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2020 US Neutral Rate Assessment

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Abstract

This paper presents Bank of Canada staff's current assessment of the US neutral rate, along with a newly developed set of models on which that assessment is based. The overall assessment is that the US neutral rate currently lies in a range of 1.75 to 2.75 percent. This represents a decline of 50 basis points relative to the range judged at the time of the Bank's last neutral rate update in April 2019. Roughly half of this decline reflects an assessment of conditions prevailing in late 2019 and is thus unrelated to the COVID-19 pandemic. The other half reflects the balance of several key channels through which the COVID-19 shock is likely to influence US interest rates over the years ahead, including its impacts on potential output growth, inequality, demand for safe assets and the level of US government debt. Results from the new models specifically point to upward pressure from higher government debt being more than offset by downward pressure from lower potential output growth, higher inequality and heightened demand for safe assets.

Bank topics: Economic models; Interest rates; Monetary policy
JEL codes: E, E4, E40, E43, E5, E50, E52, E58, F, F4, F41

Résumé

Cette étude présente l'évaluation actuelle, par le personnel de la Banque du Canada, du taux neutre aux États-Unis, ainsi qu'un nouvel ensemble de modèles sur lesquels repose cette évaluation. La Banque estime globalement que ce taux se situe en ce moment dans une fourchette allant de 1,75 à 2,75 %, soit 50 points de base de moins que celle publiée lors de la dernière mise à jour, en avril 2019. Environ la moitié de ce recul correspond à l'évaluation des conditions économiques qui prévalaient à la fin de 2019 et n'est donc pas attribuable à la pandémie de COVID-19. Le reste tient à la résultante des effets du choc de la COVID-19 susceptibles d'être transmis aux taux d'intérêt américains par différents grands canaux dans les années à venir, notamment ses effets sur la croissance de la production potentielle, les inégalités, la demande d'actifs sûrs et le niveau de la dette publique aux États-Unis. Les résultats obtenus à partir des nouveaux modèles semblent indiquer que la pression à la hausse exercée par un niveau plus élevé de dette publique est plus que compensée par les effets d'une croissance potentielle moindre, de plus grandes inégalités et d'une plus forte demande d'actifs sûrs.

Sujets : Modèles économiques; Taux d'intérêt; Politique monétaire
Codes JEL : E, E4, E40, E43, E5, E50, E52, E58, F, F4, F41

1. Introduction

This paper presents Bank of Canada staff's current assessment of the US neutral rate. Like previous neutral rate updates, it focuses on a medium- to long-run neutral concept that identifies the neutral rate with the policy rate consistent with stable inflation and output at its potential level after the effects of all cyclical shocks have dissipated (Mendes 2014).

Headline results

Our overall assessment is that the US neutral rate currently lies in a range of 1.75 to 2.75 percent.[1] This represents a decline of 50 basis points relative to the range judged at the time of the Bank's last neutral rate update in April 2019.[2] As we will explain in greater detail momentarily, about half of this decline reflects an assessment of conditions prevailing prior to the onset of the COVID-19 pandemic, while the other half represents our assessment of COVID-19's likely impact on the US neutral rate.

How was this assessment reached? What channels does it aim to capture?

While staff's previous assessments of the US neutral rate relied heavily on the Federal Reserve's Summary of Economic Projections (SEP),[3] a distinguishing feature of the 2020 assessment is that it marks a shift to a model-based approach relying on a new suite of structural models that staff have recently developed. This allows for more in-depth exploration of the US neutral rate's potential determinants, including key channels through which the COVID-19 shock is likely to influence US interest rates going forward.

To facilitate the shift from the SEP-based approach to a model-based approach, the analysis in this paper treats the December 2019 SEP as a pre-pandemic benchmark on which we then layer model-based estimates of the effects of COVID-19. More specifically, we construct our pre-pandemic benchmark by following Carter, Chen and Dorich (2019) in centring a range of plus or minus 50 basis points around US monetary policy-makers' median assessment of the appropriate "longer-run" level of the federal funds rate, as reported in the December 2019 SEP. As shown in **Table 1**, this results in a pre-pandemic range of 2 to 3 percent for the US neutral rate, suggesting that the US economy entered the COVID-19 crisis with a neutral rate 25 basis points lower than that assessed at the time of the Bank's last neutral rate update in April 2019.

