BANK OF CANADA
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Staff Analytical Note/Note analytique du personnel—2022-3

Last updated: April 13, 2022

Potential output and the neutral rate in Canada: 2022 reassessment

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DOI: https://doi.org/10.34989/san-2022-3 | **ISSN** 2369-9639
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Acknowledgements

We acknowledge the important contribution of Julien Champagne, Gabriella Hermary and Kurt See to the analysis presented in this note. We thank Brigitte Desroches, Stefano Gnocchi, Marc-André Gosselin, Lawrence Schembri, Rodrigo Sekkel and Alexander Ueberfeldt for their useful comments and suggestions. We also thank Colette Stoeber and Alison Arnot for their editorial assistance. Finally, we thank Guylaine Letourneau and Sylvie Vancappel for their help in translating this note into French.

Overview

We present a reassessment of potential output and neutral rate estimates for Canada. Relative to the April 2021 assessment, we revised potential output growth in 2021 down by 1.4 percentage points while revising expected growth up by an average of 0.6 percentage points from 2022 to 2024 (**Table 1**).[1] These revisions largely reflect pressures from global supply disruptions that emerged in 2021 and that are expected to remain elevated in the first half of 2022 before gradually easing. The faster-than-anticipated labour market recovery and lower expected impact of the COVID-19 pandemic on labour market scarring have also contributed to upward revisions over 2022–24. The resolution of supply disruptions explains much of the anticipated pickup in potential output growth over 2022–24. However, this pickup is also supported by stronger population growth resulting from a recovery in immigration, which we expect to remain robust given the official 2022–24 immigration targets. Nevertheless, significant uncertainty exists around many of these factors, resulting in both upside and downside risks.

The estimate for the nominal neutral rate was revised up by 25 basis points and currently ranges between 2.00% and 3.00% (**Table 2**). The revision reflects reduced long-term effects of the pandemic. On the domestic side, a key contributor was stronger growth in long-term trend labour input (TLI) and potential output. On the international side, a key contributor is the global neutral rate (proxied by the US neutral rate), which was revised up by 25 basis points to a range of 2.00% to 3.00% (see Boutilier et al. 2022).

Table 1: Comparison of potential output estimates relative to April 2021

Annual rates (%)

	Potential output		Potential output growth (excluding temporary supply disruptions)	Revisions to the level of potential output
	Annual growth	Range for growth		
2021	2.3 (3.7)	2.1–2.5	1.3 (1.5)	-1.2
2022	1.7 (1.6)	1.3–2.3	1.7 (1.3)	-1.1
2023	3.3 (2.0)	2.9–3.9	2.0 (2.0)	0.2
2024	2.5 (2.2)	2.3–2.9	2.3 (2.2)	0.5
2025	2.3	2.1–2.6	2.3	

Note: Estimates of annual growth rates of potential output from the April 2021 assessment appear in parentheses. The range for potential output growth represents the methodological range implied by the risk scenarios presented in Table 3.

[1] As in the *Monetary Policy Report*, this staff analytical note distinguishes between potential output and potential output excluding temporary supply disruptions to account for the relatively short-lived nature of some of the decrease in supply.

Table 2: Summary of estimates of the nominal neutral policy rate

Annual rates (%)

	2022 estimates	2021 estimates
Pure interest rate parity	2.00–3.00	1.75–2.75
Reduced-form model	2.25–2.75	2.00–2.75
Overlapping-generations model	2.50–3.25	2.25–3.00
Risk-augmented neoclassical growth model	2.25–3.00	2.00–2.75
Overall assessment	2.00–3.00	1.75–2.75

Note: Rates are in nominal terms. All estimates have been rounded to the nearest 25 basis points. Reported ranges are constructed methodologically based on different counterfactuals with respect to key parameters and inputs.

Canadian potential output

The Canadian economy has been significantly impacted by the ongoing supply chain disruptions, which have intensified since early 2021. As a result, we estimate that potential output expanded by 2.3% in 2021, 1.4 percentage points lower than anticipated at the time of the April 2021 assessment. We have upgraded potential output growth for 2022–24 by 0.6 percentage points on average relative to last year's assessment. This revision mainly reflects the easing of supply disruptions as well as a lower expected impact of the pandemic on labour market scarring.

