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Articles

Canada, George VI, 5 cents: 1938

Desirous of discontinuing designs that had been in use, in some cases, for more than 65 years, the Canadian government issued a truly national series of coins in 1937, featuring Canada's flora and fauna. The beaver featured on the 5-cent piece was designed by British engraver George Kruger-Gray. In 1938 demand for the 5-cent piece fell. Production was about one-quarter that in each of the preceding four years. It picked up again in 1939 and 1940 in response to wartime demands, but the reason for the reduced demand in 1938 remains a mystery.

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Factors Behind the 2014 Oil Price Decline

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- Oil prices have declined sharply over the past three years. Brent prices, for example, fell from an average of US$110 per barrel between January 2011 and June 2014 to a low of US$29 in January 2016 and an average of only US$50 since 2015.
- While both supply and demand factors played a role in the large oil price decline of 2014, global supply growth seems to have been the predominant force. This view is supported by economic models designed to disentangle the effects of shifts in supply and demand factors.
- The surprising growth of US shale oil production together with the decision by the Organization of the Petroleum Exporting Countries to maintain output played a key role in the initial decline in oil prices. Weaker-than-expected global growth and concerns over the Chinese economy in late 2015 also help explain the persistence of the price decline.

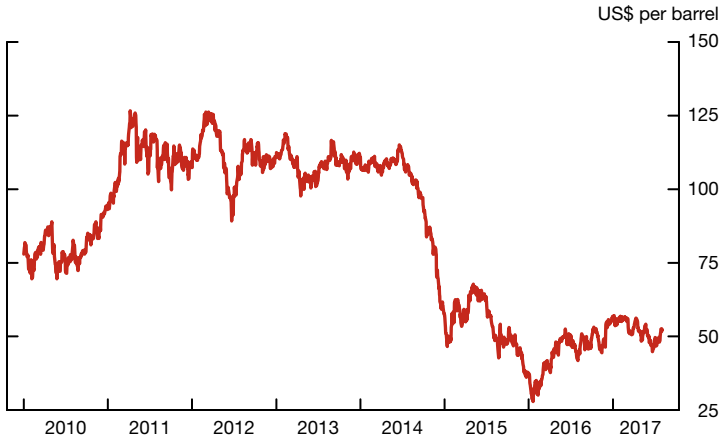
Between January 2011 and June 2014, Brent oil prices were relatively stable around US$110 per barrel—a three-and-a-half-year average that, in real terms, had never been seen before. However, oil prices fell steadily from that point, reaching a low of US$29 in January 2016, and have averaged US$50 since 2015 (**Chart 1**). In this article, we argue that both supply and demand played a role in the large oil price decline after June 2014 but that strong supply growth was the key factor.

The 2014 decline in oil prices coincided with a large increase in oil production and inventories as well as a modest increase in consumption. This pattern is consistent with an outward shift in the oil supply curve, which is empirically supported across a range of economic and statistical models designed to disentangle the price effects of shifts in the global supply and demand curves.

Although these models cannot isolate the specific shocks that led to this outward shift in the oil supply curve, this article discusses the events that likely had the greatest impact. In part, the strong supply response can be traced back to rising levels of economic growth in emerging-market economies (EMEs), particularly China, in the early 2000s. This growth helped support oil demand and pushed prices to levels that encouraged new

Chart 1: Crude oil prices since 2014

Brent crude oil prices, daily data



Source: Intercontinental Exchange via Haver Analytics

Last observation: August 2, 2017

investment in oil production. However, after the rebound in global output following the global financial crisis, economic growth began to be persistently overestimated, eventually resulting in an excess of oil production that helped precipitate the 2014 price collapse.

On its own, a misjudgment of future demand conditions would likely only have a temporary—though potentially long-lasting—effect on oil prices. If, for example, producing a new barrel of oil costs US$100, prices should be expected to return to that level once the excess supply in the oil market has been absorbed. However, other factors have also contributed to the outward shift in the supply curve, with the potential of permanently affecting future oil prices. In particular, innovations in US shale production have developed a new, potentially lower-cost source of supply that can respond more quickly to changes in oil prices—a major change in an industry where there have traditionally been long lags between price changes and new output.[1] The uncertainty caused by this new source of supply led the Organization of the Petroleum Exporting Countries (OPEC) to refrain from cutting output and instead take a wait-and-see approach, further exacerbating the oil price decline in mid-2014.

Oil and gas extraction made up roughly 30 per cent of total business investment in 2014

The decline in oil prices in 2014 had a significant impact on the Canadian economy. Canada is a net oil exporter, and the price of oil affects the country's terms of trade, its gross domestic income and the value of its dollar. Furthermore, while oil and gas extraction accounts for only 6 per cent of Canadian gross domestic product (GDP), it made up roughly 30 per cent of total business investment in 2014. Initial Bank estimates found that in the absence of any monetary policy response, the oil price decline would have reduced the level of Canadian GDP after 2014 by roughly 2 per cent (Bank of Canada 2015). The Bank therefore decreased interest rates twice in 2015 to help the economy adjust to lower oil prices.

Looking ahead, there are structural factors that could push the price of oil in either direction. Technological innovation in US shale oil extraction continues to progress, and novel techniques are slowly spreading in ways that could boost oil production in other countries, especially Canada. The recent

1 In this article, we use "shale oil" to refer to all forms of tight oil, which are light crude oils contained in low-permeability rock formations that can be accessed through hydraulic fracturing.

oversupply has, however, caused many oil firms to slash their exploration and production budgets. Since conventional oil projects take three to five years to build, on average, this reduction in investment raises the risk of insufficient supply if shale oil is unable to satisfy the growth in global oil demand. Finally, there are growing concerns among some market participants that "peak demand" could be imminent in the oil market. As policies are developed to address climate change and as electric vehicle battery technology improves, the demand for oil in transportation, one of the main sources of the demand for oil, could fall sharply.

Structure of the Global Oil Market

Before discussing the drivers of the 2014 oil price decline, we provide a short review of the structure of the global oil market. Roughly 60 per cent of global oil production comes from low-cost countries where government policy plays an active role in output decisions. This group is composed of national oil companies (NOCs) that are both in OPEC—which makes up about 40 per cent of global liquid fuel production—and in other, non-OPEC countries, such as Russia or Mexico.[2] Because the oil industry is traditionally characterized by long lags between price changes and new output, these NOCs can influence the price of oil by temporarily increasing or withholding production (Golombek, Irarrazabal and Ma 2014; Huppman 2013). These limited interventions likely help anchor price expectations in periods of temporary excess supply or demand. However, research suggests that longer-term co-operation is rare (Almoguera, Douglas and Herrera 2011; Dale 2015), in part because of the significant problems with coordinating actions across so many different producers.

The ability of this first group to affect the market price of crude oil is limited by the presence of another group of highly competitive firms that, individually, have no market power (i.e., the competitive fringe). This group includes a wide variety of firms: oil sands producers in Canada; large, private international oil companies; and small shale oil production companies in the United States. When the competitive fringe improves its ability to produce crude oil, as it did in the years leading up to the oil price decline, it weakens the market power of OPEC and other NOCs. The competitive fringe can do this in two ways: by reducing its costs of production or by reducing the lag between oil price movements and new output—both of which played a role in the recent oil price decline and will be discussed in greater detail in this article.