Table 1: Staff's recent estimates of the US neutral rate

	Range (%)
Last neutral rate update (based on the March 2019 Summary of Economic Projections*)	2.25 to 3.25
Pre-pandemic benchmark (based on the December 2019 Summary of Economic Projections*)	2 to 3
Current assessment (based on a new suite of structural models)	1.75 to 2.75

* Ranges are constructed by centring a band of plus or minus 50 basis points around respondents' median assessment of the appropriate "longer-run" level of the federal funds rate. In both cases, the resulting range covers 15 of 16 total responses.

Given this pre-pandemic benchmark, we use a suite of newly developed structural models to explore and quantify key channels through which the COVID-19 shock and associated public and private sector responses are likely to impact the US neutral rate. Our analysis emphasizes four channels in particular:

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[1] Throughout this paper, we round our headline results to the nearest 25 basis points.

[2] See Section 2.1 in Carter, Chen and Dorich (2019).

[3] See again Section 2.1 in Carter, Chen and Dorich (2019), along with Section 3.1 in Chen and Dorich (2018).

- **Lower potential output growth**. The COVID-19 shock has led to significantly lower potential output growth, as detailed in Chen et al. (2020). This represents an important source of downward pressure on the neutral rate.
- **Increased inequality**. The costs of the COVID-19 shock are not being distributed evenly across households, and experience from previous epidemics and recessions points to a possibility that the shock could set the scene for a sustained increase in inequality. To the extent that higher inequality places relatively more resources in the hands of richer households with higher propensities to save, this channel should put additional downward pressure on the neutral rate.
- **Higher perceived levels of tail risk**. The COVID-19 shock will also likely lead to a sustained increase in the perceived level of tail risk in the economy now that firms and households are more aware of the possibility of global pandemics and their negative effects on economic activity. To the extent that agents demand more safe assets as insurance against such risk, this channel should put further downward pressure on the neutral rate.
- **Expanded US government debt**. The extraordinary fiscal measures deployed in response to COVID-19 have led to a significant expansion of US government debt. While the theoretical literature is divided on whether this should lead to a higher or lower neutral rate, simulations in a model designed to capture two of the key mechanisms at play point to a net positive impact, driven by an increase in the supply of safe, liquid assets available to savers.

As shown in **Table 1**, results from the new models suggest that these channels have had the net effect of reducing the US neutral rate by about 25 basis points relative to our pre-pandemic benchmark. More specifically, results point to upward pressure from higher government debt being more than offset by downward pressure from lower potential output growth, higher inequality and an increase in the perceived level of tail risk in the economy.

The new modelling suite in greater detail

Our analysis relies on a suite of three newly developed structural models, each emphasizing different aspects of neutral rate determination:

- **HALO model**. For the channels related to inequality and government debt described above, we rely on a new model that we built specifically to capture these channels. For reasons on which we elaborate below, we call this the "heterogeneity- and liquidity-adjusted semi-open-economy model," or "HALO" for short. Though stylized, this framework can be calibrated to match estimates of the pre-COVID-19 distribution of income, marginal propensity to save among rich households and elasticities of domestic and foreign demand for US government bonds. As a result, the model provides a laboratory for exploring the macroeconomic consequences of shifts in inequality and in the level of US government debt.
- **Risk-augmented neoclassical growth model**. For the tail risk channel described above, we rely on a new US version of the risk-augmented neoclassical growth model that Carter, Chen and Dorich (2019) first developed in a Canadian context. This framework was designed specifically to capture the role of macroeconomic risk in neutral rate determination, though we explain below that some modifications were needed to address special modelling challenges presented by COVID-19.
- **Overlapping generations (OLG) model**. We have also developed a new US version of an OLG model that was first introduced in a Canadian context by Mendes (2014). It aims to capture demographic and life-cycle factors that the other models abstract from.

As shown in **Table 2**, these models differ somewhat in terms of the ranges in which they currently place the US neutral rate. However, all models point to ranges centred at or near 2.25 percent, along with

1.75 percent as a lower bound. While the appropriate upper bound is less clear, we note that an upper bound of 3 percent is supported only by specific calibrations of one of the three models. For this reason, we maintain Bank staff's usual practice of focusing on a symmetric range of plus or minus 50 basis points, resulting in an overall current assessed range of 1.75 to 2.75 percent.