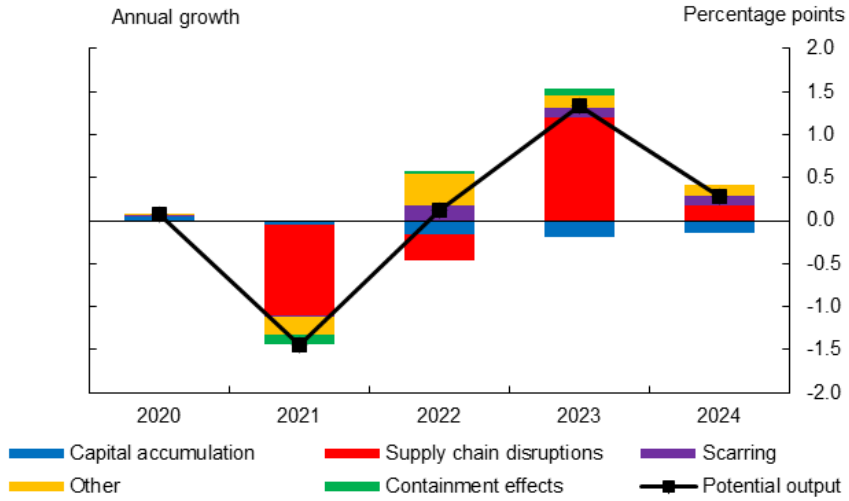
Capital accumulation and growth of trend total factor productivity are expected to pick up as the unwinding of supply bottlenecks ease the pressures on manufacturing production, contributing to the strong average growth of 2.5% over 2022–25. A strong labour market outlook and solid population forecasts will also support potential output growth through TLI over the projection horizon.

Revisions to growth

Global supply disruptions have significantly limited production in durable goods sectors (such as motor vehicles) since early 2021. Transportation bottlenecks, labour shortages and difficulties sourcing essential inputs (such as semiconductors and construction materials) are all causing supply constraints and production slowdowns for businesses. This can be seen, for example, in delivery delays and cancelled sales, which have made existing capital and workers less productive and have discouraged investment (Bank of Canada 2022). The main impact of these disruptions on our estimates of potential output come through the downward revisions to trend total factor productivity. We also estimate them to have negatively affected business investment and trend hours worked, but to a lesser extent. Altogether, these impacts amount to a negative revision to potential output growth of -1.1 percentage points in 2021. The negative impact from the unanticipated global supply bottlenecks in 2021 is likely to dissipate

only gradually over 2022–23, resulting in an average upward revision of 0.7 percentage points in the growth of potential output in 2023 and 2024 (**Chart 1**).

Chart 1: Potential output growth is revised down in 2021 because of global supply disruptions



Note: The category "other" includes revisions based on changes to historical data, judgment related to the impacts of digitalization on total factor productivity, and updates to Statistics Canada's population projections.
Sources: Statistics Canada and Bank of Canada estimates and projections
Last data plotted: 2024

The contribution of capital accumulation to potential output growth over the projection is revised down. This decrease is explained by elevated uncertainties stemming from Russia's invasion of Ukraine as well as by the impacts from supply disruptions. However, the negative impact is somewhat offset by higher energy prices, stemming in part from the Russian invasion, that are expected to increase investment in the oil and gas sector.

Growth in both TLI and potential output over the projection horizon is supported by the fast recovery of the labour market. This recovery has been stronger than previously anticipated. This is reflected in labour scarring that is less severe and upward revisions to trend employment. These developments, together with upgraded projections of population growth, contribute positively to the potential output growth revision in 2022 and 2023 (0.3 percentage points on average).

Containment measures account for a 0.1 percentage point downgrade to potential output growth in 2021. In last year's assessment, we expected these containment measures to be removed completely by the end of 2021.[2] However, the spread of new variants of COVID-19 led to the renewal of public health measures, which weighed more heavily on potential output growth.

