

Introducing the Scotiabank Recession Probability Model

- What are financial markets signalling about recession risks? The current flattening of the yield curve, in conjunction with the length of the expansion in the United States and to a lesser extent Canada, is being interpreted by some market participants as a signal that the risk of a recession is rising (chart 1).
- To assess the risk of recession in Canada implied by financial variables, we have developed a quarterly model to identify the probability of a recession up to four quarters ahead, using the slope of the yield curve, the probability of a recession in the US as determined by the New York Fed, the change in consumer confidence, and the short term interest rate. The model successfully predicts nearly every recession in Canada since late 1960s.
- Our analysis suggests a simplistic framework relying on the yield curve alone as an indicator of recession risk in Canada misses a number of other important indicators. When we account for the factors in our Recession Probability Model, we find that the probability of a recession in Canada over the next four quarters is very low by historical standards (chart 2).
- The low estimated probability of a recession is consistent with the reasonably strong growth we continue to expect in Canada in 2018, as laid out in our most recent monthly forecast. The consistency is despite the recession probability being based almost exclusively on financial variables, while the macroeconomic forecast is informed by our macroeconomic model of the Canadian economy, which projects growth on the basis of a broad range of economic fundamentals (Scotiabank's Global Macroeconomic Model).

This September the Canadian economy reached a milestone—100 months since emerging from the 2008–09 recession in June of 2009.¹ This makes it the third longest economic expansion since the 1950s. How long can this expansion continue? The flattening of the yield curve could be interpreted as a signal that the expansion may come to an end. This note introduces the Scotiabank Recession Probability Model (SRPM), to quantify the likelihood of a recession in the next few quarters based on financial market developments alone.

MATURING ECONOMIC CYCLE AND FLATTENING YIELD CURVES

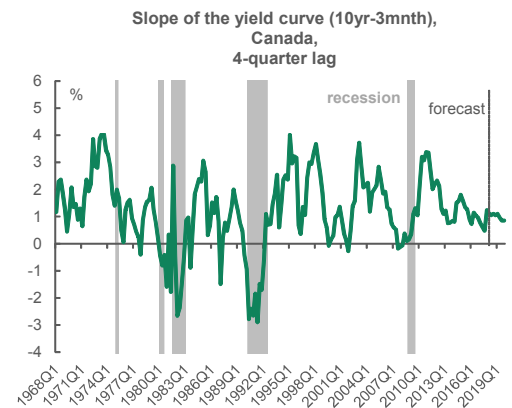
Surprisingly strong economic growth over the past four quarters has all but eliminated any remaining excess supply in Canada, with the output gap likely to close in 2017Q4. Scotiabank Economics projects that during 2017H2–18H2 the economy will start to build excess demand (see [Scotiabank Economics report from November 3rd, 2017](#)). If the real economy is to work off this excess demand, with

¹ Throughout the note we rely on the C.D. Howe Institute Business Cycle Council, recognized authority on dating the business cycle in Canada, for the dates of recessions in Canada. To translate the monthly recession indicator from C.D. Howe Institute into a quarterly one we assume the economy to be in recession in a given quarter if the monthly indicator takes the value of 1 in any month in that quarter.

CONTACTS

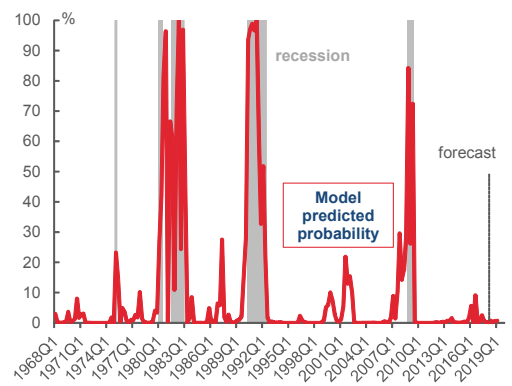
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Chart 1: The slope of the yield curve historically declined in times of economic stress



Sources: Scotiabank Economics, Haver Analytics.

Chart 2: The model shows a small probability of a recession in Canada in the next four quarters



Sources: Scotiabank Economics, Haver Analytics.

the level of real GDP converging to that of potential output, and inflation being at the Bank of Canada's (BoC) 2.0% target, GDP will have to grow slower than potential output in the later years, partly on the back of rising monetary policy rates. Given the low growth in potential output projected for the next five years, around 1.6% annually, GDP growth should slow down significantly (see [Scotiabank Economics, report from November 20th, 2017](#)). In this context, the vulnerability of the economy to adverse shocks is expected to rise.

