

An Update on the Neutral Rate of Interest

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- The neutral rate of interest is the real policy rate that prevails when an economy's output is at its potential level and inflation is at the central bank's target, after the effects of all cyclical shocks have dissipated. The neutral rate serves as a benchmark to gauge the degree of monetary stimulus in place and provides a medium- to long-run anchor for the real policy rate.
- Estimates of the global neutral rate have been steadily falling over the past few decades. These point estimates are subject to considerable uncertainty.
- Several factors affecting the global economy's supply of savings and demand for investment determine the evolution of the global neutral rate. In articles and speeches in 2014 and 2015, the Bank of Canada documented how the evolution of those factors had explained the decline of the neutral rate until then. In this article, we review those factors to reassess our view of the neutral rate.
- Since 2014, there has been a reduction in the global savings glut emanating from emerging-market economies and oil-exporting countries. But several other factors, such as population aging coupled with high life expectancy, the elevated level of inequality and high corporate savings, are all likely to continue supporting a high desired rate of saving in advanced economies over the medium term. Global desired investment, in contrast, will likely remain modest in response to low growth in trend productivity and labour force. Overall, our reassessment is that the global neutral rate of interest will likely remain low for some time.
- Both global and domestic factors have likely reduced the Canadian neutral rate. The Bank's estimate of the Canadian real neutral rate is a range from 0.5 to 1.5 per cent, down from a range of 1.0 to 2.0 per cent three years ago. This low neutral rate has important implications for monetary policy and financial stability.

How can we measure the extent to which monetary policy is stimulating or hampering the economy? How often is conventional monetary policy expected to be constrained by the effective lower bound (ELB)—the lowest point that the nominal policy rate can go? What is the interest rate level that economic agents should expect in the medium to long run? These questions are very important to policy-makers and can be answered only with the help of a critical input: the neutral rate of interest.

There are several accepted definitions of the neutral rate of interest. Ours stipulates that the neutral rate is the real policy rate that prevails when output is at its potential level and inflation is equal to its target of 2 per cent, after the effects of all cyclical shocks have dissipated.¹ This is a medium- to long-run concept that varies over time with slow-moving factors, such as demographic change and shifts in trend productivity growth.

The neutral rate is a medium- to long-run anchor for the real policy rate. Some countries have started moving their policy rate toward their nominal neutral rate. The US Federal Reserve recently began raising interest rates from their unprecedented low levels. The Bank of Canada increased its policy rate in July 2017 for the first time in close to seven years, followed by another move in September, removing some of the substantial monetary stimulus implemented in response to the Great Recession. For these countries, real policy rates are expected to converge to their respective neutral rates of interest once all cyclical headwinds have dissipated.

Since the neutral rate is achieved when the central bank is neither stimulating nor slowing the economy, the difference between the real policy rate and the neutral rate is a measure of the central bank's monetary policy stance. A real policy rate below the neutral rate would be considered stimulative, whereas a real policy rate above the neutral rate would be considered restrictive. Moreover, for a given inflation target, the neutral rate influences how much conventional monetary stimulus can be provided before hitting the ELB as well as the probability of encountering ELB episodes. The neutral rate can also have important implications for financial stability. For example, a neutral rate that is lower now compared to the past could encourage excessive risk taking by institutional investors if return expectations were slow to adjust to the new reality. Such behaviour might undermine financial stability in the economy.

The neutral rate has been declining in recent decades. In 2014 the Bank provided an estimate for the Canadian neutral rate prevalent at that time and discussed the factors that had affected it since the pre-crisis period.² Since then, economists' measures of the neutral rate have continued to fall globally as well as in Canada. This article provides an update on the evolution of the neutral rate of interest and discusses its implications for monetary policy and financial stability.

Estimating the Global Neutral Rate

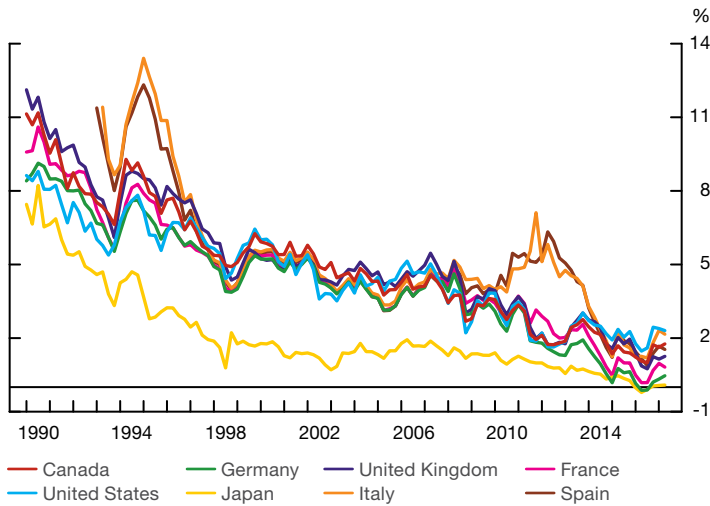
The level of output often diverges from its potential, inflation often deviates from its target, and cyclical shocks continuously influence the dynamics of the economy. Consequently, the neutral interest rate that would prevail in the absence of these conditions cannot be directly observed.