Table 2: Summary of the three structural models' current assessed ranges for the US neutral rate

	Range (%)
HALO model	1.75 to 3
Risk-augmented neoclassical growth model	1.75 to 2.75
Overlapping generations model	2 to 2.5
Full range of estimates	1.75 to 3
Staff's overall view	1.75 to 2.75

Road map for the remainder of the paper

The remainder of this paper is organized as follows. In Section 2, we elaborate on the issues of inequality and government debt raised above, then present the HALO model that we used to tackle them and the results it implies. In Section 3, we repeat for tail risk perceptions and the risk-augmented neoclassical growth model. Section 4 then turns attention to the OLG model. Section 5 offers some concluding remarks and identifies potential avenues for future work.

2. Inequality and government debt: insights from the HALO model

In this section, we briefly explain why inequality and government debt matter for the neutral rate and how the COVID-19 shock will likely impact these two variables. We then introduce the HALO model and use it to quantify the potential implications for the US neutral rate.

2a. Inequality, COVID-19 and the neutral rate

The link between inequality and the neutral rate arises because the neutral rate plays an important role in balancing savings and investment in the medium to long run. To the extent that higher inequality places a larger share of the economy's resources in the hands of richer households with higher propensities to save, it tends to put upward pressure on aggregate savings and downward pressure on the neutral rate.

While there is evidence to suggest that the *short-term* costs of the COVID-19 shock are not being distributed evenly across households, what is essential for the purposes of the time horizons relevant to the neutral rate is that the shock also leave a medium- to long-run signature on the level of inequality. On this front, Furceri et al. (2020) use an international panel to study the medium- to long-run evolution of inequality following previous epidemics such as severe acute respiratory syndrome (SARS), H1N1 influenza and Middle East respiratory syndrome (MERS). In countries where outbreaks were accompanied by economic downturns, the authors find that these epidemics were associated with sustained increases in income inequality lasting at least five years. Galletta and Giommoni (2020) offer complementary evidence from Italian experience following the 1918 influenza epidemic.

Though these empirical references do not attempt to identify the underlying mechanisms at work, at least two mechanisms could contribute to a significant increase in US inequality over the years ahead:

- **A labour-market-based mechanism.** Heathcote, Perri and Violante (2020) offer evidence that (i) job losses among poorer households tended to increase inequality during previous US recessions, and (ii) these effects tended not to reverse fully during subsequent recoveries. The authors attribute this pattern to a combination of scarring effects and skill-biased technological change, both of which can make it difficult for poorer workers laid off during recessions to find their way back into secure employment. A repeat of this pattern stands out as a potential channel through which the COVID-19 shock could lead to a sustained increase in US inequality, especially if the recovery proves weak for in-person service industries or if automation trends accelerate.

- **A mechanism based on market concentration.** At the same time, larger firms' greater resources and access to financial markets may leave them better positioned to weather the COVID-19 shock and associated downturn when compared against smaller firms. To the extent that ownership of larger firms is concentrated among wealthier households, the resulting increase in market concentration could lead to higher inequality. Moreover, this dynamic could be reinforced to the extent that migration from in-person shopping to online commerce benefits "superstar" firms like Amazon and Google.

2b. Government debt, COVID-19 and the neutral rate

In addition to potentially setting the scene for an increase in inequality, the COVID-19 shock has also led to fiscal interventions that have put US government debt on track to revisit highs last witnessed in the 1940s when measured as a share of gross domestic product (GDP).[4]

Unlike was the case for inequality, the literature is somewhat divided on the direction of the impact of higher government debt on the neutral rate. While a full review of the literature lies outside the scope of this paper, we view this tension partly as a consequence of the fact that two of the key mechanisms at play work in opposite directions, making their net effect a quantitative issue. These mechanisms, both of which the HALO model aims to capture, are as follows:

- **Supply of safe, liquid assets.** On the one hand, expansions in government debt increase the supply of safe, liquid assets available to savers. This puts upward pressure on the neutral rate, all else equal.
- **Indebted demand.** On the other hand, higher levels of government debt can also be associated with debt overhang and "indebted demand" problems of the sort recently emphasized by Mian, Straub and Sufi (2020a, 2020b). One of the main insights of these authors is that government debt tends to be held disproportionately by wealthier households. As a result, debt service can serve as a mechanism to concentrate resources among agents with relatively low propensities to consume. This puts downward pressure on aggregate demand, especially in cases where debt service is being financed at the expense of government spending or transfers to lower-income households. To the extent that weaker aggregate demand then puts downward pressure on interest rates, this indebted-demand mechanism tends to link higher debt with a lower neutral rate, all else equal.