When the competitive fringe improves its ability to produce crude oil, it weakens the market power of the Organization of the Petroleum Exporting Countries and other national oil companies

Identifying the Factors Behind the Oil Price Decline

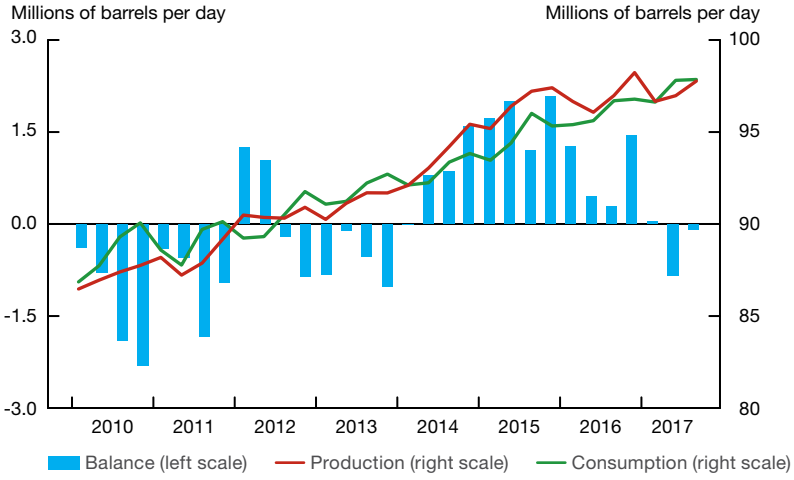
Economic theory provides three explanations for declines in oil prices.[3] First, prices could decline because of an outward shift in the oil market's supply curve. In this case, the price decline should be associated with an immediate increase in production and eventual rise in consumption. Second, they could decline because of an inward shift in the oil market's demand curve. In this case, the price decline should be associated with an immediate decrease in consumption and eventual decline in production.

2 NOCs are oil companies that are fully or majority-owned by national governments.

3 In this article, we focus on supply and demand factors rather than shocks. For this reason, we do not analyze the results of the Kilian and Murphy (2014) model, which is a model of shocks. A short example can help us understand the difference between the two. An outward shift in the oil market's supply curve is considered a supply factor, but the original reason behind that shift is known as a shock. If the supply curve shifted outward because of expectations of strong future demand, it would be caused by a demand shock.

Chart 2: Global oil market since 2010

Global petroleum production and refined products consumption, quarterly data



Note: "Balance" is the difference between total global production and total global consumption.

Sources: International Energy Agency and Bank of Canada calculations

Last observation: 2017Q3

Finally, if agents believe that future oil market conditions will be much less favourable for oil prices than current conditions, they would react by selling their level of oil inventories on hand. Note that shifts in the demand for oil inventories comprise expectations of future supply relative to future demand and thus can be driven by either supply or demand factors.

Output began to exceed demand after the second quarter of 2014

To get a sense of what drove the oil price decline in mid-2014, we first examine data on global oil production and consumption from the International Energy Agency (IEA, **Chart 2**). Between 2010 and 2013, production and consumption moved closely together, with each growing close to their 2001–13 annual average of 1.4 per cent.[4] However, output began to exceed demand after the second quarter of 2014, and production growth rose to an average of 2.7 per cent in that year, while consumption growth remained in line with its longer-term average. This imbalance persisted for 12 consecutive quarters, the longest such run ever recorded. Over time, the size of the imbalance shrank as production growth moderated, and consumption growth rose modestly above its long-term average. As of the second quarter of 2017, the gap between production and consumption appears to have closed. Nevertheless, the imbalances from 2014 to 2016 led to a large buildup in oil inventories, which has yet to be fully drawn down (**Chart 3**).

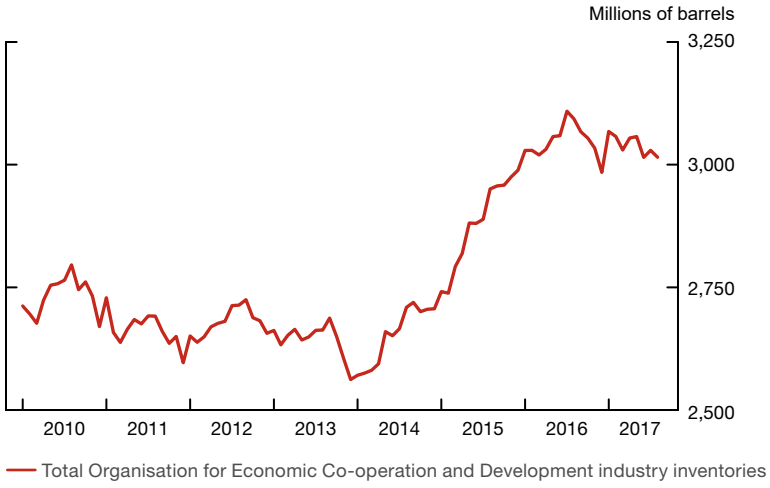
A pickup in production growth followed by an eventual rise in consumption growth suggests that supply factors explain most of the decline in oil prices since mid-2014. This analysis is supported by a range of models designed to disentangle the effects of supply and demand factors on oil prices (see **Box 1** for an explanation of these models).

Chart 4 (panels a and b) presents the oil price decompositions from our models. The model of oil demand and the commodity price factor model find that shifts in oil demand explain roughly 20 per cent and 40 per cent,

4 We chose 2001 as the starting point to coincide with the end of a recession in the United States and the Chinese accession to the World Trade Organization, both of which are considered important events for oil demand.

Chart 3: Elevated levels of petroleum inventories

Private inventories of refined and unrefined products, monthly data



Sources: International Energy Agency and Bank of Canada calculations Last observation: August 2017

Box 1

Models of Oil Supply and Demand Factors

This article uses two different models to decompose oil price movements into supply and demand factors. Using multiple models can help give us greater confidence in our results if these models all point in the same direction. We explain the structure and interpretation of these models below.

Model 1: Model of oil demand

This model, first presented by Hamilton (2014) and later modified by Bernanke (2016), relates changes in oil prices to factors that proxy for oil demand and are independent of oil supply. These factors include changes in copper prices, in the 10-year US Treasury interest rate, in a broad-weighted index of the US dollar, and in stock market volatility (proxied by the volatility index derived from stock options [VIX]).[1] The equation is estimated using ordinary least squares. Changes in the price of oil predicted by the model are meant to measure movements in oil demand, while all other movements are attributed to oil supply. Note, however, that to the extent that demand factors are not fully specified in this model, the model may be overestimating the effect of supply factors. In addition, this model is unable to determine whether supply or demand factors are driven by current conditions or by movements in future expectations.

1 How independent some of these factors are from oil supply can be disputed. For example, the United States is a net oil importer, so a decline in oil prices should boost the US dollar, all else being equal. We make no attempts to control for these issues in this article.

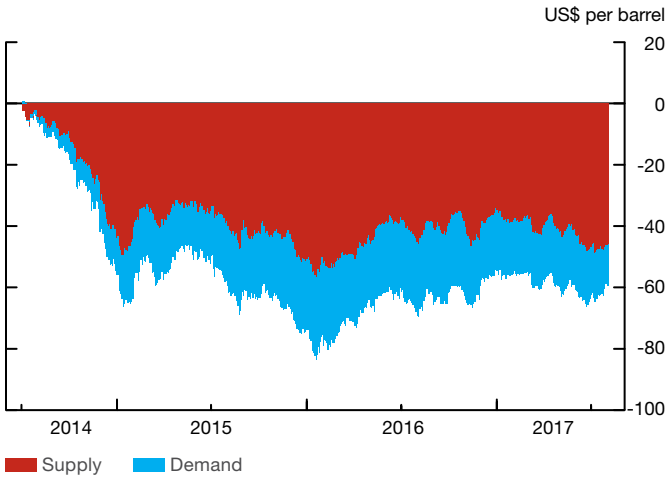
Model 2: Factor model of commodity prices

This model was first presented by Delle Chiaie, Ferrara and Giannone (2015) and was later extended to better match commodities that are of interest to Canada by Bilgin and Ellwanger (2017). The model uses a quasi-maximum likelihood estimation to break down the common movements across a large cross-section of commodity prices into three distinct categories: a global component; a group-specific, or block, component; and a commodity-specific, or idiosyncratic, component. The global component captures price trends that are common to all commodities included, which are typically related to global commodity demand (Alquist and Coibion 2014). One limitation of this approach is that movements in the global component could also be driven by changes in the US dollar, the currency in which most commodities are priced. Furthermore, this model cannot distinguish whether block or idiosyncratic components are driven by supply factors or by commodity-specific demand factors, though the narrative evidence that we provide for oil prices suggests these movements are mostly related to supply factors (e.g., the rise of US shale oil production).