◀ *The neutral interest rate that would prevail in the absence of specific conditions cannot be directly observed*

¹ See Mendes (2014) for a discussion of this and alternative definitions of the neutral rate.

² See Wilkins (2014), Mendes (2014) and Reza and Sarker (2015).

Chart 1: Long-term nominal government bond yields in advanced economies



Source: Bloomberg

Last observation: 2017Q2

Long-term nominal interest rates have been declining steadily across advanced economies (Chart 1), as well as in many emerging-market economies (EMEs), for the past three decades. Both inflation and implied term premia, however, have been relatively stationary during this time. This suggests that the trend decline in long-term rates may be attributed to a secular fall in the real neutral rate.

Researchers have provided several estimates for the unobservable neutral rate for the United States and other countries. Since estimated neutral interest rates in the United States and other countries have followed a similar trend, we follow Mendes (2014) and interpret the US neutral rate as an important proxy for the global neutral rate. Using the US rate as a starting point is especially appropriate for Canada because the two economies share strong links and tend to move in tandem.

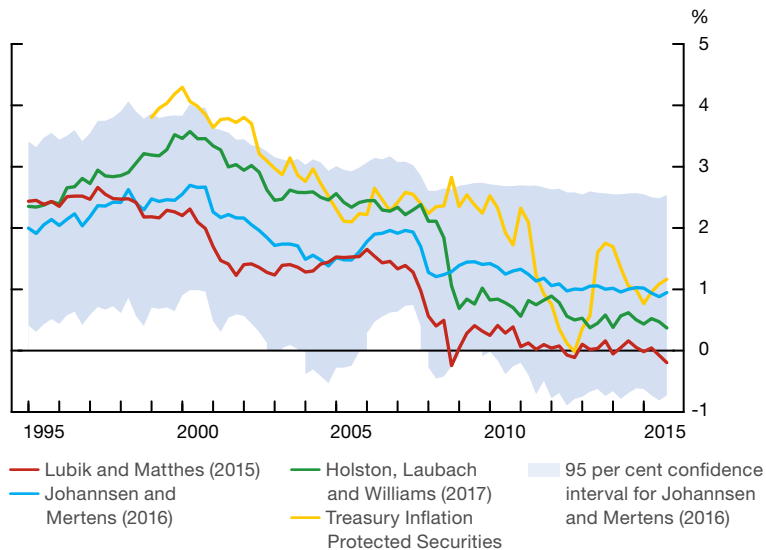
◀ *Using the US rate as a starting point is especially appropriate for Canada because the two economies share strong links and tend to move in tandem*

Chart 2 shows the US real neutral rate estimates from four approaches with varying degrees of structural underpinnings: (i) Holston, Laubach and Williams (2017) assume that the neutral rate is driven by both the growth rate of potential output and other unobserved factors;³ (ii) Lubik and Matthes (2015) identify the neutral rate as the medium-to-long-term forecast of the policy rate; (iii) Johannsen and Mertens (2016) take a similar approach to that of Lubik and Matthes (2015), though they place additional emphasis on the ELB constraint faced by US policy rates in the past decade; and (iv) Christensen and Rudebusch (2017) use Treasury Inflation Protected Securities to uncover investors' expectations for the real policy rate for the five-year period starting five years ahead.

Some caveats apply to these approaches. First, Hamilton et al. (2016) argue that it is hard to pin down a stable relationship between real interest rates and growth in the United States. Moreover, *ex ante* long-term real rates in the United States could deviate substantially from global rates at any given year. Second, approaches that extract signals about the neutral rate from market-based prices could provide distorted estimates during periods when

³ The authors use a version of the Laubach and Williams (2003) model that extracts only highly persistent components of the natural rates of output and interest. In contrast, the original estimates of Laubach and Williams (2003) allow for a neutral rate that varies more in cyclical frequencies.

Chart 2: Different estimates of the real neutral rate in the United States



Sources: Federal Reserve Board, Federal Reserve Bank of San Francisco, Federal Reserve Bank of Richmond

Last observation: 2015Q4

long-term rates have been depressed by unconventional monetary policy stimulus, such as the recent quantitative easing from the US Federal Reserve, the Bank of England and the European Central Bank.