2c. The HALO model

HALO in a nutshell

The HALO model aims to capture the impacts of inequality and government debt on the US neutral rate. In its overall structure, HALO closely follows a framework laid out in an article in the *American Economic Review* by Kumhof, Rancière and Winant (2015). It also shares many features in common with the model in Mian, Straub and Sufi (2020a). HALO's key properties can be summarized as follows:

- **Household income heterogeneity.** The model's household block features a distinction between "top earners" and other households. We specifically follow Kumhof, Rancière and Winant (2015) in identifying "top earners" with the top 5 percent of the income distribution and the other households with the remaining 95 percent. Though this distinction is stylized, we calibrate key parameters to match estimates of the pre-COVID-19 income distribution and rich households' marginal propensity to save. As a result, the model provides a laboratory for exploring issues of inequality.

[4] See Congressional Budget Office (2020).

- **Liquidity and safety benefits from owning government bonds.** We assume that households derive some liquidity and safety benefits from owning government bonds, with the elasticity of the resulting demand curve calibrated to match empirical estimates from Krishnamurthy and Vissing-Jorgensen (2007). This helps make the model a useful laboratory for exploring the consequences of expansions in the supply of government bonds. Moreover, the indebted-demand mechanism described in Section 2b can be explored to the extent that the model has top earners owning a large share of government bonds in equilibrium and to the extent that the government budget constraint can be used to explore the tax-and-spending implications of changes in the level of government debt.
- **Select open economy features.** While the model does not feature a full open-economy block, it allows the government to access foreign funding sources, with the elasticity of foreign creditors' demand calibrated to match empirical estimates from the above-noted article by Krishnamurthy and Vissing-Jorgensen. This further improves the model's usefulness as a laboratory for exploring the consequences of expansions in government debt, especially in view of the significant share of US government debt held abroad.

Calibration and neutral assessment

As mentioned above, we calibrate the model's key parameters to match estimates of the pre-COVID-19 income share of the top 5 percent, rich households' marginal propensity to save, and the domestic and foreign price elasticities of demand for government bonds. We then calibrate the model's remaining parameters to engineer an initial steady state in which the interest rate on government debt falls in the range of values for the neutral rate assessed under our pre-pandemic benchmark, with other variables broadly in line with US experience prior to COVID-19.

Given this initial steady state, our neutral assessment involves comparison with an alternative steady state where we account for changes in three key inputs: (i) the rate of output growth, (ii) the debt-to-GDP ratio and (iii) the level of income inequality. Our adjustments to the first two of these inputs rely specifically on staff's current potential assessment, along with a forecast from the Congressional Budget Office of how much the US debt-to-GDP ratio is expected to increase over the Bank's current projection horizon.[5] As for inequality, the literature on COVID-19's longer-run quantitative implications for inequality is still in its infancy. However, a natural benchmark emerges from the above-noted work by Furceri et al. (2020) on international experience with previous epidemics such as SARS and H1N1. When those authors restrict attention to countries where outbreaks were accompanied by economic downturns, they find evidence of a sustained increase in income inequality that places the net Gini coefficient about 2 percentage points higher after five years' time. We therefore adjust the labour share parameters of the two household groups to engineer a similar increase in inequality inside HALO.[6]

[5] See again Congressional Budget Office (2020) and note that our baseline neutral assessment assumes that the government adjusts transfers to households in the bottom 95 percent of the income distribution as needed to balance its budget constraint at the new, higher debt level. However, our overall range of estimates for the HALO model also includes results from experiments where the government is instead assumed to rely on adjustments in the taxes levied on rich households or its own level of spending on goods and services.