WHAT IS A RECESSION AND WHY SHOULD WE CARE ABOUT IT?

According to the C.D. Howe Institute's Business Cycle Council a recession is a "pronounced, pervasive and persistent" decline in aggregate economic activity (see Cross and Bergevin, 2012). This definition is different from the so-called "technical" recession, i.e. two consecutive quarters of negative growth in real GDP.

- For intuition, it is instructive to look at 2015H1. While real GDP contracted for two quarters in a row, the contraction did not constitute a recession, according to the C.D. Howe Institute, as only a handful of industries contracted, the contraction in real GDP was relatively short, and national employment continued to expand during 2015H1 (see C.D. Howe Institute's Business Cycle Council, 2016).

The costs associated with recessions are usually significant and widespread. While the Global Financial Crisis of 2008–09 led to large losses in short- and long-term output for most countries in the OECD (see Ball, 2014), the costs of a more typical recession are considerable as well (see Blanchard *et al.*, 2015). Moreover, these costs are widely felt:

- Households experience lower growth in labour compensation (wages and salaries), partly due to falling hours worked, and increasing unemployment (table 1). Corporations see aggregate profits fall and equity returns decline;
- In addition, the longer-term costs of recessions could include the decline in labour force participation, the erosion of workers' skills and lower productivity.

Mitigating the costs of recessions is a challenge for policymakers:

- While the BoC has responded aggressively to the 2008–09 recession, its ability to respond to cyclical downturns in the future is more limited: by the BoC's own calculations the neutral rate, which is the rate consistent with a closed output gap and consumer price inflation at the target, has declined to just 3% and the effective lower bound is estimated at -0.5% (see BoC, 2017 and Witmer and Yang, 2016);
- The government's fiscal position usually deteriorates with the onset of a recession, as tax revenues fall and spending, such as unemployment benefits, increases. Nevertheless, an optimal response to a recession may mean an even larger increase in spending to offset a cyclical fall in private demand. A large increase in spending may face political opposition or may run counter to the goal of fiscal sustainability. Policies to counter long-term (structural) costs of recessions may require economic reforms, which are usually politically difficult.

Table 1: Costs of recessions have been widely felt

Canada, 1968Q1–17Q2		Recessions	Expansions
Wages and salaries, nominal	%saar	3.2	6.1
Actual hours worked	%saar	-3.1	2.0
Total return index, S&P TSX	%ar	11.9	15.8
Net operating surplus, corporations	%saar	-12.5	13.5
Change in unemployment rate	p.p.	0.6	-0.1
Change in output gap, BoC, EMVF	p.p.	-1.0	0.1

Sources: Scotiabank Economics, Haver Analytics

A RECESSION OVER THE NEXT 4 QUARTERS IS UNLIKELY

Given the economic implications of a recession, a large economic literature has developed various techniques to give advance warning to policymakers and the private sector of upcoming downturns. Still, accurately forecasting a recession's onset remains a challenge, in particular since each economic contraction is associated with a unique set of economic conditions and trigger events. In Canada, there have been five recessions since the 1970s, two of which were triggered by a financial crisis in the US (1975 and 2008–09), two were triggered by a spike in oil prices and tight monetary policy (1980 and 1981–82), and one (early 1990s) that was exacerbated in part by the Gulf War and the introduction of the GST in Canada (see Cross and Bergevin, 2012).

Nevertheless, several useful indicators have been found that can signal an upcoming contraction roughly a year in advance, chief among them the slope of the yield curve. For Canada we adapt the model in Estrella and Trubin (2006) which uses the slope of the yield curve for the US to quantify the probability of a recession a year ahead. We include additional regressors to make the identification of recessionary episodes more robust (see charts 1,3–5; box 1 explains the methodology in more detail).²