Considering all these factors together, we have revised potential output growth up by 0.6 percentage points per year on average over 2022–24. Accordingly, the level of potential output is 0.5% higher by 2024 (fourth column of **Table 1**). Excluding temporary supply

[2] See Brouillette et al. (2021) for the details of last year's potential output assessment.

disruptions, we find potential output evolved much more in line with last year's assessment. This can be seen in the third column in **Table 1**, which shows a counterfactual measure of potential output growth without supply chain bottlenecks, labour market mismatch and containment measures.[3] The slightly higher expected growth of potential output over 2022–24 compared with last year's assessment largely reflects the structural improvements in the labour market outlook that are resulting in milder scarring effects.

Dynamics of potential output growth

Growth of potential output is expected to decline from 2.3% in 2021 to 1.7% in 2022 because of lingering supply chain issues, along with the fading of containment effects that contributed to above-average growth in 2021. Potential output growth will then pick up to 2.5% on average over 2022–25. Given that pressures on manufacturing production and trade stemming from supply bottlenecks are anticipated to remain elevated in 2022, we expect growth in trend labour productivity to remain relatively weak until 2023 (**Chart 2**). As these pressures ease, capital accumulation and growth in trend total factor productivity should pick up, supporting the rebound in growth of trend labour productivity to an average of 1.5% over 2023–25. However, Russia's invasion of Ukraine raises uncertainties around how long global supply disruptions will persist or how severe they might become. Higher energy prices are also expected to support capital accumulation in 2023 and 2024 through higher investment in the oil and gas sector.[4]

With the easing of containment measures and a significant recovery in employment following the pandemic, TLI grew 2.4% in 2021. We expect TLI to rise at an annual rate of 1.3% on average between 2022 and 2025. As remaining containment measures are lifted, supply chain disruptions are resolved and labour market mismatch induced by the pandemic dissipates, the trend employment rate is expected to recover, expanding by 0.2% on average over 2022 and 2023 (**Chart 3**).

The combined impact of non-temporary factors on potential output can be seen more clearly in **Table A-1** in the Appendix, which shows the counterfactual estimates without the effects of containment and supply chain disruptions. Without these temporary factors, projected growth of the trend employment rate is roughly constant over 2022–24 and coincides with stable TLI growth of about 1.1%. Scarring effects induced by the pandemic are now expected to be modest, reducing TLI growth by 0.1 percentage point on average between 2021 and 2023 but dissipating after that. Population aging also acts as a drag on potential output. Potential output growth would be 0.2–0.3 percentage points higher on average if the demographic structure of the population remained unchanged. Offsetting these factors is the strong positive contribution from immigration. With respect to labour productivity, the non-temporary factors

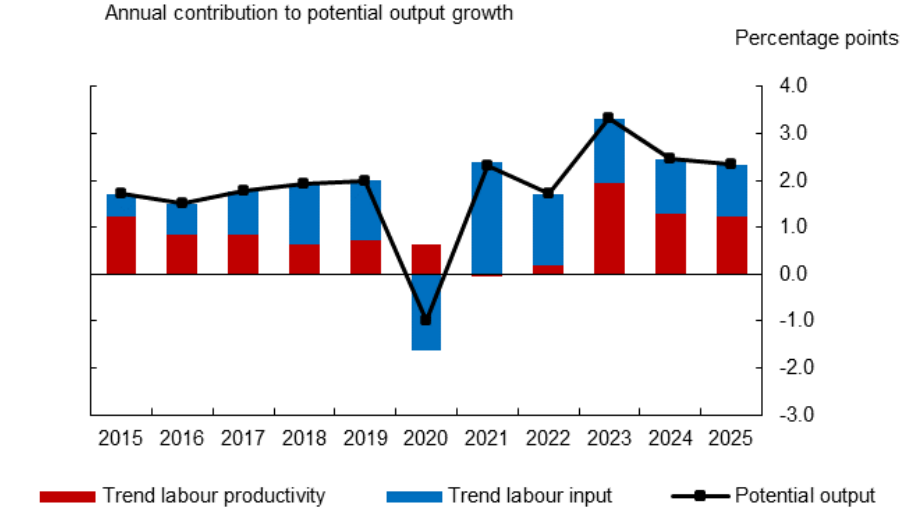
[3] Temporary containment measures include mandatory business closures for hard-to-distance services and stay-at-home orders.

