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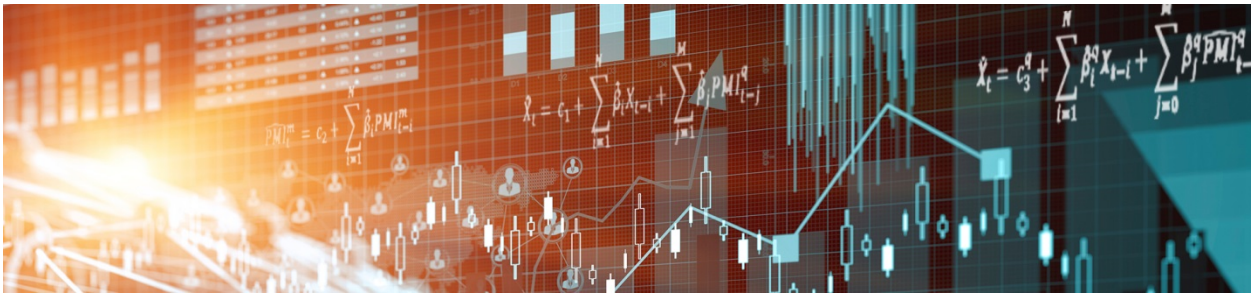
The Neutral Rate in Canada: 2019 Update



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Abstract

This note provides an update on Bank of Canada staff's assessment of the Canadian neutral rate. The neutral rate is the policy rate needed to keep output at its potential level and inflation at target once the effects of any cyclical shocks have dissipated. This medium- to long-run concept serves as a benchmark for gauging the degree of monetary stimulus provided by a given policy setting. Staff's overall assessment, which is based on the combined output of a suite of four distinct approaches, is that the Canadian neutral rate likely lies in a range of 2.25 to 3.25 per cent in nominal terms, lower than the range of 2.5 to 3.5 per cent reported at the time of the last update in April 2018. Although this downward shift stems mainly from a lower assessed global neutral rate, the overall assessment also reflects some improved modelling techniques enabling staff to better capture the medium- to long-run impact of macroeconomic risk on the level of the neutral rate. Moreover, while staff's assessed range for the neutral rate captures important sources of uncertainty, it should not be interpreted as reflecting the full extent of the uncertainties surrounding the neutral rate.

Bank topics: Economic models; Interest rates; Monetary policy
JEL codes: E40, E43, E50, E52, E58, F41

Résumé

Cette note met à jour l'évaluation par le personnel de la Banque du taux neutre canadien, c'est-à-dire le taux directeur requis pour maintenir la production à son niveau potentiel et l'inflation à son taux cible, une fois disparus les effets des chocs cycliques. Ce concept de moyen à long terme sert de point de référence pour évaluer le degré de détente monétaire résultant d'une politique donnée. Selon l'évaluation globale du personnel, qui est basée sur la juxtaposition des résultats de quatre approches distinctes, le taux neutre canadien se situe probablement dans une fourchette allant de 2,25 à 3,25 % en termes nominaux, ce qui est un peu plus bas que la fourchette de 2,5 à 3,5 % publiée lors de la dernière mise à jour, en avril 2018. Même si cette révision à la baisse découle surtout d'une réduction de la valeur estimée du taux neutre mondial, l'évaluation globale résulte également d'une meilleure modélisation, qui a permis au personnel de mieux rendre compte des effets à moyen et long terme des risques macroéconomiques sur le niveau du taux neutre. Par ailleurs, bien que la fourchette du taux neutre estimée par le personnel tienne compte d'importantes sources d'incertitude, elle ne devrait pas pour autant être vue comme la résultante de l'ensemble des incertitudes qui entourent le taux neutre.

Sujets : modèles économiques; taux d'intérêt; politique monétaire
Codes JEL : E40, E43, E50, E52, E58, F41

1 Introduction and main results

This note provides an update on Bank of Canada staff's assessment of the Canadian neutral rate relative to its assessed range at the time of the last update in April 2018, as described in Chen and Dorich (2018). While many definitions are used in the literature, staff focus on one that associates the neutral rate with the policy rate needed to keep output at its potential level and inflation at target once the effects of any cyclical shocks have dissipated. The deviation of the current policy setting from this medium- to long-run anchor serves as a gauge of the level of stimulus provided by monetary policy.