Chart 4: Decompositions of price shocks to crude oil prices

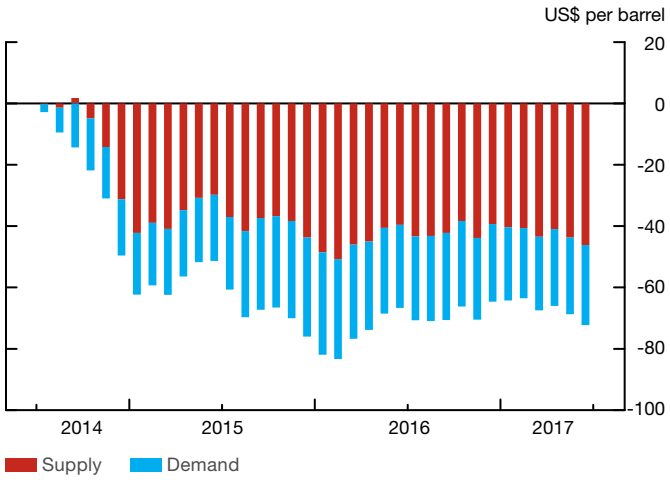
Cumulative dollar shocks since June 2014

a. Oil demand model decomposition, daily data



Source: Bank of Canada Last observation: August 4, 2017

b. Commodity price factor model decomposition, monthly data



Note: Supply is the sum of the block and idiosyncratic components, and demand is the global component.

Source: Bank of Canada Last observation: June 2017

respectively, of the oil price decline between June 2014 and August 2017. The remainder, constituting the bulk of the oil price decline, is attributed to shifts in oil supply.

While these models can help decompose price movements into supply and demand factors, they are not designed to identify the specific supply and demand developments that drove these movements over the 2014 oil price decline. To complement the findings from these models, the next section outlines the major events that we believe provide the best explanation for the movements in supply and demand since 2014. We pay particular attention to three events: the lagged effect of previously strong demand conditions, the development of new oil extraction technologies and OPEC's decision to not cut production in late 2014.

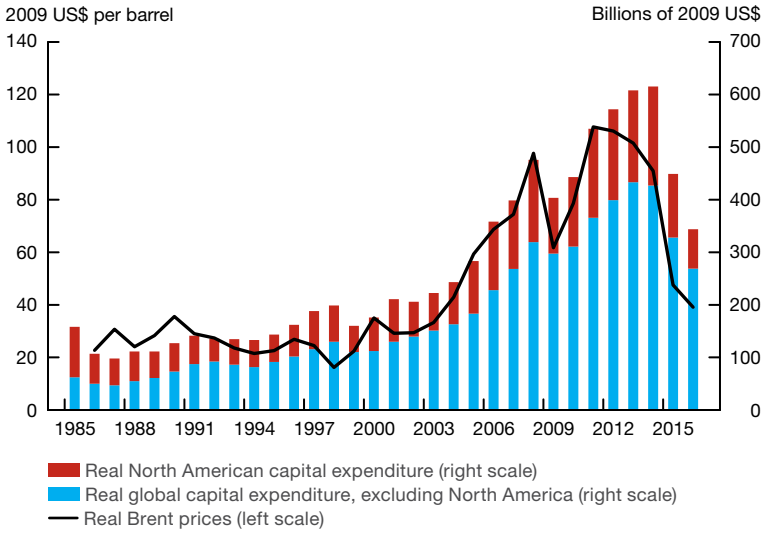
Past Demand Conditions Fuel an Excess Output Response

Strong economic growth in the early 2000s, especially in EMEs and particularly in China, led to steady growth in oil demand and upward pressure on oil prices. This process—where a period of high commodity prices over time eventually leads to new investment and output and an eventual decline in commodity prices—is sometimes referred to as a commodity price supercycle (for a survey, see Büyükşahin, Mo and Zmitrowicz 2016). As growing demand increased the price of oil, it also led to a substantial increase in oil-related capital expenditures (**Chart 5**). This new capital helped develop previously unprofitable areas of oil production, such as the oil sands in Canada, offshore deepwater oil in the Gulf of Mexico and, especially, shale oil in the inland United States.

However, after the sharp recovery in global output following the global financial crisis in 2009, this process started to reverse. Starting in 2011, there was a broad decline across all commodity prices, suggesting concerns about the underlying strength of global economic growth. In part, this weakness likely reflected a series of downward revisions to global growth

Chart 5: Global oil-related capital expenditures and the price of oil

Chained 2009 dollars, annual data

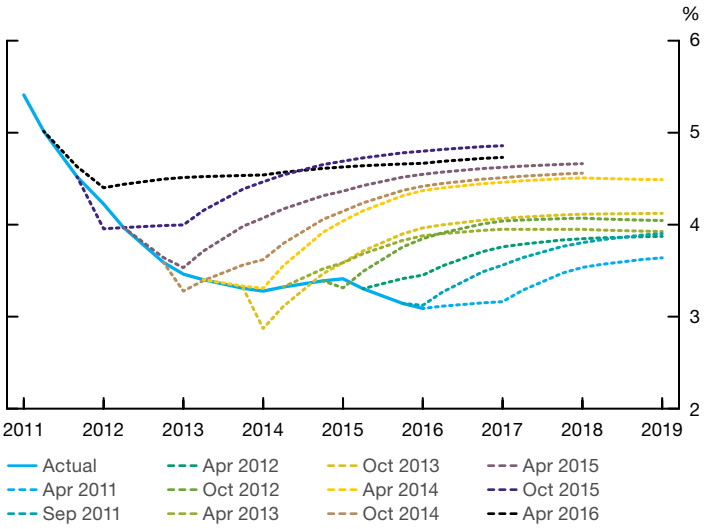


Sources: US Bureau of Economic Analysis and *Financial Times* via Haver Analytics, Barclays and Bank of Canada calculations

Last observation: 2016

Chart 6: World gross domestic product forecasts

Annualized real gross domestic product growth forecasts, by IMF *World Economic Outlook* vintage



Source: International Monetary Fund

expectations. **Chart 6** shows that global GDP growth was 3.5 per cent by 2014, almost 1.5 percentage points lower than what the International Monetary Fund, along with most other analysts, had expected three years earlier. Many oil projects that had been sanctioned in earlier periods when demand was much stronger only began to come online during this period of slowing growth, likely contributing to a slow but progressive excess in the amount of oil production over demand.

Many oil projects that had been sanctioned in earlier periods when oil demand was much stronger only began to come online in this period of slow growth, likely contributing to a slow but progressive excess in the amount of oil production over demand

Developments in China have been especially important for the decline in oil prices. China accounted for almost 70 per cent of the increase in global oil consumption between 2000 and 2014. As such, initially strong forecasts for

Chinese growth followed by repeated downward revisions likely contributed to the excess oil supply response and had an outsized effect on prices. Furthermore, concerns over future expected Chinese growth were particularly important for the decline in oil prices in early 2016, when the Brent oil price hit a low of US$29 in January of that year. At that time, a correction in the domestic Chinese stock market touched off concerns over the sustainability of future economic growth, but oil prices began to recover steadily as those concerns eased.[5]

New Technologies Also Help Set the Stage

The expansion of US shale oil extraction has proven to be particularly disruptive to the way oil is produced

The steady increase in oil prices over the 2000s also helped spur the development of several new oil extraction technologies that are still being improved upon today. The expansion of US shale oil extraction has proven to be particularly disruptive to the way oil is produced. The main technology behind the exploitation of shale oil involves fracking: a process where high-pressure liquids are injected into subterranean formations to fracture them and make it possible to extract the oil and gas they contain.