Chart 2 shows that the estimated real neutral rate has been falling throughout the past two decades, regardless of the model used. This suggests that the decline in the global neutral rate is not a recent phenomenon related to the Great Recession. Moreover, the actual path of the real federal funds rate remained below most of these estimates during the ELB episode, suggesting that US monetary policy was accommodative during that time.

Estimates of the real neutral rate, however, come with large degrees of uncertainty. Chart 2 shows uncertainty bands only for the Johanssen and Mertens (2016) numbers. The other estimates also have large bands.

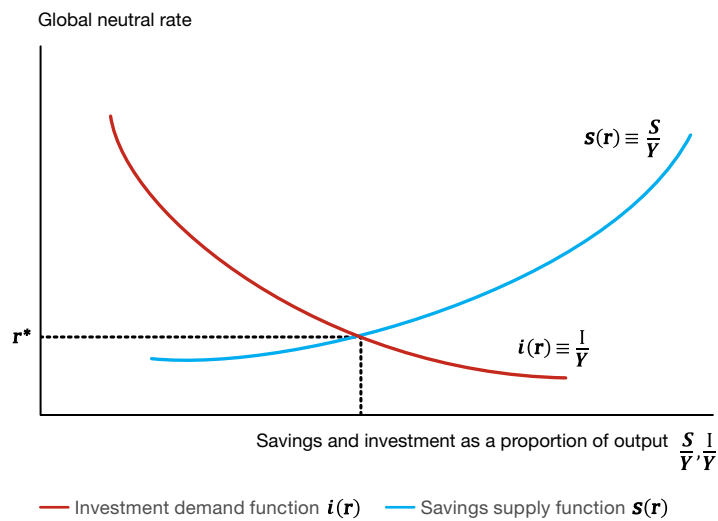
◀ *Estimates of the real neutral rate come with large degrees of uncertainty*

Based on these trends, policy-makers also expect interest rates to remain low relative to their average values in the past two decades in the long term (Bernanke 2016). The median of the long-term projections of the nominal federal funds rate by members of the Federal Open Market Committee has been declining for the past few years, from 4.25 per cent toward mid-2012 to 3 per cent in mid-2017.

Studies conducted for other countries show that global factors are important in determining neutral rates across different countries. Holston, Laubach and Williams (2017) also show that neutral rate estimates for Canada, the United Kingdom and the euro area follow a downward trend similar to that experienced in the United States.

Understanding the Decline in the Global Neutral Rate

In theory, the global neutral interest rate is the price that equilibrates the global economy's supply of savings with its demand for investment in the long run (Chart 3). Therefore, to explain the reduction in the global neutral rate, we examine factors that have either decreased the investment demand or increased the savings supply. We also summarize how these factors have evolved since we last discussed them in Reza and Sarker (2015).

Chart 3: The global neutral rate (r^*), investment demand $i(r)$ and savings supply $s(r)$ 

Lower potential output growth: demographics and technology

Potential output growth is expected to be lower than in the pre-crisis era because of reduced growth in both labour force and technological progress.⁴

Falling growth in the labour force

Slow population growth and aging populations are already reducing labour force growth in most advanced economies. **Chart 4** shows working-age population growth forecasted as far out as 2030. The existing drag on the working-age population is most evident in Japan, where it has been shrinking since 1996. Europe's working-age group began dwindling in 2011. In the United States and Canada, the growth of the working-age population has remained positive but has slowed. Moreover, the distribution of the working-age population is also shifting toward the older, who, in general, participate less in the labour force either as employed or by actively searching for a job.⁵

Technological change

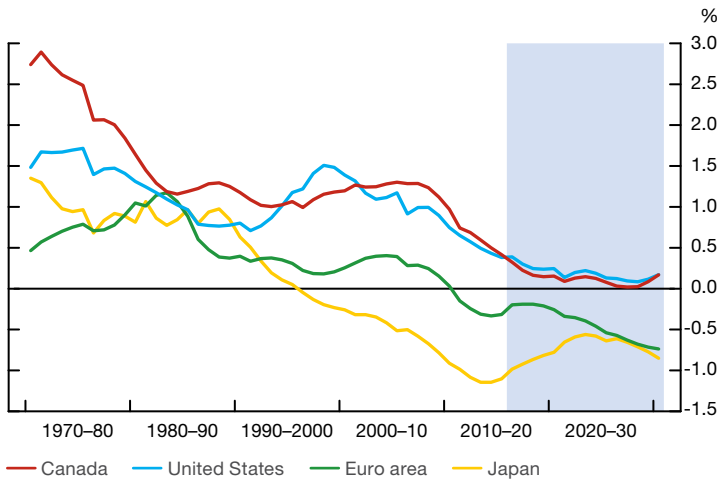
Total factor productivity (TFP) growth has slowed in advanced economies. For example, **Chart 5** shows that TFP growth in the United States has come down to the levels prevalent in the 1980s and early 1990s. As discussed in Reza and Sarker (2015), there are conflicting views about the prospect for productivity growth in the future. Gordon (2014) and others argue that there is little evidence to suggest that productivity growth will pick up. In contrast, others, such as Mokyr (2014) and Brynjolfsson and McAfee (2011), believe that new inventions like robotics and three-dimension (3D) technologies may soon show up in higher productivity growth. In our baseline projection of global potential output growth, however, the Bank takes the view that the rate of TFP growth over the next few years will remain modest.⁶