Our overall assessment is that the Canadian neutral rate likely lies in a range of 2.25 to 3.25 per cent in nominal terms, somewhat lower than the range of 2.5 to 3.5 per cent reported in the 2018 update. This downward shift stems mainly from a lower assessed range for the global neutral rate, which the Canadian rate is closely linked to because of the highly open nature of the Canadian economy. The overall assessment also reflects some improved modelling techniques, which we elaborate on below.

Staff's current and 2018 ranges for the Canadian neutral rate were both constructed by aggregating the most likely ranges implied by a suite of methodologies after gauging each methodology's sensitivity to key parameters and other inputs. By virtue of being reached in this way, staff's overall assessment captures important sources of uncertainty but should not be interpreted as reflecting the full extent of the uncertainties surrounding the neutral rate. As first laid out in Mendes (2014), the methodological suite specifically comprises a set of four distinct but complementary approaches, each emphasizing the role of different factors in determining the level of the neutral rate. These approaches are

(i) a pure interest rate parity benchmark under which the Canadian neutral rate coincides with the global neutral rate, thus placing full emphasis on foreign factors;

(ii) a closed-economy neoclassical growth model (NCGM) that shifts attention to domestic factors;

(iii) a reduced-form model that combines domestic and foreign factors on an agnostic basis; and

(iv) a small open economy model with overlapping generations that captures demographic and life-cycle factors that the other models largely abstract from.

While most of these approaches are essentially unchanged relative to their forms at the time of the last update, staff refine the suite on an ongoing basis and have focused their most recent efforts on improving the NCGM. These improvements specifically involve using newly developed methods to better capture the medium- to long-run effects of macroeconomic risk on the level of the neutral rate.[1] Capturing these effects is especially important given indications of a secular increase in the likelihood of hitting the effective lower bound on nominal rates, coupled with

[1] Chen and Dorich (2018) identified this as an area where the modelling suite required some enhancement.

multiple sources of significant and persistent uncertainty in the global outlook. Indeed, our results suggest that failure to account for these considerations may lead to overstatement of the neutral rate. For clarity, we refer to the new version of the NCGM as the "risk-augmented neoclassical growth model."

Table 1 summarizes the ranges implied by each of the four approaches, along with the ranges that they implied at the time of the 2018 update.[2] In the case of the risk-augmented NCGM, the range in the right-hand column is what the model *would have implied* had it been in place at the time.

Table 1: Summary of neutral nominal policy rate estimates for Canada

Approach	2019 estimates (%)	2018 estimates (%)
Pure interest rate parity	2.25–3.25	2.5–3.5
Risk-augmented neoclassical growth model	2.25–3.25	2.25–3.25
Reduced-form model	2.25–3.0	2.5–3.25
Overlapping generations model	2.5–3.25	2.75–3.25
Overall assessment	2.25–3.25	2.5–3.5

The remainder of this note is organized as follows. Section 2 provides details on the four approaches, along with the results that they imply. Section 3 then offers some concluding remarks and identifies avenues for future work that may warrant attention as staff continue refining and enhancing the neutral rate modelling suite.

2 Approaches and results in greater detail

2.1 Pure interest rate parity

Given the open nature of the Canadian economy, pure interest rate parity represents a natural benchmark for neutral rate assessment. Under this approach, we abstract from frictions that might impede cross-border capital flows, in which case nominal interest rates should equalize in the long run across countries with similar inflation rates.[3]

As in Mendes (2014), Dorich, Reza and Sarker (2017) and Chen and Dorich (2018), we treat the US neutral rate as a proxy for the global neutral rate and centre a ±50 basis point range for the US neutral rate around the median assessment of the appropriate "longer-run" level of the federal funds rate, as reported by Federal Open Market Committee (FOMC) members in the

[2] All rates reported in this note have been rounded to the nearest 25 basis points.

[3] More specifically, pure interest rate parity implies that nominal interest rate differentials should arise only if agents expect compensating movements in nominal exchange rates. However, under a standard assumption that real exchange rates should remain constant in the long run, countries with equal inflation rates should also exhibit constant nominal exchange rates in the long run and should therefore converge to a common nominal interest rate.