Over the years, fracking has been combined with other technologies that have allowed it to become competitive with conventional oil development.[6] The US Energy Information Administration (EIA) estimates that between 2008 and 2016 US shale oil production rose from close to zero to about 4.25 million barrels per day of crude oil (EIA 2017). This represented roughly 48 per cent of total US crude oil production and 5 per cent of global crude oil production in 2016. For perspective, US shale crude oil production, which took around 7 years to develop, now roughly matches total oil production in Canada, which took approximately 70.[7]

Moreover, shale oil production can respond to changes in oil prices much more quickly than traditional oil projects (i.e., its output response is more elastic to price shifts).[8] **Chart 7** shows that most projects started in the 2000s took three to five years to develop, meaning there was a substantial lag between changes in oil prices and new production. This situation gave oil-producing countries with significant spare capacity—particularly Saudi Arabia—the ability to influence oil markets by releasing or withholding supplies at strategic times. The rise of US shale oil production has attenuated this ability. Because US shale oil can be brought to market within six months to a year, it can react more quickly to price changes. Note, however, that while US shale oil is quick to develop, it is also quick to deplete relative to conventional oil production (Kleinberg et al. 2016). This means that to remain constant, relative to conventional oil, shale oil production requires a more rapid discovery of new deposits and a steady stream of new investment.

Improvements in fracking technology have cut extraction costs, which means that lower oil prices can be sustained over longer periods than before

Finally, improvements in fracking technology have cut extraction costs, which means that lower oil prices can be sustained over longer periods than before. **Chart 8** shows evidence from Rystad Energy, a major independent oil consultancy, that the oil price needed to profitably develop a US shale oil well (the "break-even" price) declined by roughly 50 per cent between

5 This contention is also supported by the results of the oil price decomposition models discussed previously, which all point toward demand factors as the reason behind the oil price drop in early 2016.

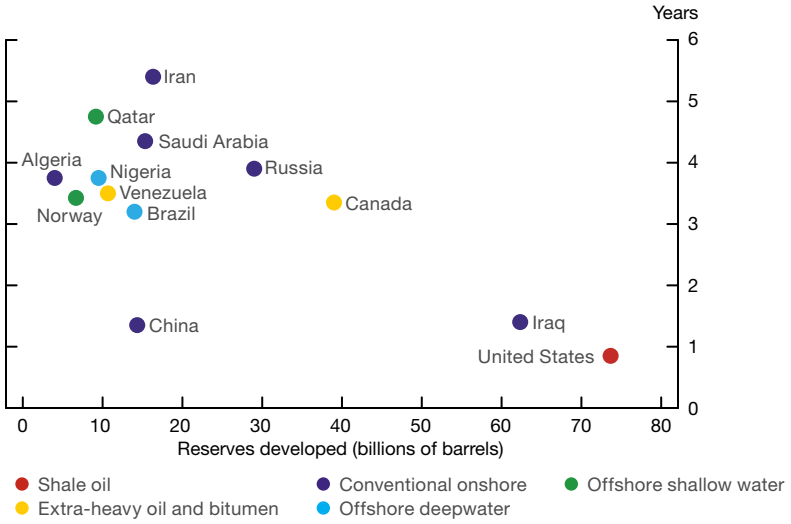
6 These include horizontal well-drilling, enhanced seismic imaging and improved drilling techniques, such as pad drilling and greater rig mobility (EIA 2012).

7 This comparison uses total liquids production, the International Energy Agency's broadest definition of oil and oil substitutes, encompassing crude oil, natural gas liquids and nonconventional oil production (e.g., output from oil sands mines).

8 This is due in part to the greater resemblance of tight oil production to a manufacturing-style process, where the same rigs and processes can be used to drill many wells in similar locations (Dale 2015).

Chart 7: US shale versus other oil investment, by country

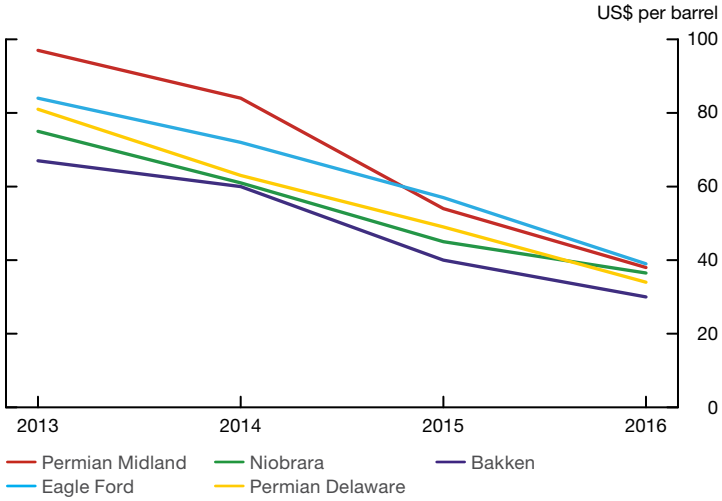
Average lead times after final investment decision announcement (2000–14)



Source: International Energy Agency

Chart 8: Break-even prices across US shale oil basins

Wellhead break-even prices



Source: Rystad Energy

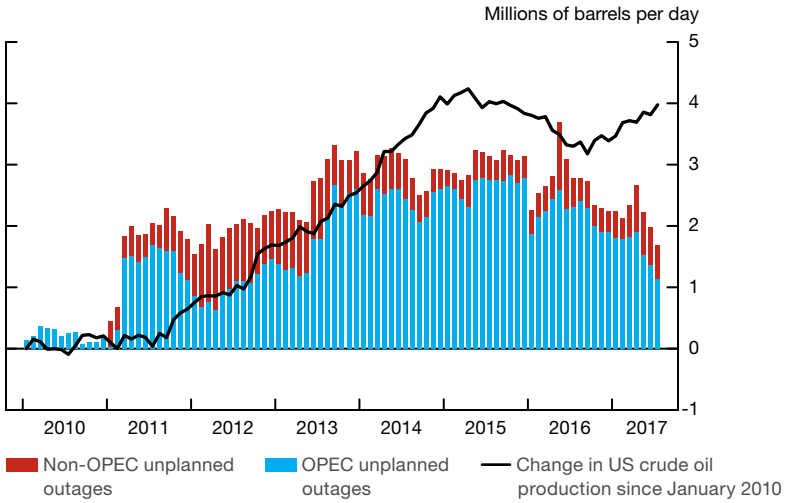
Last observation: 2016

2013 and 2016 across all major producing regions (Rystad Energy 2016). These rapid cost declines are likely one of the key factors holding back any sustained recovery in oil prices over the past three years. Nevertheless, it remains unclear to what degree these cost declines will persist. For example, Rystad Energy also presents evidence that the decline in oil prices led to weaker demand for oil field services, temporarily reducing their cost, a process that should reverse as demand for drilling activity picks up (i.e., the cost declines result more from shifts in economic rent than technological factors). The evolution of break-even costs for US shale oil remains a key uncertainty for oil price forecasting going forward.

