position of the large banks prevents creditors from withdrawing funding. A risk scenario that somehow triggers a disproportionate loss in confidence by bank creditors might also lead to more severe outcomes.

Even in a substantially more severe risk scenario, the resilience of the Canadian financial system would be supported by additional layers of protection. Banks have a range of tools they can use to manage shocks, such as seeking additional equity capital. Fiscal policy and additional monetary policy actions may be used to mitigate macroeconomic effects. And, should any financial institution face significant financial stress, authorities have a powerful set of crisis management tools that can be deployed to limit damage to the financial system.

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