Federal Reserve's Summary of Economic Projections. As of the most recent release in March 2019, this median assessment stood at 2.75 per cent, down from 3.0 per cent at the time of the Bank's previous neutral rate update. This leads to a likely range of 2.25 to 3.25 per cent for the neutral nominal policy rate, an interval that currently includes 15 of the 16 longer-run assessments reported in the Summary of Economic Projections. It also includes several other sources' projections of the level at which US nominal interest rates will settle in the medium to long run, as reported in **Table 2**.

Table 2: Current estimates of the nominal interest rate in the United States over the medium to long run

	Estimate (%)	Date of estimate
Federal Reserve	2.75 (median)	March 2019
International Monetary Fund	3.0	July 2018
Macroeconomic Advisers	2.5–2.75	September 2018
TD Economics	2.5	March 2019
Congressional Budget Office	3.0	January 2019

2.2 Risk-augmented neoclassical growth model

While the approach above focuses on foreign determinants of the Canadian neutral rate, our second approach focuses on domestic determinants in the context of a closed-economy NCGM. We have made significant improvements to this model since the 2018 neutral rate update. As explained in Chen and Dorich (2018), a shortcoming identified in the Bank's neutral rate modelling suite at the time of the last update was that the suite lacked a formal accounting for the effects of macroeconomic risk. Since agents tend to respond to risk by increasing their demand for safe assets, this omission entailed an implicit abstraction from a potential source of downward pressure on the neutral rate. We have now addressed this issue by shifting attention to the NCGM's stochastic steady state, as opposed to the deterministic steady state considered in the 2018 update and much of the wider literature to date. While the same factors influencing the neutral rate in deterministic steady state also act as drivers in stochastic steady state, the stochastic approach recognizes that background risks will persist in the economy in the medium to long run and may leave a signature on the neutral rate as agents demand safe assets to better insure themselves.

In shifting attention from the NCGM's deterministic steady state to its stochastic steady state, we rely on methods recently developed by Emmanuel Farhi (Harvard University) and François Gourio (Federal Reserve Bank of Chicago) in an article forthcoming in the *Brookings Papers on Economic Activity*. In the Farhi-Gourio framework, which builds on the "rare disasters" tradition of Reitz (1988) and Barro (2006), the economy faces a probability p of a tail event associated with

reductions in the capital stock and labour productivity, both of which fall by factor $(1-\epsilon)$ should a tail event occur. In this case, the household Euler equation reads as follows in stochastic steady state:

$$r = \underbrace{\zeta + n + \sigma g}_{*} - DSA(\theta, p, \epsilon), \tag{1}$$

where r denotes the real risk-free rate; n denotes the rate of population growth; g denotes the growth rate of output per capita; σ denotes the inverse elasticity of intertemporal substitution (IES); ζ is an intercept that depends on the household discount factor, in addition to collecting unmodelled factors like the household credit spread; and $DSA(\theta, p, \epsilon) > 0$ is a function capturing households' demand for safe assets as insurance against risk, which tends to increase in the coefficient of relative risk aversion θ, tail probability p and tail event size ϵ. The starred term thus captures the same factors that influence the neutral rate in deterministic steady state and coincides with the expressions characterizing the neutral rate in the NCGMs considered in Mendes (2014) and Chen and Dorich (2018). In contrast, the new term $DSA(\theta, p, \epsilon)$ arises from our shifting attention to a stochastic context.

This extra term in the Euler equation complicates the task of finding values for the model's parameters. Fortunately, the main insight of Farhi and Gourio is that the same forces introducing a demand-for-safe-assets component into the risk-free rate also introduce risk premiums into the pricing of risky assets, including equities.[4] This suggests that equity-pricing data can play a role in disciplining our calibration. In particular, our baseline approach treats the tail event as a relatively rare occurrence—namely, by setting its probability to p = 5 per cent—then calibrates the tail event size ϵ as needed to account for the average price-to-dividend ratio observed over a long historical sample (1985–2011), assuming risk aversion of $\theta = 60$ in line with Piazzesi and Schneider (2007).[5,6] We then estimate the intercept ζ using the method in Mendes (2014), while setting IES to $\sigma = 1.14$ as in Dorich et al. (2013).