⁴ See Mendes (2014) for a discussion of the different channels through which potential output growth affects the neutral rate.

⁵ Increased longevity is leading to some increase in participation rates of older workers in the labour force, but this is not sufficient to offset the effect of the shift of the population to older cohorts.

⁶ See Alexander et al. (2017) for the Bank of Canada's latest estimation of global potential output.

Chart 4: Working-age population growth in advanced economies



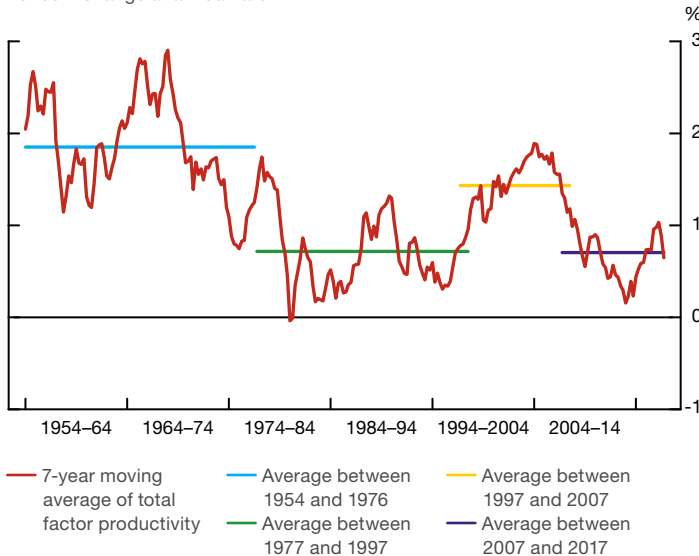
Note: Shaded area represents forecasted values.

Source: United Nations

Last observation: Dec. 2016; Last data plotted: 2030

Chart 5: US long-term average productivity growth

Per cent change at annual rate



Source: Federal Reserve Bank of San Francisco

Last observation: 2017Q1

Population aging and high life expectancy

Population aging and high life expectancy may also directly affect the neutral interest rate through shifting household consumption and savings decisions. To smooth consumption over their lifespans, working-age generations save to finance their retirement, and they need to save more as they live longer. Older generations, in contrast, draw down their savings once they withdraw from the work force.

As baby boomers with high life expectancies pass through the later part of their working lives, rates of saving will remain high. This would continue to exert downward pressure on the global neutral rate.⁷ Even if aggregate savings fall as older generations begin using their accumulated wealth to

⁷ Using an overlapping generations model, calibrated to advanced country data, Lisack, Sajedi and Thwaites (2017) show that demographic change may continue to push interest rates downward until 2050.

finance their retirement, the impact on the neutral rate will also depend on how investment changes in response to lower demand for durable goods from an aging population.

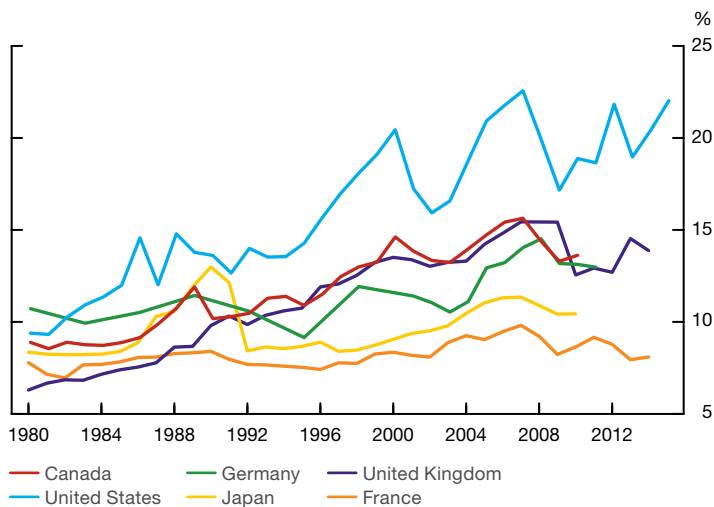
Rise of superstar firms and corporate savings