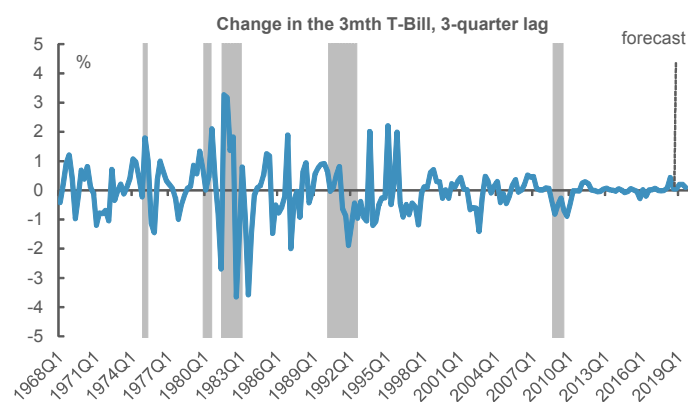
- the slope of the yield curve is defined as the difference between the 10-year Canadian government bond yield and the 3-month Treasury bill. A flatter yield curve can be a signal of slowing growth/weaker inflation or overly tight monetary policy;
- to capture the close relationship between the Canadian and US economies, we include the probability of a recession in the US, which is based on the slope of the US yield curve, as calculated by the NY Federal Reserve;
- since a recession is a broad decline in economic activity, consumption growth usually slows, and so consumer sentiment can provide a useful warning in the absence of changes in the slope of the yield curve. Thus, we include the quarterly percentage change in consumer confidence in Canada;³
- finally, an increase in the short-term borrowing costs is typically intended by policymakers to slow economic growth. Thus, we include the quarterly change in the 3-month Treasury bill rate.

Chart 3: A small probability of a US recession going forward



Sources: Scotiabank Economics, Haver Analytics.

Chart 4: The short-term interest rate increases are gradual enough to support growth over the next 4 quarters



Sources: Scotiabank Economics, Haver Analytics.

² Given the nonlinear nature of the model the coefficient values cannot be interpreted as elasticities of the recession probability to the regressors.

³ Canada's consumer confidence index prior to 2002 is constructed by using an equation with US consumer confidence and other determinants.

The model features significant nonlinearities, as shown in box 1: a simultaneous change in all regressors produces a much stronger recessionary signal, compared to the same changes in one regressor at a time.

The model fits well over the post-1970 period, producing few false signals (chart 2), with all but one of the recessions observed since the 1970s correctly identified. Moreover, periods of economic stress, such as the 1987 stock market crash, and the 2001 US recession, are picked up by the model.

- Among the regressors, the slope of the yield curve is the dominant indicator of the probability of recession in Canada, while the probability of a recession in the US is the second most important component.
- Once both indicators above start to flash warning signs, a decline in consumer confidence helps confirm the recessionary signal.
- As an illustration, consider 2016Q3, when the probability of a recession jumped to 9%, from 0.1% in the previous quarter. This is explained by a decline in consumer confidence of about 11% in 2016Q1. In addition, the slope of the Canadian yield curve flattened somewhat in 2015, and the probability of a US recession had started to increase.

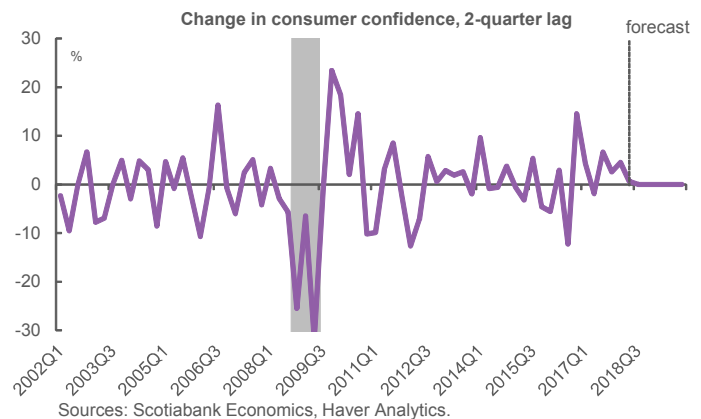
Taking into account the available data for the regressors and the forecast published by Scotiabank Economics (see [Scotiabank Economics report from November 3rd, 2017](#)) the probability of a recession in 2018 is at most just below 1%, which is low by historical standards.