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[4] More specifically, it can be shown that the same factors driving households' demand for safe assets also give rise to a risk premium in the expected return on capital,

$$r^K = r + RP(\theta, p, \epsilon),$$

which then pins down the price-to-dividend ratio, namely through (a leverage-adjusted version of) the Gordon growth formula:

$$\frac{P}{D} = \frac{1+g+n}{r^K + \omega(r^K - r) - (g+n)},$$

where ω denotes the ratio of net debt to equity. All else being equal, these formulas thus encode a negative relationship between the price-to-dividend ratio and risk premium: the lower the price-to-dividend ratio, the higher the risk premium that agents incorporate into the rate at which they discount future dividends, namely due to some combination of higher θ, p and/or ϵ. Since the Gordon growth formula above implicitly assumes that firms pay the risk-free rate on their debt, we have also experimented with an alternate formula that takes into account the average spread on corporate debt. The implied results have been included in the ranges reported in **Table 1**.

[5] See also Campbell and Cochrane (1999), Tallarini (2000), Van Binsbergen et al. (2012), Rudebusch and Swanson (2012) and Swanson (2016).

[6] Note that the ranges reported in **Table 1** also include the results implied by a variety of alternative choices on the pair (θ, p) and by alternative calibration strategies under which we instead fix values for the pair (p, ϵ) or (θ, ϵ), then

Given the estimated value for the intercept ζ and above-noted values for the triplet (p, θ, σ), we assess the level of the neutral rate by setting n and g respectively equal to staff's projections on the rates at which population and potential output per capita are expected to grow over the 2019–22 period.[7] When doing so, we also adjust the tail event size ϵ to account for the possibility that the level of risk prevailing over this horizon might differ from that prevailing over the historical sample.[8] This allowance is natural in view of the fact that our historical sample includes many observations from the Great Moderation period. In contrast, the projection horizon is associated with a heightened risk that the effective lower bound might constrain the amount of stimulus that policy-makers could provide in response to tail events; the experience of the global financial crisis and Great Recession may also have led agents to revisit their assessments of the impact that tail events can have on the economy.[9] For these reasons, we specifically form our baseline view on the level of risk likely to prevail over the projection horizon by adjusting the tail event size ϵ as needed to account for the average price-to-dividend ratio observed over a post-recession sample (2012–18).[10] In fact, this updating step represents the only aspect of our approach that differs from the simpler exercises in Mendes (2014) and Chen and Dorich (2018), since the term $DSA(\theta, p, \epsilon)$ would otherwise be constant and could thus simply be treated as part of the intercept ζ. Put differently, the risk-adjusted approach can be viewed as nesting the simpler one as a special case where we assume a common level of risk across the projection horizon and historical sample.

Under our baseline approach, we find that results favour a neutral rate around 2.50 per cent in nominal terms, significantly lower than the range of 3.25 to 3.50 per cent that the older version of the NCGM would imply because it abstracts from the risk-related forces that we have emphasized. To construct a range around this point estimate, we repeat our calculations under a variety of alternative calibrating, sampling and updating strategies. Overall, we find that these exercises favour a likely range of 2.25 to 3.25 per cent for the neutral nominal policy rate.

2.3 Reduced-form model

While the two approaches discussed above are somewhat imbalanced in the sense that they restrict their full attention to either domestic or foreign determinants of the Canadian neutral rate, the reduced-form approach posits a relatively agnostic relation of the form

$$i = \alpha + \beta_0 g_{ypot} + \beta_1 i_{global}, \qquad (2)$$

use equity prices to calibrate θ or p, respectively. In addition, the ranges reported in **Table 1** include results implied by several alternative historical samples, including samples from which the dot-com boom and global financial crisis have been omitted.

[7] See Brouillette et al. (2019).

[8] Note that the ranges reported in **Table 1** also include the results implied when changes in the level of risk are instead captured through adjustments in the tail probability p, rather than the tail event size ϵ.

[9] See, for example, Kozlowski, Veldkamp and Venkateswaran (forthcoming).