Some commentators have argued that the world economy is now dominated by large service-providing superstar firms (Google and Amazon, for example), and they are no longer creating value through extensive investment outlays. Innovation—and certain service production, it would seem—does not require as much physical investment as it did in the past, resulting in excess corporate savings (Chen, Karabarbounis and Neiman 2017; PIMCO 2017). Several potential factors, including the nature of new technology, globalization, deregulation and the associated rise in monopoly power, may be linked to this trend. Even in EMEs, the rise of large firms, such as the Chinese online retail giant Ali-Baba, mirrors the trend seen in advanced economies. Moreover, the rise of superstar firms has also been associated with a declining share of labour income (Autor et al. 2017). This is an additional channel through which this trend may contribute to rising inequality and, in turn, to lowering aggregate demand.

Income inequality

Some have argued that elevated income inequality in advanced economies (particularly the United States) is a drag on aggregate demand and will remain so (Chart 6). Because wealthier people tend to save a greater share of their incomes, the more income is shifted toward them, the greater the upward pressure on national saving and, therefore, the greater the downward pressure on the neutral rate. Since the shift in inequality has taken place over the past two decades, it appears structural, and the downward pressure on demand could well persist.⁸

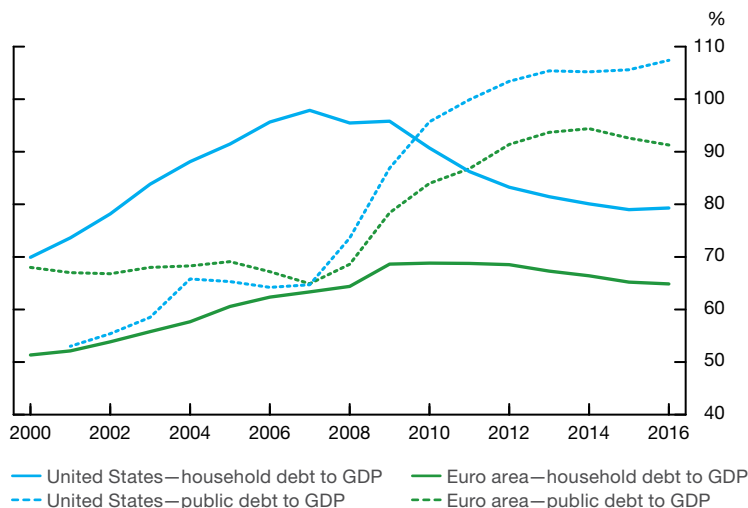
Chart 6: Income share of top 1 per cent



Last observations: United States, 2015; United Kingdom and France, 2014; Germany, 2013; Canada and Japan, 2010

Source: World Wealth & Income Database

⁸ The relationship between income inequality and national savings rates can be counteracted by other factors. For example, while inequality has been growing in the United States, savings rates were falling until the crisis brought about a sharp correction. Many authors have noted, however, that the decline in savings was largely driven by an unsustainable pre-crisis credit boom, when low-income households were encouraged to consume beyond their means (e.g., subprime lending) (Rajan 2011; Summers 2014). Now that the credit cycle has turned, household savings have reverted to normal, more sustainable levels.

Chart 7: Household deleveraging is under way, but public debt remains elevated

Sources: US Bureau of Economic Analysis,
Eurostat and the International Monetary Fund

Last observation: 2016

Deleveraging

Throughout the pre-crisis years, demand in the United States and Europe was supported by a marked increase in private sector leverage. Although public finances were improving in the lead-up to the financial crisis of the late 2000s, large-scale fiscal stimulus during and after the crisis caused public debt to increase substantially. This led to a situation where both the private and the public sector simultaneously began taking steps to reduce their indebtedness. This active deleveraging by both sectors has been putting downward pressure on the neutral rate of interest throughout the post-crisis recovery.⁹ Households in advanced economies, however, have made significant progress in deleveraging, so this source of drag on the neutral rate is expected to diminish (Chart 7).