- The probability of a recession in the US is estimated at between 5% and 10% in 2018 based on the NY Fed's model, low by historical standards (see chart 3);
- Given the nonlinearity of the model, the slope of the domestic yield curve, the probability of a US recession and consumer confidence need to move together to signal a high probability of a recession in Canada. The Canadian yield curve remains relatively flat and close to historical norms (see chart 1), with both the 3-month treasury bill rate and the 10-year government bond yield increasing relatively gradually so far this year (see chart 4), and consumer confidence in Canada remains solid. Thus the probability of a recession in Canada remains relatively low over the next four quarters.

Given the simplicity of the model, however, this estimate is likely an understatement. Notwithstanding its signalling power, the slope of the yield curve has a number of drawbacks as a predictor of recessions, both in general and in the current context, which motivated the inclusion of other variables, such as consumer confidence.

- the Canadian yield curve is likely to be affected by unconventional monetary policy in the US, potentially distorting its predictive ability in the current context;
- although we control for other factors, the model does not take into account the projected slowdown in the Canadian economy past 2018, as well as the larger macroeconomic backdrop as forecasted by Scotiabank Economics;

Chart 5: Consumer confidence in Canada has been rising recently



- finally, the model is unlikely to capture changes in economic uncertainty that are not reflected in the indicators we included. Arguably, current economic uncertainty is larger than normal, for example given a potentially significant impact from the outcome of NAFTA trade negotiations.

CONCLUSION

This note introduced the Scotiabank Recession Probability Model, which tracks the probability of a recession in Canada based on the slope of the yield curve, the probability of a recession in the US, consumer confidence in Canada, and the change in the 3-month Treasury bill rate.

- Intended to be regularly updated, the model provides a reading on the vulnerability of the Canadian economy to a recession 2–4 quarters ahead.
- While the yield curve is the most important indicator in the model, a decline in consumer confidence and an increase in the probability of a recession in the US would generally be needed to confirm a coming economic contraction in Canada. Thus, to signal a recession, a deterioration in all of these indicators is usually required—and this combination is not currently present.
- Over the next four quarters, the quarter by quarter probability of a recession is relatively low, at most just below 1%, because most of the indicators we look at are close to historical norms and consumer confidence has been rising in Canada.

Box 1: Scotiabank Recession Probability Model

The model described in this note is a probit model, estimated by maximum likelihood. The dependent variable, *recession_indicator*, takes the value of 1 in the quarters when the Canadian economy is in recession, according to the C.D. Howe Institute, and 0 otherwise. The model is defined as:

$$recession_indicator_t = \left(1 - \Phi\left(-x'_{i,t}\beta\right)\right) + \varepsilon_t$$

where Φ is the cumulative density function (cdf) of a standard normal distribution. The use of the standard normal cdf gives the model its nonlinear character. The regressors we use in the model, $x_{i,t}$ as well as the results of the estimation, are listed in table B.1.

Variable	Coefficient	Z-Statistic
Constant	-1	-4.59
Slope of the yield curve, 4-quarter lag	-111	-4.84
Change in the 3mth T-Bill, 3-quarter lag	49	2.80
Change in the 3mth T-Bill, 4-quarter lag	-57	-2.94
Change in consumer confidence, 2-quarter lag	-9	-3.38
Probability of a U.S. recession, 2-quarter lag	2	2.02
McFadden R-squared		0.62
Quarters in expansion		178
Quarters in recession		21
Sample:		1968Q1-17Q2

The nonlinear nature of the model is seen in table B.2, which shows the impact on the average probability of a recession in Canada during 2018H2–19Q1 from a one standard deviation shock to the level of each factor—one at a time (panel A), and all shocks together (panel B). While shocks to individual variables have a relatively small impact on the probability of a recession, once all variables move together the impact is significant, and much higher than the sum of individual contributions from panel A.

Panel A		
Shock to the level of:	Shock size (1 standard deviation)	Impact on the probability relative to the base case, each shock separately
10-year Government Bond yield	-65bps (17Q3+)	+2.6%
3-month Treasury Bill	+82bps (17Q4+)	+2.3%
Consumer Confidence	-9% (18Q1+)	+0.6%
Probability of the US being in recession in a given quarter	+8p.p. (18Q1+)	+0.3%
Panel B		
Shock to the level of:	Shock size (1 standard deviation)	Impact on the probability relative to the base case, all shocks together
All variables above hit by 1 standard deviation shocks on the level	see above	+19.0%

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