[4] Partially offsetting the impact from higher energy prices on capital deepening is the impact of higher TLI growth, which decreases the capital-to-labour ratio.

supporting the gradual improvement in trend labour productivity growth include the impacts from accelerated digitalization and the post-pandemic recovery in investment (including from higher energy prices).

Chart 2: Potential output growth picks up over 2023–24 as supply disruptions ease

Annual contribution to potential output growth

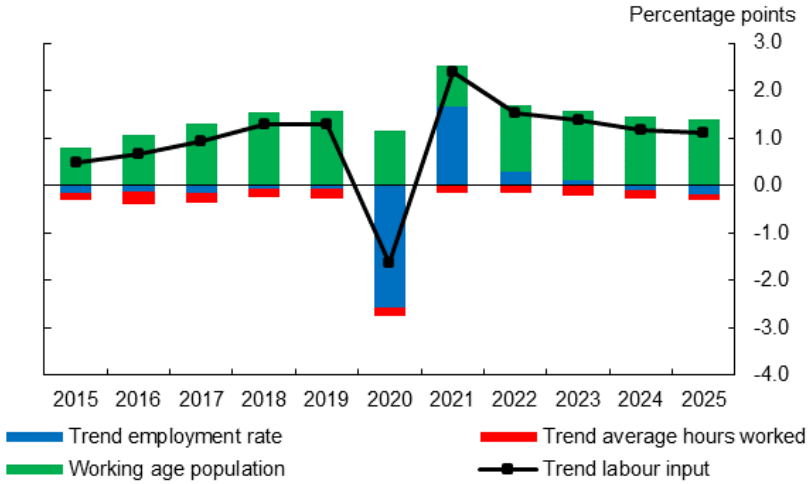


Sources: Statistics Canada and Bank of Canada estimates and projections

Last data plotted: 2025

Chart 3: Population growth supports growth in trend labour input over the projection

Annual contributions to growth in trend labour input



Sources: Statistics Canada and Bank of Canada estimates and projections

Last data plotted: 2025

Population growth dynamics are another important driver of TLI growth over the projection. Growth in the working-age population declined to 0.9% in 2021 and is expected to increase to

1.4% on average over 2022–25 (**Chart 3**).[5] These dynamics depend crucially on immigration. The sharp decline in new immigrants from the onset of the pandemic to mid-2021 weighed heavily on population growth. Immigration recovered strongly in the second half of 2021 and is expected to remain strong over 2022–24, in line with the new, higher Canadian government immigration targets. This immigration provides an important offset to the negative impact of population aging on the working-age population. However, the population projection has both upside and downside risks.

Uncertainty around the base-case scenario

Uncertainty around our estimates of potential output growth remains significant. This section presents the main risks to our outlook.

Statistics Canada's high and low population growth scenarios present upside and downside risks to our TLI outlook. Over the projection, these scenarios mainly reflect differences in assumptions regarding new immigrants, including temporary workers. The substantial backlog in immigration and visa applications, combined with above-average immigration rates over the second half of 2021, suggests that official immigration targets are likely to be met and perhaps even exceeded, posing an upside risk. Contributing to this upside risk is the increasing number of refugees fleeing Ukraine. These refugees have so far been relocating mainly to neighbouring European countries, but they could migrate to Canada in greater numbers than currently expected. On the downside, the US administration's 2021 immigration bill could increase competition for new migrants. In addition, the pandemic could have longer-lasting impacts on immigration than anticipated: for example, ongoing travel and quarantine restrictions in many countries could make people less willing to immigrate and risk being unable to visit extended families. The high (low) scenario would add (subtract) 0.1–0.2 percentage points to (from) the baseline potential output growth over 2022–25 (**Table 3**).

The dynamics of global supply chain disruptions also have upside and downside risks.[6] On the negative side, supply disruptions could intensify somewhat over the first half of 2022, particularly because of unexpected supply disruptions stemming from the invasion of Ukraine, before beginning to ease.[7] On the positive side, some recent indicators show that the supply bottlenecks may have already peaked, implying potentially faster improvements both in

[5] Working-age population is defined as persons aged 15 and over.