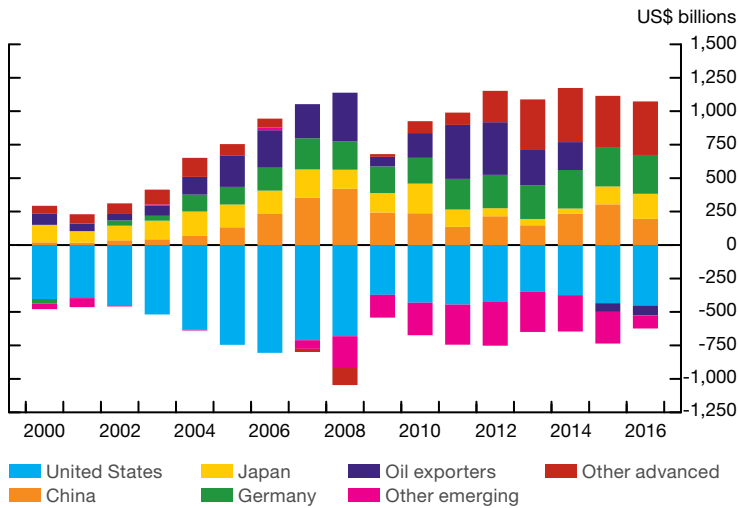
Savings glut from emerging-market and other surplus economies

Bernanke (2005, 2015) and several others have argued in the past that the rise in savings from EMEs and oil-exporting countries in the early 2000s was a major source of downward pressure for the neutral rate in advanced economies, notably the United States. This mechanism manifested itself as a widening US current account deficit in the early 2000s. By definition, a country's current account balance is equal to the excess of savings over investment in that economy. The deficit in the US economy, as argued, was driven mainly by a glut of savings from external sources—namely, EMEs and oil-exporting countries. This additional savings supply was high compared with the pre-existing demand for investment in the United States and resulted in pushing the neutral rate downward.

Recently, oil prices have fallen. Current account deficits in the United States and other advanced economies have declined, while surpluses in EMEs and oil-exporting countries have shrunk (Chart 8). China's trade surplus

⁹ When growth is strong, governments can reduce their debt ratios simply by increasing their borrowing at a rate that is less than economic growth, effectively "growing out" of their debt over time. Since the crisis, a lack of growth in many countries has made this difficult, and authorities opted for reducing public spending.

Chart 8: Global current account balances



Source: International Monetary Fund Balance of Payment Statistics

Last observation: 2016

has also declined because of the gradual rebalancing of the Chinese economy toward more domestic-consumption-driven growth. The neutral rate, however, has continued to fall. This brings into question the argument that excess savings from the EMEs and oil-exporting countries had been primarily responsible for the falling neutral rate.

Some, such as Fischer (2017), argue that it is the movement in the desired investment in the United States, rather than an injection of savings from external sources, that is at play. Long-term structural factors, such as low productivity growth and aging demographics, were becoming evident even before the crisis and reducing desired investment demand in the United States. Fischer (2017) argues that had it not been for an unsustainable rise in US borrowing during the pre-crisis era, the neutral rate would have fallen even more during that time.

Other potential factors

It has also been argued that the downward trend in the neutral rate may reflect an increase in the demand of safe assets compared with risky ones by institutional investors because of their preferences about exchange rate regimes or regulatory reasons, such as tighter financial regulations (Caballero and Fahri 2014; Blanchard, Furceri and Pescatori 2014). This argument is, however, difficult to reconcile with the observed decline in the risk premium to historically low levels.

Some have also argued (e.g., Summers 2014) that a secular decline in the relative price of durable goods could be contributing to a declining neutral rate. However, the trend of relative global investment prices has stabilized since the mid-2000s. This factor is therefore unlikely to put further downward pressure on the neutral rate in the future.

Going forward

Since our last review of the global factors driving the neutral rate in Reza and Sarker (2015), there has been a clear reduction in the global savings glut emanating from EMEs and oil-exporting countries. But several other factors, such as population aging and high life expectancy, the elevated level of

inequality and higher corporate savings resulting from the rise of superstar firms, are all likely to continue contributing positively to advanced economy savings rates over the medium term. Productivity growth also remains tepid, as expected, and labour force dynamics are mostly progressing as forecast. The balance of the evolution of these individual factors suggests global investment rates will likely remain modest. Our reassessment of these factors therefore indicates that over the medium term, the global neutral rate is likely to remain low.

Over the longer term, as baby boomers continue to move into retirement, their rate of saving should eventually reverse. This long-run decline in savings could also potentially be supported by an end to private sector deleveraging and a rebalancing in China and other EMEs toward consumption-led growth. Meanwhile, the demographic trend suggests investment demand in advanced economies will decline through the medium term and into the longer run. Overall, we consider that these risks balance one another and that the global neutral rate will remain low for the foreseeable future.