[6] While adjustments through labour share parameters represent a natural way to capture an increase in inequality driven by the labour-market-based mechanism described in Section 2a, our overall range of estimates for the HALO model also includes results from experiments where we instead increase inequality through adjustments to firms' markups. This is a natural way to capture the alternative mechanism based on market concentration that we described in Section 2a, since firms in the HALO framework are owned by top earners.

This procedure places the post-COVID-19 neutral rate at around 2.25 percent when starting from an initial steady state characterized by a neutral rate at the mid-point of the 2 to 3 percent range representing our pre-pandemic benchmark. However, there is a significant amount of uncertainty surrounding the pre-COVID-19 value of the neutral rate. To account for this and other sources of uncertainty, we repeat the procedure described above for a variety of alternative calibrations accounting for the full range of our pre-pandemic benchmark, along with different values for several of the key parameters noted earlier. This procedure yields an overall range of 1.75 to 3 percent for the HALO model.

To quantify the relative importance of the various inputs driving the shift in the HALO model's assessed range, **Table 3** reports results from experiments where we adjust individual inputs in isolation. This allows us to break down the overall impact on the neutral rate into contributions arising from individual inputs, along with an interaction term stemming from the non-linear nature of the HALO framework. In particular, the middle rows of the table report the ranges within which the individual contributions and interaction term fall across all the various calibrations described above.[7] Results generally point to upward pressure from higher government debt being more than offset by downward pressure from the combined effects of lower potential output growth and higher inequality. Moreover, the consistently positive net effects of higher government debt suggest that asset supply considerations quantitatively dominate the indebted-demand effects described in Section 2b, at least in terms of their implications for the relationship between government debt and the neutral rate.

Table 3: Factors driving the neutral assessment in the HALO model

	Range (%)
Pre-pandemic benchmark	2 to 3
Impact of changes in potential	(-0.22) to (-0.21)
Impact of higher government debt	+0.21 to +0.48
Impact of higher inequality	(-0.36) to (-0.10)
Interactions	0 to +0.16
Current assessment (rounded to the nearest 25 basis points)	1.75 to 3

3. Tail risk perceptions and the risk-augmented neoclassical growth model

In this section, we turn our attention to another channel through which the COVID-19 shock may impact the neutral rate—namely, that the shock may have induced a sustained shift in the perceived level of tail risk in the economy. The mechanism that we have in mind was recently emphasized by Kozlowski, Veldkamp and Venkateswaran (2020) in a paper presented at the Jackson Hole Economic Symposium:

- Prior to the COVID-19 shock, very few firms or households would have seriously entertained the possibility that a global pandemic could take such a significant toll on economic activity throughout the world.

[7] Note that the individual contributions and interaction term vary in terms of the particular calibrations at which they reach their largest values.

- Even after the current crisis has passed, the awareness that such extreme outcomes are possible and could repeat themselves may lead agents to demand more safe assets as insurance against this risk, putting downward pressure on the neutral rate.[8]

To address these issues, we rely on a new US version of the risk-augmented neoclassical growth model first developed in a Canadian context by Carter, Chen and Dorich (2019). However, as we explain below, some modification to the model is needed to address special challenges presented by the COVID-19 shock.

The risk-augmented neoclassical growth model provides a laboratory for exploring the effects of macroeconomic risk on the neutral rate. It closely follows recent work by Farhi and Gourio (2018) and builds more generally on the "rare disasters" tradition of Barro (2006) and others. Households in the model demand safe assets partly as insurance against a macroeconomic shock associated with reductions in the effective capital stock and labour productivity. This introduces an extra term into the household Euler equation, which reads as

$$\underbrace{i^{safe} - \bar{\pi} = \zeta + g_N + \sigma g_{PC}}_{standard\ Euler\ equation} \overbrace{- DSA(\theta, \Omega)}^{effects\ of\ risk}, \quad (1)$$

where i^{safe} denotes the nominal risk-free rate paid on safe assets,[9] $\bar{\pi}$ denotes the central bank's inflation target, g_N denotes the net rate of population growth, g_{PC} denotes the net growth rate of output per capita, σ denotes the inverse elasticity of intertemporal substitution, ζ is an intercept that depends on households' discount factor, and $DSA(\theta, \Omega) > 0$ is a function capturing households' demand for safe assets as insurance against risk. This last term naturally depends on agents' risk aversion, θ, along with their perceived distribution of the above-noted macroeconomic shock, Ω.