The effects of fracking on oil prices took a few years to be fully realized. US shale oil was initially seen as a relatively high-cost source of supply, and its supply elasticity was unknown. The ability of shale oil producers to continue

US shale oil was initially seen as a relatively high-cost source of supply, and its supply elasticity was unknown

Chart 9: US shale oil production and global unplanned outages, including those from the Organization of the Petroleum Exporting Countries



Sources: Energy Information Administration, International Energy Agency and Bank of Canada calculations

Last observation: July 2017

to reduce costs in the face of falling oil prices—while definitely highlighted as a risk (Bank of Canada 2015)—only became clearer over time. In addition, **Chart 9** shows that, until mid-2014, the surprising growth in US shale oil production was offset by a rise in unplanned production outages in the rest of the world. These outages were the result of geopolitical events, including the civil war in Libya, economic sanctions against Iran, and the rise of the group known as the Islamic State in Syria and Iraq. After 2014, the level of unplanned outages began to abate, but US shale oil output continued to grow strongly, helping precipitate the imbalance between production and consumption seen in **Chart 2**.

OPEC's Decision Exacerbated the Oil Price Decline

The decision by OPEC to refrain from cutting oil production in November 2014 also contributed to the decline in oil prices. While this decision caught markets by surprise, it was broadly consistent with the behaviour of Saudi Arabia—the key player in any OPEC agreement—since the oil price collapse of 1986 (Fattouh, Poudineh and Sen 2015). Several studies have sought to model Saudi Arabia and OPEC's decision-making process more formally (see Behar and Ritz 2017 for a recent example). These models broadly agree that a minimal set of conditions must be in place for Saudi Arabia to sign on to any agreement to cut production. We can summarize these conditions as follows:

1. The ability of other OPEC members to raise their own output must be limited; otherwise, they could offset the effects of a Saudi cut.
2. The ability of non-OPEC producers to raise their own output in response to a cut should be limited and well understood.
3. The shock facing the oil market should be considered temporary, which helps to ensure that any agreement has a built-in expiry date (Dale 2015).

These conditions were absent between November 2014 and September 2016. On the OPEC side, Iran was making progress toward the removal of economic sanctions against its oil exports, and Iraq was finally solving the infrastructure bottlenecks that had plagued it since 2003. In fact, Iraqi oil production had already increased by around 0.7 million barrels per day (mb/d) between 2011 and 2014, contributing to the overall excess of supply. As a result, neither country was ready to discuss any formal agreement to restrict output in November 2014. On the non-OPEC side, US shale oil was clearly changing the nature of the oil market. Faced with these conditions, Saudi Arabia seemed willing to allow prices to decline enough to slow down non-OPEC production growth and increased its production amid falling prices. While counterintuitive, this decision was likely the rational, revenue-maximizing decision, especially when the price level needed to manage non-OPEC output was uncertain. A similar reasoning can explain why later OPEC meetings in December 2015 and April 2016 also ended without any formal agreement or guidance on future policy.

Conditions had shifted by the time of the September 2016 OPEC meeting. By then, output from Iran and Iraq had plateaued, lessening the concern that they could easily offset any output cuts. Also, the nature of the US shale supply curve was—at that time—thought to be better understood. By December 2016, Saudi Arabia therefore helped orchestrate an output cut of 1.8 mb/d between OPEC and other non-OPEC oil producers. This agreement had the limited goal of reducing oil inventories that had built up over the preceding three years back to their five-year average. However, it remains to be seen whether this will be achieved, given the ongoing technological progress occurring in US shale oil projects.

Future Outlook

Some of the trends outlined here are still developing, and thus the future path for oil prices remains highly uncertain. Below we sketch out some of the most important developments that could affect the oil market in the foreseeable future.

Shale oil technology could spread around the globe

The United States is the only country to have massively increased its oil production through shale oil development, but this could change. Substantial shale oil deposits have been identified in Argentina, China and Russia. The development of these deposits has thus far been hampered to some extent by unfavourable political and regulatory environments (Alquist and Guénette 2013). Should this change, shale oil development could quickly spread outside North America. In addition, much of the drilling technology recently developed for shale oil is already being used in Canada and Russia and could be applied to conventional wells (Farchy 2016; Tertzakian 2017). If these technologies continue to spread, any rise in oil prices could be constrained over the longer term.

New technology and policy could lead oil demand to decline

There are growing concerns among some market participants that demand for crude oil could peak soon and then begin to decline over the next few decades, which would also negatively affect oil prices. New technologies, such as electric vehicles (EV), could significantly reduce the demand for oil. For example, the IEA expects the number of EVs being driven to rise twentyfold in the next 10 years, reducing oil demand by 0.3 mb/d (IEA 2016).

The outlook for EV penetration remains highly uncertain because it is difficult to predict how fast the technology will evolve and how much support it will receive from governments.[9]

In the past, economic considerations have driven the trend toward greater energy efficiency, but environmental policies could play a more important role in the future. Despite a recent pullback in the United States, most countries are committed to slowing, or even reversing, the effects of commodity consumption on air and water quality and the climate, especially after the 21st Council of the Parties agreement on climate change was signed in December 2015. If the governments of these countries implement the committed regulatory changes, such as carbon pricing, these efforts could reduce future oil consumption.

Current pace of oil-related capital spending may be insufficient to meet future demand needs

As shown in **Chart 5**, oil-related capital expenditures tend to track oil prices closely. The decline in oil prices since 2014 has raised concerns that these capital expenditures are now so low that future oil supply may be insufficient to meet demand and, thus, could lead to a significant spike in oil prices. Given the rate of decline in traditional oil fields and continued demand increases driven by economic development in EMEs, the IEA has estimated that an additional 22 mb/d of non-US shale oil production could be needed by 2025 (IEA 2016). This is a staggering amount—it would require newly sanctioned oil projects to return to levels last seen in the 1970s and would likely require a sharp rise in oil prices for production to meet demand.

Conclusion

In this article, we argue that both supply and demand factors played a role in the large oil price decline of 2014. A long-delayed output response from a time of higher oil prices, the surprising growth of US shale oil production and the OPEC decision to maintain output levels played key roles in the initial decline in oil prices. The weakness in oil prices has also been supported by slower-than-expected global growth as well as concerns over the Chinese economy in early 2016.

9 For example, the governments in France and the United Kingdom recently committed to banning the sale of petroleum and diesel engine vehicles after 2040, suggesting that future policy decisions could also play a key role in future EV penetration.

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Acceptance and Use of Payments at the Point of Sale in Canada

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- Using data from two recent surveys conducted by the Bank of Canada, this article studies how consumers and merchants interact with each other to determine which payment methods are accepted and used at the point of sale.
- Merchants in Canada almost universally accept cash. While nearly all large businesses accept debit and credit cards, only two-thirds of small or medium-sized businesses do. Our analysis suggests that merchant's perceptions and the costs they incur from accepting payment methods are not the only factors that determine which methods they accept. Merchants also consider which payment methods consumers are likely to carry and prefer.
- Most consumers carry cash as well as debit cards and credit cards—their perceptions and the costs of using a specific payment method seem to have only a small influence on which ones they carry.
- Given that most merchants accept several methods, it is mainly consumers who determine which they will use. We find that cash is still widely used, especially for small-value transactions, even at large businesses that accept cash and cards. Debit cards are used mainly for medium-value transactions and credit cards for large-value transactions.
- These findings highlight the importance of the interaction between consumers and merchants as well as network externalities in a two-sided market.