[10] Note that the ranges reported in **Table 1** include results implied when using more recent samples to form our view on the level of risk likely to prevail over the projection horizon. These ranges also include the results implied when using samples from which the year 2018 has been omitted.

where i and i_{global} denote the neutral nominal rates at home and abroad, respectively; g_{ypot} denotes the growth rate of domestic potential output; and $(\alpha, \beta_0, \beta_1)$ are coefficients to be estimated using methods described in Mendes (2014), which also provides discussion of potential micro-foundations.

When estimating equation 2 using 1995–2018 data, we find that the foreign factors captured by i_{global} tend to play a quantitatively more important role than the domestic factors captured by g_{ypot}. More specifically, we find that $(\alpha, \beta_0, \beta_1) = (0.29,\ 0.27,\ 0.68)$. Given these coefficients, equation 2 places the Canadian neutral nominal rate around 2.75 per cent when we set i_{global} equal to the 2.75 per cent midpoint of the range established in subsection 2.1 while setting g_{ypot} equal to staff's current projection for the rate at which potential output is expected to grow over the 2019–22 period.[11]

To construct a range around this point estimate, we entertain alternative scenarios where the global neutral rate is instead set equal to the upper and lower bounds of the 2.25 to 3.25 per cent range implied by the pure interest rate parity benchmark discussed in subsection 2.1. These alternative scenarios place the Canadian neutral rate in a likely range of 2.25 to 3.0 per cent on a nominal basis.

2.4 Overlapping-generations model

Our last approach imposes an overlapping generations (OLG) structure on a small open economy model in which the neutral rate is given by the sum of the global neutral rate and a country-specific risk premium. The latter is assumed to depend on Canada's net foreign asset (NFA) position as a percentage of gross domestic product (GDP)—in particular, the premium is assumed to rise when Canadians owe more debt to other countries. Foreign determinants thus impact the domestic neutral rate both directly through the global neutral rate and indirectly through the country-specific risk premium. On the other hand, domestic determinants, including life-cycle and demographic factors, are captured through their impact on domestic saving and investment decisions, which influence the NFA-to-GDP ratio and country-specific risk premium in turn.

The OLG model generates estimates for the Canadian neutral rate based on estimates of the global neutral rate and domestic inputs such as productivity growth, demographic trends, credit spreads and the average price markup. Relative to their assessed levels at the time of the 2018 update, three of these inputs have shifted somewhat. More specifically, the rates of trend productivity growth and trend labour input growth are, respectively, somewhat lower and higher, as detailed in Brouillette et al. (2019). Recent empirical work by De Loecker and Eeckhout (2018) and Diez, Leigh and Tambunlertchai (2018) has also pointed to the possibility that the average price markup in Canada might be higher than the 20 per cent level assumed for the 2018 update. While we find that the shifts in trend productivity growth and trend labour input growth roughly offset the effects of the lower global neutral rate, OLG simulations suggest that higher markups could lead to some downward pressure on the Canadian neutral rate. This is because the

[11] See again Brouillette et al. (2019).

monopolistic distortions associated with higher markups tend to reduce output and investment, thus leading to a higher current account, higher NFA-to-GDP ratio and lower country-specific risk premium. In particular, we find that OLG simulations place the neutral nominal policy rate in a range of 2.5 to 3.25 per cent when we entertain average markups in the 20 to 25 per cent range, the upper bound of which falls more in line with the longer-run average values documented in the two references noted above.

3 Concluding remarks

To summarize, the combined output of a suite of four distinct but complementary approaches leads staff to an overall assessment that the Canadian neutral nominal policy rate likely lies in a range of 2.25 to 3.25 per cent. This interval is somewhat lower than the range of 2.5 to 3.5 per cent reported at the time of the last update in April 2018. Note that ranges should not be interpreted as reflecting the full extent of the uncertainty surrounding the neutral rate.

With regard to future work, we close by highlighting two avenues that may warrant attention as staff continue refining and enhancing the neutral rate modelling suite. Given that the improved neoclassical growth model identified an important role for macroeconomic risk in determining the level of the neutral rate, the first such avenue could involve adapting some of the other models in the suite to include a formal accounting for the potential impact of macroeconomic risk. However, since many of the relevant risks also act on the foreign neutral rate, which these other models all take as a key input, we note that part of their impact is likely already being captured, albeit indirectly. In addition, given the elevated level of household debt in Canada, another natural avenue for future work could focus on incorporating a formal role for household debt into our neutral rate assessments.

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