Calibration of the perceived shock distribution is the main challenge for the risk-augmented neoclassical growth model. This is particularly the case to the extent that the COVID-19 pandemic may have induced a structural shift in tail risk perceptions, thus limiting the amount of informative data available to discipline calibration. For this reason, we rely on a calibration strategy different from that described in Carter, Chen and Dorich (2019) and broadly in line with that used in the above-noted paper by Kozlowski, Veldkamp and Venkateswaran (2020). One of the main insights from the latter paper is that it is difficult for firms and households to be confident about the distribution of macroeconomic shocks. Instead, Kozlowski, Veldkamp and Venkateswaran posit a simple learning heuristic through which agents update their beliefs on that distribution as more observations become available. We therefore calibrate the pre-COVID-19 perceived shock distribution by running this learning heuristic over a long historical sample ending in 2019. To calibrate the post-COVID-19 distribution, we then use the same heuristic to quantify the change in beliefs that would occur if 2020 witnessed a shock large enough to replicate the cumulative losses that staff currently forecast over the projection horizon, compared with the Bank's January 2020 projections.

As for the model's other parameters, we take an approach similar to that for the HALO model, calibrating them to engineer an initial steady state in which the risk-free rate lies at the midpoint of the 2 to 3 percent range representing our pre-pandemic benchmark for the US neutral rate. Our baseline neutral rate assessment then involves comparison with an alternative steady state where we adjust the

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[8] Consistent with this notion, some literature suggests that generations that have experienced deep downturns tend to save more heavily going forward and concentrate those savings in safer asset categories. See Malmendier and Nagel (2011) and Aizenman and Noy (2015), along with the references therein.

[9] Since the neutral rate concept considered in this paper identifies the neutral rate with the policy rate, which is risk-free, i^{safe} represents its natural in-model analogue in the risk-augmented neoclassical growth model.

rates of output and population growth in line with staff's current potential assessment while adjusting the perceived shock distribution as described above. We then repeat this procedure for alternative parameterizations accounting for the full range of our pre-pandemic benchmark and other sources of uncertainty. **Table 4** reports results from these experiments, computed as in the previous section. These results point to shifts in the potential outlook as the main driver of a downward shift in the assessed neutral range, reinforced by a smaller but still significant contribution from higher perceived tail risk.[10]

Table 4: Summary of results from the risk-augmented neoclassical growth model

	Range (%)
Pre-pandemic benchmark	2 to 3
Impact of changes in potential	(-0.23)
Impact of higher perceived tail risk	(-0.13) to (-0.06)
Current assessment (rounded to nearest 25 basis points)	1.75 to 2.75

4. The overlapping generations model

We also developed a new US version of an OLG model first introduced in a Canadian context by Mendes (2014). Unlike its Canadian analogue, which has small-open-economy features, the US OLG is a closed-economy model. The model generates neutral rate estimates based on trend paths for productivity, demographic factors and other key inputs. Results point to a downward shift in the US neutral rate, which the OLG currently places in a range of 2 to 2.5 percent. This shift mainly reflects deterioration in the outlook for potential output.

5. Concluding remarks

Even in the best of times, the unobservability of the neutral rate makes it a difficult object to assess. At present, the unusual size and nature of the COVID-19 shock have complicated this task considerably, raising important questions about the informativeness of pre-pandemic data while calling attention to new channels that warrant consideration in our analysis. While we have taken several important first steps toward addressing these issues, we stress that much work remains to be done, both here at the Bank and across the broader profession.

In terms of future work, we view the HALO model as a promising but still relatively stylized framework that we can build on over the months ahead, especially as the underlying literature expands. Natural avenues for future work include enrichment of the model's fiscal block and a fuller exploration of the open-economy dimensions of neutral rate determination.

[10] Unlike was the case for the HALO framework, the more linear nature of the risk-augmented neoclassical growth model implies that it is not necessary to keep track of interactions in addition to the direct impacts of changes in the potential outlook and agents' risk perceptions.

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