The Determination of the Neutral Rate in Canada: Global Versus Domestic Factors

In a small open economy like Canada, the neutral rate is generally affected by both global and domestic factors. Mendes (2014) shows that a framework to illustrate this idea is one in which the long-run Canadian interest rate is the sum of the global neutral rate and a country-specific risk premium. The latter is normally assumed to decrease with Canada's net foreign assets (NFA), the main intuition being that an accumulation of Canadian NFA leads foreign investors to view lending to Canadians as a less risky proposition.¹⁰

The global factors discussed in the previous section can influence the Canadian neutral rate through their impact on both the global neutral rate and the Canadian risk premium. For example, a rise in the long-run saving supply from EMEs and oil-exporting countries reduces the global neutral rate. This reduction has two effects on the Canadian neutral rate. While it exerts a direct downward pressure on the Canadian neutral rate, the lower global neutral rate leads to a decrease in NFA (through lower domestic savings and higher domestic investment), which indirectly places upward pressure on both the Canadian risk premium and the neutral rate. The net effect on the Canadian neutral rate would then depend on the relative strength of these two competing channels. For plausible sensitivities of the Canadian risk premium to NFA, the direct effect always dominates.

Domestic factors can also affect the Canadian neutral rate, but only through their effects on the Canadian risk premium. To illustrate how domestic factors can affect the Canadian risk premium, suppose that Canadian trend labour productivity slows down, causing a decline in Canadian potential output growth. One of this slowdown's main effects would be to lower domestic investment demand. All else being equal, this would lead to a higher current account balance and, consequently, a higher NFA, placing downward pressure on the Canadian risk premium and neutral rate. A similar analysis can be done for other domestic factors, such as Canadian trend labour input growth and Canadian credit risk spreads. This generally implies that the more the Canadian risk premium is sensitive to changes in NFA, the more these factors will weigh on the Canadian neutral rate.

◀ *In a small open economy like Canada, the neutral rate is generally affected by both global and domestic factors*

¹⁰ An additional factor is that more negative values for Canadian NFA can be achieved only if foreign investors are willing to concentrate more of their wealth in Canada, which normally requires a higher premium for diversification-related reasons.

The relative importance of global and domestic factors in determining the Canadian neutral rate is uncertain. Moreover, uncertainty around each of these factors and around the proper framework to estimate the Canadian neutral rate makes the quantitative measures of this concept subject to considerable uncertainty. Consequently, Bank staff use four approaches to estimate the Canadian neutral rate. These approaches take explicit account of domestic factors such as Canadian potential output growth, while also capturing global factors through a foreign interest rate variable. The relative importance of these factors in determining the Canadian neutral rate varies with each model. Specifically, Bank staff use the following approaches (Mendes 2014):

- (i) A pure interest parity condition that implies that the neutral rate is equal to the global neutral rate in the long run. This approach abstracts entirely from the country-specific risk premium through a simplifying assumption that global capital markets are frictionless.
- (ii) A neoclassical growth model that allows for only domestic developments. Canadian potential output growth plays a prominent role in this approach.
- (iii) A linear reduced-form model that relates the neutral rate to the growth rate of Canadian potential output and to the foreign neutral rate. The estimates of this model generally put greater weight on the foreign neutral rate than on Canadian potential output growth. The results are sensitive to the sample period used for the estimation of the model.
- (iv) A small open economy overlapping-generations model in which the neutral rate is explained by the foreign neutral rate and domestic factors, such as productivity, demographics and credit risk spreads. The relative quantitative importance of each factor varies with the calibration of the model, particularly with the value of the elasticity of the country-specific risk premium to the NFA position.

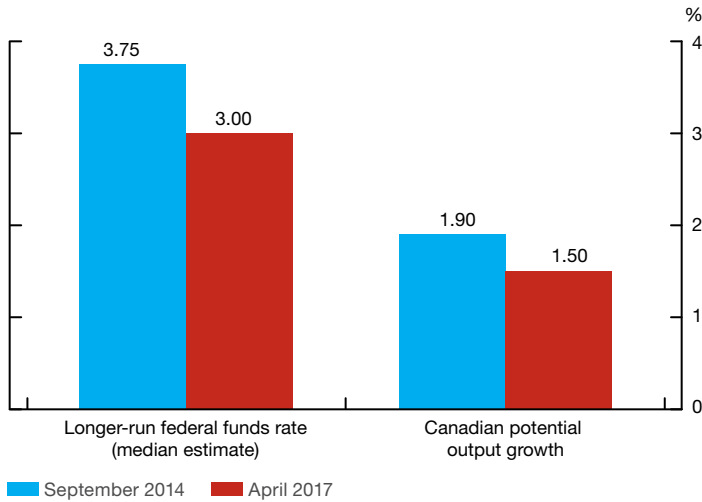
Using these approaches, Bank staff estimated in April 2017 that the real neutral policy rate in Canada is 1.0 per cent (in a range of 0.5 to 1.5, see **Table 1**).¹¹ This point estimate is 50 basis points lower than the 2014 estimate. This reduction of the neutral rate is mainly explained by a lower global neutral rate and reduced potential output growth in Canada relative to September 2014 (**Chart 9**).