[6] Our baseline estimates assume that pressures from global supply disruptions begin to ease in the first half of 2022 and are fully resolved by the second half of 2023.

[7] According to recent results from the Bank's Business Outlook Survey, firms continue to face challenges meeting unanticipated increases in demand (Bank of Canada 2022).

Canada and among its major trading partners.[8] **Table 3** shows the impacts of these downside and upside scenarios on potential output growth.

The share of employment in digitally intensive sectors has been increasing in Canada, and the pandemic appears to have accelerated this trend. Labour productivity is higher in these sectors than in non-digitally intensive ones, suggesting that this sectoral shift could lift potential growth over the projection horizon.[9] The positive impact of digitalization on total factor productivity included in last year's assessment is small relative to what some empirical evidence suggests, particularly when greater use of digital technologies has persistent growth impacts.[10] While our previous view on digitalization is still reasonable, upside risks to our assessment of potential output growth remain.[11]

Table 3: Ranges for potential output growth based on alternative risk scenarios
Annual rates (%)

Risk	Scenario	2021	2022	2023	2024	2025
Population growth	Lower	0.0	-0.1	-0.2	-0.2	-0.2
	Higher	0.0	0.1	0.2	0.2	0.2
Global supply disruptions	More prevalent	0.0	-0.3	0.2	0.1	0.0
	Less prevalent	0.1	0.3	-0.2	0.0	0.0
Accelerated digitalization	Larger	0.1	0.2	0.1	0.1	0.1
Labour productivity scarring	More scarring	-0.2	0.0	0.1	0.0	0.0
Growth impact range		-0.2–0.2	-0.4–0.6	-0.4–0.6	-0.2–0.4	-0.2–0.3

Finally, our analysis of labour market scarring focuses on implications for employment and average hours worked. However, it is well known that workers who lose their jobs suffer from persistent losses in earnings even when they get back to work, suggesting potential scarring in the form of a temporary decline in labour productivity.[12] We use estimates of the decline in hourly earnings among displaced workers during the Great Recession in the United States (from

[8] As of the first quarter of 2022, the Purchasing Managers' Index of manufacturing backlogs and supplier delivery times points to an easing of supply disruptions, but these disruptions remain elevated in Canada. See Benigno et al. (2022) for recent developments in supply disruptions in some of Canada's major trading partners.

[9] Liu (2021) presents evidence on the digitalization trends and productivity differences between digitally intensive and non-digitally intensive sectors in Canada. See Liu and McDonald-Guimond (2021) for details on the classification of digitally intensive industries in Canada.

[10] See Brouillette et al. (2021) for details.

[11] See, for example, Gal et al. (2019), who find that firms that increase their use of digital technologies such as cloud computing or high-speed broadband by 10% are 4% to 10% more productive after five years.

[12] The lost productivity could reflect job-specific skills workers had accumulated in their previous job or simply a better fit between their skills and their previous job.

Lachowska, Mas and Woodbury 2020) to approximate the impact on future earnings from temporary unemployment during the pandemic in Canada. This shows how large labour productivity scarring could be and is the basis for the final downside risk listed in **Table 3**.

Taken together, the risks around the baseline estimates are broadly balanced; we summarize them in the bottom row of **Table 3**. However, Russia's invasion of Ukraine represents additional uncertainty in this outlook that is hard to quantify.

Canadian neutral rate

As in previous neutral rate reassessments, we use a concept that defines the neutral rate as the policy rate consistent with output at its potential level and inflation equal to the target after the effects of all cyclical shocks have dissipated (Mendes 2014).

We assess that the Canadian nominal neutral rate lies in the range of 2.0% to 3.0%. The estimated range for the Canadian neutral rate is based on the output from four assessment methods used in previous years (**Table 2**):[13]

- an interest rate parity approach
- a reduced-form model
- an overlapping-generations model
- a risk-augmented neoclassical growth model

This year we have reviewed, recalibrated and significantly extended the overlapping-generations model to incorporate new domestic forces (such as population aging, fiscal policy and income inequality) as possible drivers of the Canadian neutral rate. These forces were highlighted in recent literature as important drivers of the neutral rate. We discuss these additions in **Box 1** below.