The Bank of Canada has an interest in conducting surveys to track the evolution of the use of cash

In Canada, consumers pay for transactions using several payment methods, including cash, debit cards and credit cards. As the sole issuer of bank notes in Canada, the Bank of Canada has an interest in conducting surveys to determine which payment methods consumers prefer to use at the point of sale (POS) to track the evolution of cash use.[1] Research based on these consumer surveys found that the share of cash payments is decreasing in

1 See Arango and Welte (2012) and Henry, Huynh and Shen (2015) for more information about the method-of-payment surveys conducted by the Bank of Canada in 2009 and 2013, respectively.

terms of value and volume (Arango et al. 2012; Fung, Huynh and Stuber 2015). To better understand the replacement of cash by cards and other payment methods, the Bank of Canada undertook another survey in 2015 on the costs Canadian merchants incur when they accept payments.[2]

The goal of this article is to combine data from two of the Bank's recent surveys to analyze how consumers and merchants in Canada interact with each other to determine POS payment methods. This is necessary because the payments market is two-sided, with a distinct user group on each side.[3] On one side, consumers choose a payment method among those the merchant will accept. Consumers can also favour stores that accept their preferred method. On the other side, merchants will likely accept payment methods that help them attract customers, even if they are costlier or less preferable than other payment methods.

We begin with a brief description of the methodology used in the surveys. We then discuss perceptions and the costs of different methods, as well as their acceptance by merchants and adoption by consumers. Next, we turn to a discussion of how merchants and consumers interact with one another to determine payment outcomes. We end with a discussion of future work.

Survey Methodology

Merchant survey

The objective of the 2015 Retailer Survey on the Cost of Payment Methods (RSCPM) was to collect information from merchants about the payment methods they accepted at the POS in 2014 and the costs of accepting these methods, with a focus on cash, debit cards and credit cards (**Box 1**). Details of the survey objectives and measurement are available in Kosse et al. (2017). Merchants are diverse, so the data were collected based on merchant size, sector and region. For sectors, we focused on the retail trade, the food and accommodation sector, and personal service providers such as dry cleaners and hair stylists. For size, we segmented the merchants into two broad categories: (i) small and medium-sized businesses (SMBs), which have a single store and employ fewer than 50 people, and (ii) large businesses (LBs), which have a single store with more than 50 employees or have multiple locations. Details about the sampling framework, questionnaire, response rate and coverage are discussed in Welte (2017).

Consumer survey

The Bank of Canada regularly conducts surveys to study the use of different methods of payment, the most recent of which was conducted in 2013.[4] The 2013 Methods-of-Payment (MOP) Survey consisted of two parts: a questionnaire that asked for detailed demographic information about the respondent and a diary that captured a respondent's transactions during a three-day period. Henry, Huynh and Shen (2015) provide a detailed discussion of the 2013 MOP Survey and the results.

2 This survey was one of the main components of the wider cost-of-payments study that included consumers, merchants, financial institutions and infrastructure providers (for example, cash-in-transit companies), the Bank of Canada and the Royal Canadian Mint. Results of this study are available in Kosse et al. (2017). The Bank also conducted a smaller-scale study on the costs of accepting payments by retailers in 2006; see Arango and Taylor (2008).

3 Rysman (2009) offers an in-depth explanation of two-sided markets.

4 The Bank of Canada is now conducting the 2017 MOP survey, and the results will be available in 2018.

Box 1

The 2015 Retailer Survey on the Cost of Payment Methods

The 2015 Retailer Survey on the Cost of Payment Methods (RSCPM) collected 900 responses from small and medium-sized businesses (SMBs), and sample weights were constructed to create a representative sample.[1] As well, 169 large businesses (LBs) responded.[2] Based on the sampling frame of the survey, the LB responses accounted for almost two-thirds of point-of-sale (POS) turnover at Canadian LBs. For a detailed discussion of the sampling methodology used for SMBs and LBs, see Chen and Shen (2017) and Jiongo (2017), respectively. Hatko (2017) discusses the methodology used to account for unit non-response (not answering a survey) and item nonresponse (omitting survey questions).

Table 1-A shows that the characteristics of the SMB and LB samples for sales, employees and payment infrastructure are quite different. Half of SMBs have sales of less than $375,000 and fewer than four employees. The median sales and the median number of employees for LBs are much higher at $2,426,508 and 85 people, respectively. More than half of SMBs have one POS terminal and one cash register, which is considerably fewer than for LBs. In terms of cash holdings, half of the SMBs that responded hold less than $300 of cash on hand compared with a median cash holding of $1,800 among LBs.

1 Only 826 of the responses from SMBs were usable for analysis.

2 This includes 114 large independent businesses and 55 chains.

Table 1-A: Merchant characteristics and infrastructure (median)

	SMB	LB
Total annual sales	$375,000	$2,426,508
Number of employees	4	85
Point of sale terminals	1	6
Cash registers	1	3.5
Cash holdings	$300	$1,800

Notes: SMB means small and medium-sized business. LB means large business.
Source: 2015 Retailer Survey on the Cost of Payment Methods

Merchant Acceptance, Stated Perceptions and Costs

Since a payment method can be used only if it is accepted at the POS, the merchant plays a large role in the evolution of the use of cash and other payment methods. Using data from the 2015 RSCPM, we examine how merchants' choices are influenced by their stated perceptions and the costs of various payment methods at the POS.

Merchants play a large role in the evolution of the use of cash and other payment methods

Merchant acceptance

Canadian merchants were asked to report which of the following payment methods they accepted: cash, debit cards, credit cards, store-branded prepaid gift cards, cheques, mobile payments and even bitcoin (**Table 1**). As expected, cash is almost universally accepted, by 94 per cent of SMBs and 98 per cent of LBs. Debit and credit card acceptance by LBs is also nearly universal, at around 98 per cent, while card acceptance by SMBs is considerably less frequent, at approximately only 67 per cent. When merchants accept cards, they tend to accept both debit and credit cards. Overall, LBs accept cash, debit cards and credit cards at similar rates, while SMBs are more likely to accept cash than cards.[5]

Among SMBs, cash and card acceptance varies across industries and locations. Venues that offer accommodation or food have the highest acceptance of both cash and cards. While cash is uniformly accepted across the country, cards are accepted most often in Ontario and the Atlantic provinces and least often in Quebec.

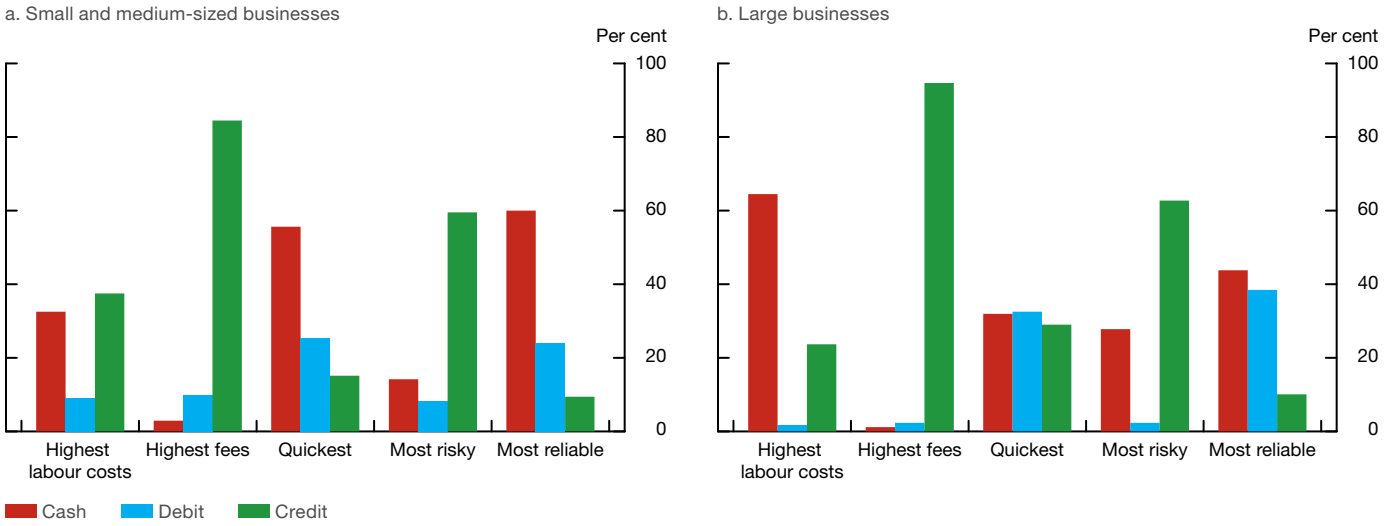
5 Prepaid store-branded gift cards are accepted by more than half of LBs and by only 22 per cent of SMBs. More than 60 per cent of merchants accept cheques, although their use has continued to decline in recent years. In contrast, personal service providers (e.g., dry cleaners, hair stylists) have the lowest acceptance of cards. However, 78 per cent of these merchants still accept cheques, which is the highest among all sectors. Very few merchants accept newer payment methods, such as mobile payments and bitcoin, reflecting the low adoption and use of these payment methods by consumers.