Table 1: Summary of real neutral rate estimates for Canada (per cent)

Approach	April 2017	September 2014
Pure interest parity	0.50 to 1.50	1.00 to 2.00
Neoclassical growth model	1.25 to 1.50	1.75 to 2.00
Reduced-form model	0.50 to 1.00	1.00 to 1.50
Overlapping-generations model	1.00 to 1.50	1.50 to 2.00
All approaches	0.50 to 1.50	1.00 to 2.00
Midpoint	1.00	1.50

¹¹ See the Appendix in the April 2017 Bank of Canada *Monetary Policy Report*

Chart 9: Estimates of the longer-run federal funds rate and Canadian potential output growth



Note: Canadian potential output growth is shown as an average of the published projection period.
Sources: Federal Reserve Board and Bank of Canada

Implications of a Lower Canadian Neutral Rate

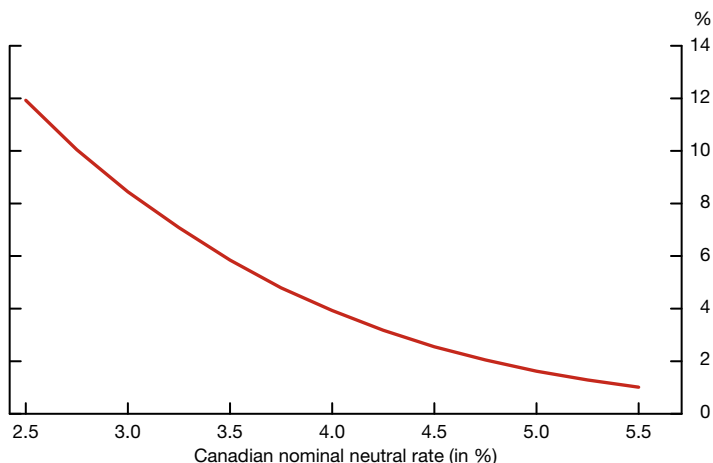
Since the Bank targets an inflation rate of 2 per cent, the Bank staff’s estimates of the Canadian real neutral rate translate into a range of 2.5 to 3.5 per cent for the nominal neutral rate, down from a range of 4.5 to 5.5 per cent estimated in the pre-crisis period. This lower neutral rate has two important implications for monetary policy and financial stability. First, for a given inflation target, a lower neutral rate reduces the amount of conventional monetary stimulus that can be provided without hitting the ELB and makes it more likely that the policy rate will be constrained by the ELB, which the Bank currently estimates at -0.5 per cent. Second, the lower neutral rate suggests that when the policy rate normalizes, it will likely converge to lower levels than those seen before the crisis. This low-rate environment may encourage excessive risk taking. The remainder of this section discusses these two implications in greater detail.

The neutral rate of interest is a key determinant of the probability of being constrained by the ELB. To get a better sense of the practical importance of the relationship between these two variables, we follow Dorich et al. (forthcoming) and run simulations using ToTEM, the Bank of Canada’s main policy model.¹² Our results are presented in Chart 10. They show that, for Canada, a decline in the nominal neutral rate from 5 per cent to 3 per cent is associated with a substantial increase in the likelihood of being at the ELB, namely from 1.6 per cent to 8.4 per cent. Moreover, they show that the current range of estimates for the Canadian nominal neutral rate implies that the probability of being at the ELB is in a range of 5.8 to 11.9 per cent.

A low interest rate environment may increase the incentives for banks and other financial institutions to take on more risks. Consider, for example, a life insurer anticipating a certain number of claims in a given period or a pension fund anticipating a certain amount of benefit payments. In a high-rate environment, it might be possible to meet these obligations by investing in government bonds or other highly rated assets. However, a low-rate environment might necessitate a shift into higher-yielding, riskier instruments.

◀ A low interest rate environment may increase the incentives for banks and other financial institutions to take on more risks

¹² The simulation results are based on the same distribution of shocks as observed over the sample from 1995Q1 to 2015Q2.

Chart 10: The relative frequency of binding effective lower bound in Canada and the Canadian nominal neutral rate

Source: Bank of Canada estimates

Conclusion

Despite considerable uncertainty in measuring the neutral rate of interest, a variety of studies using different methodologies point to the same conclusion: the global neutral rate has remained low during the post-crisis era. While some determinants of the global neutral rate, such as the supply of high savings from EMEs and oil-exporting countries have somewhat abated, the demand for investment, particularly, remains subdued because of lower working-age population growth and tepid productivity growth. This evolution of the global factors and the evolution of Canadian factors described in this article imply that the new normal for the policy rate in Canada is likely going to be lower than in the pre-crisis era. This could pose some challenges for conducting monetary policy and ensuring financial stability.

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