Reported ranges for neutral rate estimates in **Table 2** are constructed based on different counterfactuals for key parameters and inputs for each model. Most models suggest a 25-basis-point increase. A higher estimate of the US neutral rate is naturally responsible for the increase of both bounds in the estimate from the pure interest rate parity approach. It also increases the estimates of the reduced-form model and the overlapping-generations model. Higher estimates of long-term potential output growth and long-term TLI growth also push our estimates of the Canadian neutral rate higher. Taken together, the overlapping-generations model and the risk-augmented neoclassical growth model suggest an increase of 25 basis points in both the upper and lower bounds. And the reduced-form model suggests an increase only in the lower bound of the neutral rate estimates.

[13] These methods were first introduced by Mendes (2014) and later updated by Carter, Chen and Dorich (2019).

An interval constructed using all ranges from these methods would result in an upper bound of 3.25%. However, this upper bound is supported only by a specific calibration of the overlapping-generations model. Therefore, like last year, we do not include the upper bound of the overlapping-generations model in the overall range; rather, we maintain the usual practice of focusing on an interval of 100 basis points. In sum, a reconsideration of the long-term effects of the pandemic both on our US neutral rate estimate (see Boutilier et al. 2022) and on our TLI explains the upward revision of our neutral rate estimates in Canada.

Finally, it is important to stress the inevitable uncertainty surrounding estimates of an unobservable variable such as the neutral rate of interest. This uncertainty is especially pertinent given the current context of the ongoing global pandemic and the recent invasion of Ukraine by Russia. While the ranges above reflect the sensitivity of our estimates to different models and their inputs, these ranges are narrower than what econometric models would suggest.

Box 1

New factors in the overlapping-generations model

We have extended our overlapping-generations model to include several factors that existing studies identify as historically important drivers of the neutral rate. Specifically, we account for the impact of changing demographics, fiscal policy and after-tax income inequality on the neutral rate in the context of a small open economy. In what follows, we summarize the model that focuses on the role of new factors. (We provide a more detailed description in a staff discussion paper; see Kuncl and Matveev, forthcoming.)

As in the original version of the model, the neutral rate, r^*, is the sum of the global neutral rate, r^{global}, and a country-specific risk premium, ϕ:

$$r^* = r^{global} + \phi\left[\frac{Capital\ +\ Net\ Government\ Debt\ -\ Net\ Private\ Wealth}{GDP}\right],$$

where the risk premium is increasing in Canada's net external debt position relative to its gross domestic product (GDP). Domestic factors, including the newly introduced ones, affect the domestic supply of private savings as well as the demand for business investment and public borrowing. In turn, the resulting accumulation of private wealth, capital and public debt determines the net external debt position. We capture the underlying effects of domestic factors using a structural model with overlapping generations of young, middle-age and old-age households.

Consider first demographic factors: life expectancy, fertility and migration. Increasing life expectancies are positively related to saving in anticipation of retirement, which creates a downward push on r^* (see, e.g., Carvalho, Ferrero and Nechio 2016). This demographic factor is an addition to the effects on r^*—already accounted for—stemming from a positive relationship between investment and supply of labour driven by changes in fertility and migration.

Next, we introduce as a fiscal factor the level of general government debt as a share of GDP, which positively affects r^* (see, e.g., Rachel and Summers 2020). Considering this, we find that the increase in government debt due to the COVID-19 pandemic creates an upward push on r^*.

Finally, increasing income inequality that favours high-income households with a larger propensity to save pushes up aggregate savings and negatively affects *r** (see Mian, Straub and Sufi 2021). In Canada, the recent robust fiscal policy response to the economic shutdowns driven by the pandemic have prevented a significant rise in income inequality (see, e.g., MacGee, Pugh and See 2020; and Kuncl, McWhirter and Ueberfeldt 2021). As a result, this factor currently has a quantitatively small impact on the neutral rate.