Table 1: Merchant payment acceptance (percentage)

	Cash	Debit	Credit	Cheques	Prepaid	Mobile	Bitcoin
By size							
SMBs	94	67	66	64	22	5	2
LBs	98	97	98	63	54	8	2
By industry (SMBs only)							
Specialized retail stores	93	75	72	66		6	1
General retail stores	98	69	64	63		8	1
Accommodation and food places	98	74	72	37		5	1
Personal service providers	92	56	59	78		3	3
By region (SMBs only)							
Atlantic	95	75	73	71		3	2
Quebec	91	59	56	59		4	1
Ontario	96	73	73	59		3	1
Prairies	93	64	68	77		4	5
British Columbia	94	66	60	70		11	0

Notes: Only the results of small and medium-sized business (SMBs) are further broken down by industry and region because many large businesses (LBs) operate in more than one industry and in more than one province. "Prepaid" refers to store-branded prepaid gift cards.
Source: 2015 Retailer Survey on the Cost of Payment Methods

Chart 1: Merchants' stated perceptions of payment methods



Note: These figures present the percentage of merchants in the sample who selected each method of payment as being the most costly in terms of labour or fees, most reliable, most risky in terms of fraud and safety, and quickest at the point of sale.
Source: 2015 Retailer Survey on the Cost of Payment Methods

Merchants' stated perceptions

In the 2015 RSCPM, merchants were asked to indicate their perceptions of the following five attributes of payment methods, such as cash, debit cards and credit cards: labour costs, fees, reliability, safety and speed. **Chart 1a** and **Chart 1b** show the stated perceptions of these five attributes according to both SMBs and LBs.[6]

6 All charts and tables in this paper are weighted to be representative of the relevant Canadian population.

SMBs perceive debit cards to have the lowest labour costs and to be the least risky in terms of fraud, while cash is perceived to have the lowest fees and to be the most reliable (the least sensitive to malfunctioning) and fastest. SMBs perceive credit cards to be the least preferred in all five of the attributes. LBs perceive debit cards to be the least costly in terms of labour, the least risky, and the fastest in terms of the speed of the transaction at the counter.[7] While they perceive cash to be the least costly in fees and the most reliable, they also perceive cash to be the most expensive in terms of labour. LBs also perceive credit cards to be the most expensive in fees, the riskiest, the least reliable and the slowest.

Accordingly, merchants are likely to prefer cash and debit cards. Overall, these perceptions are quite consistent across sectors and locations.

Merchants, across sectors, are likely to state that they prefer cash and debit cards

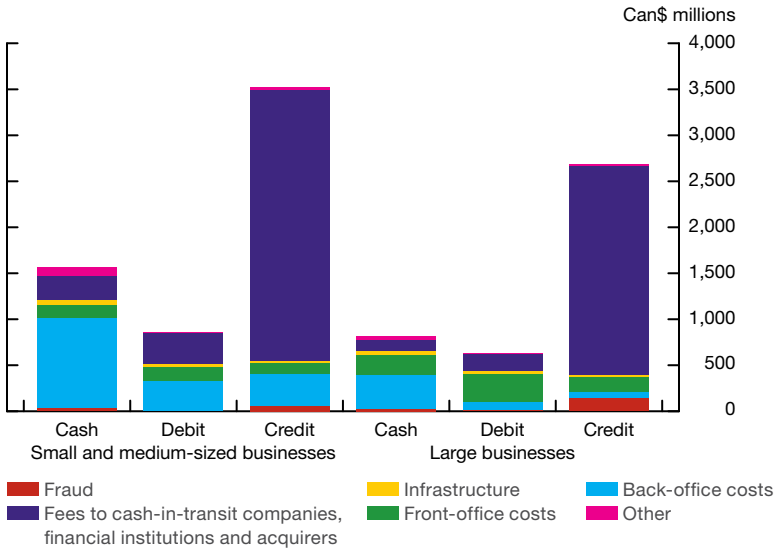
Costs of payment methods to merchants

Merchants incur costs for accepting each payment method. Their total private costs include both the resources they employ (i.e., time spent on payments administration) and fees they pay to other parties (i.e., transaction fees paid to payment processors).[8] In 2014, it cost Canadian merchants $10 billion to accept payments at the POS. The majority, $6.2 billion, was incurred for accepting credit cards, followed by $2.4 billion for cash and $1.5 billion for debit cards.

The composition of costs varies among payment methods and with merchant size. For credit cards, processing fees accounted for most of the costs (**Chart 2**). For cash, the greatest expense was on back-office functions, such as time spent counting cash and depositing it in the bank. This component is especially high for SMBs, which suggests differences in the way merchants deal with their back-office activities. For example, SMBs might prefer to deposit their cash receipts at their bank on a daily basis.

Chart 2: Total private cost by cost item

By merchant size

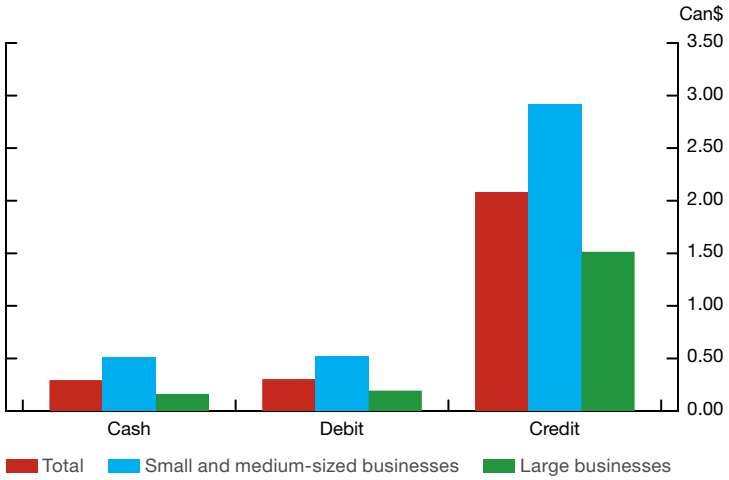


Source: 2015 Retailer Survey on the Cost of Payment Methods

7 Labour costs include time spent on processing payments at the cashier and on back-office activities such as counting and depositing cash receipts.

8 In this article, all cost measures refer to the private costs to merchants. In the literature, another cost measure is the resource cost, which differs from the private cost by excluding the fees paid to another party. For a more detailed discussion of these cost measures, see Kosse et al. (2017).