Appendix

Table A-1: Potential output growth excluding temporary supply disruptions

Annual rates (%)

	Potential output growth	Trend labour input	Trend labour productivity
2010–19	1.9 (1.9)	0.9 (0.9)	0.9 (0.9)
2020	1.5 (1.4)	0.8 (0.8)	0.6 (0.6)
2021	1.3 (1.5)	0.5 (0.4)	0.8 (1.1)
2022	1.7 (1.3)	1.2 (0.7)	0.5 (0.7)
2023	2.0 (2.0)	1.1 (0.7)	0.9 (1.3)
2024	2.3 (2.2)	1.2 (0.7)	1.1 (1.4)
2025	2.3	1.1	1.2

Note: Estimates of annual growth rates of potential output excluding temporary factors remove the impacts of supply chain disruptions, labour market mismatch and COVID-19 containment effects. Estimates from the April 2021 assessment appear in parentheses They exclude COVID-19 containment effects, which were the only temporary factor at that time. Numbers may not sum due to rounding.

References

Bank of Canada. 2022. *Monetary Policy Report* (January).

Benigno, G., J. di Giovanni, J. J. J. Groen and A. I. Noble. 2022. "A New Barometer of Global Supply Chain Pressures." *Liberty Street Economics*, January 4. Federal Reserve Bank of New York.

Boutilier, K., T. Carter, X. S. Chen, E. Ekanayake, L. Poirier, P. Shannon, A. Uppal and L. Xiang, "Assessing Global Potential Output Growth and the US Neutral Rate: April 2022," Bank of Canada Staff Analytical Note No. 2022-4 (April 2022).

Brouillette, D., G. Faucher, M. Kuncl, A. McWhirter and Y. Park. 2021. "Potential Output and the Neutral Rate in Canada: 2021 Update." Bank of Canada Staff Analytical Note No. 2021-6.

Carter, T. J., X. S. Chen and J. Dorich. 2019. "The Neutral Rate in Canada: 2019 Update." Bank of Canada Staff Analytical Note No. 2019-11.

Carvalho, C., A. Ferrero and F. Nechio. 2016. "Demographics and Real Interest Rates: Inspecting the Mechanism." *European Economic Review* 88: 208–226.

Gal, P., G. Nicoletti, C. von Rüden, S. Sorbe and T. Renault. 2020. "Digitalization and Productivity: In Search of the Holy Grail." *International Productivity Monitor* 37: 39–71.

Kuncl, M. and D. Matveev. Forthcoming. "The Neutral Rate in Canada Through the Lens of a New Overlapping-Generations Model." Bank of Canada Staff Discussion Paper.

Kuncl, M., A. McWhirter and A. Ueberfeldt. 2021. "The Uneven Economic Consequences of COVID-19: A Structural Analysis." Bank of Canada Staff Analytical Note No. 2021-17.

Lachowska, M., A. Mas and S. A. Woodbury. 2020. "Sources of Displaced Workers' Long-term Earnings Losses." *American Economic Review* 110 (10): 3231–3266.

Liu, H. 2021. "Economic Performance Associated with Digitalization in Canada over the Past Two Decades." *Economic and Social Reports* 1 (2). Statistics Canada.

Liu, H. and J. McDonald-Guimond. 2021. "Measuring Digital Intensity in the Canadian Economy." *Economic and Social Reports* 1 (2). Statistics Canada.

MacGee, J. C., T. M. Pugh and K. See. 2022. "The Heterogeneous Effects of COVID-19 on Canadian Household Consumption, Debt and Savings." *Canadian Journal of Economics* 55, Special Issue: The COVID-19 Pandemic.

Mendes, R. R. 2014. "The Neutral Rate of Interest in Canada." Bank of Canada Staff Discussion Paper No. 2014-5.

Mian, A., L. Straub and A. Sufi. 2021. "What Explains the Decline in *r**? Rising Income Inequality Versus Demographic Shifts." Presented at the 2021 Jackson Hole Symposium, August 27. Jackson Hole, Wyoming: Federal Reserve Bank of Kansas City.

Rachel, L. and L. H. Summers. 2019. "On Secular Stagnation in the Industrialized World." *Brookings Papers on Economic Activity* (Spring).