Chart 3: Average private cost per transaction

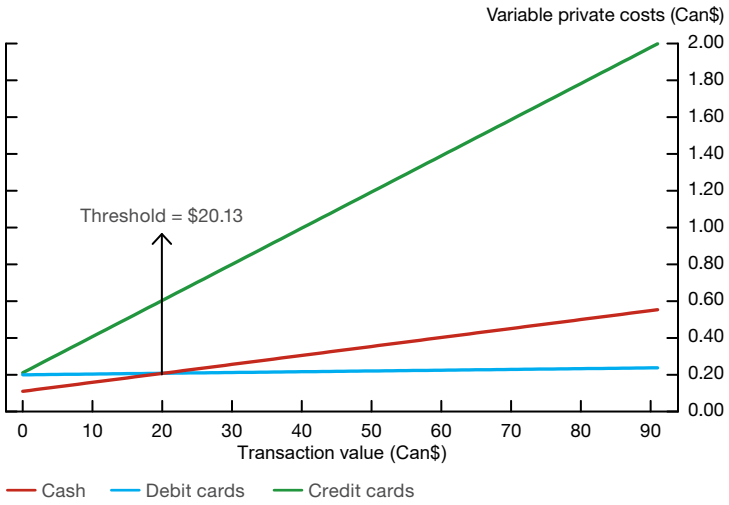


Note: The average private cost per transaction for each method of payment is calculated by dividing the private cost incurred by the number of transactions.

Source: 2015 Retailer Survey on the Cost of Payment Methods

Chart 4: Variable private costs by transaction value

All merchant sizes



Source: 2015 Retailer Survey on the Cost of Payment Methods

For debit cards, back-office costs and fees to payment processors are the largest cost components for SMBs, whereas front-office time costs make up the largest share for LBs.

The average cost per transaction is the highest for credit cards at $2.08, compared with $0.29 for cash and $0.30 for debit cards (**Chart 3**). For each payment method, SMBs incur a higher average transaction cost than LBs do. In the case of credit cards, it costs SMBs almost twice as much as it does LBs, likely because of economies of scale.[9]

Chart 4 shows that the cost of a cash or credit card transaction increases with the transaction value. In the case of cash, this is because more bank notes are involved in large-value transactions. For a payment by credit card,

The cost to merchants of a cash or credit card transaction increases with the transaction value, but it is constant for debit cards

9 Cash is used mainly for small-value transactions, and the median credit card transaction value for SMBs is almost twice as much as that for LBs. See Kosse et al. (2017) for a comparison of the costs with the value of transactions.

this is because the merchant fee is proportional to the amount paid. However, the cost of a debit card transaction is constant. **Chart 4** also shows that, ignoring fixed set-up costs, such as investments in terminals, cash is the cheapest payment method for merchants for purchases up to around $20, whereas debit cards are the least costly for transactions greater than $20.[10] Credit cards are the costliest for all transaction values. Based on the variable costs alone, merchants would prefer consumers to use cash for small purchases and debit cards for large purchases.

The stated perceptions of LBs suggest that they prefer debit cards over cash and credit cards. LBs prefer debit cards because they have similar average transaction costs as cash in general and are cheapest for purchases larger than $20. Notwithstanding their preferences and costs, LBs accept cash, debit cards and credit cards almost universally. And while fewer SMBs accept cards, those that do accept debit and credit cards at a similar rate, even though costs and stated perceptions would favour debit cards.

These results suggest that merchant perceptions and costs are not the only factors that determine their acceptance of payment methods.

Consumer Adoption, Perceptions and Costs

Consumers first choose which payment methods to carry and then which method to use at the POS. Using the results of the 2015 RSCPM and the 2013 MOP Survey, this section studies whether consumer perceptions of and costs for making a payment at the POS affect their decision about which payment methods they carry.

Consumer adoption

Most consumers in Canada have access to several payment methods they can use at the POS, including cash, debit cards and credit cards. Based on the 2013 MOP Survey, more than 87 per cent of Canadians carry cash in their wallets, while 86 per cent carry a debit card and 83 per cent carry a credit card.[11]

Consumer perceptions

In the 2013 MOP Survey, consumers were asked to indicate their perceptions regarding various aspects of different payment methods. Fung, Huynh and Stuber (2015) reported that consumers rated cash as considerably less costly and more secure than debit and credit cards. However, consumers considered all three payment methods to be about the same in terms of ease of use and acceptance and noted only a relatively small difference in terms of acceptance of cash and cards.

Consumer costs of payment

Based on the 2015 RSCPM, Canadian consumers incurred a total cost of $5.5 billion from POS payments in 2014, with the majority arising from debit cards ($2.9 billion) and cash ($2.2 billion). Consumers incurred the least costs from credit cards ($0.4 billion), of which the main cost items are annual credit card fees and the time needed to carry out the payments.[12]

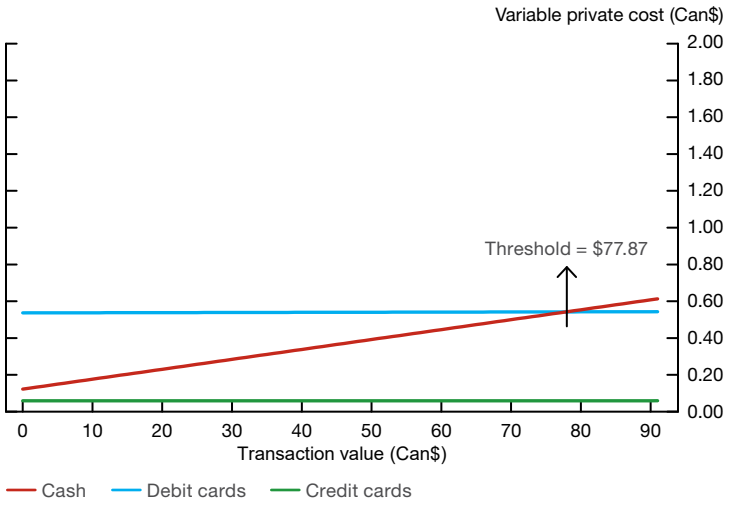
10 The threshold for LBs is slightly higher than that for SMBs. For a more detailed discussion of the chart and its calculation, see Kosse et al. (2017).

11 These results are based on the 2013 MOP diaries. Ownership is higher for debit cards; however, consumers do not necessarily carry all the payment methods they own in their wallet.

12 Interest costs of credit cards to consumers are excluded in the 2015 RSCPM since the focus of the study is on the use of credit cards as a method of payment and not as a source of credit.

Chart 5: Variable private costs by transaction value

Consumers



Sources: 2013 Methods-of-Payment Survey and other sources described in Kosse et al. (2017)

Most of consumer costs for cash came from withdrawal fees, followed by time spent withdrawing cash from automated banking machines and using it at the POS.[13] For debit cards, transaction fees paid to financial institutions and time spent at the counter making the transaction constitute the main cost items.

Consumers incur the lowest costs when using credit cards and the highest when using debit cards, except for transactions greater than $78, when cash is most expensive

Chart 5 shows that, at the transaction level, the costs of making an additional cash payment vary with the transaction size, while the costs of credit card or debit card payments do not because they mainly consist of the time costs associated with these transactions. Debit cards, however, are more expensive than credit cards because consumers are often charged a fixed fee for each transaction. Thus, consumers incur the lowest cost when using credit cards, whereas they pay the highest cost when using debit cards, except for transactions greater than $78, for which cash is most expensive.[14]

Consumers perceived cash as less costly than debit cards. This perception is in line with the actual relative costs incurred by consumers. Yet, consumers are almost equally likely to carry cash or a debit card.[15] A slightly lower percentage of consumers carry a credit card.[16] Overall, consumer perceptions and costs seem to have only a small influence on the payment methods they carry. However, these factors could have a bigger influence on the payment method they use when making a purchase.

The Use of Cash and Cards at the Point of Sale

Mainly used for small-value transactions, cash has the highest volume share and the smallest value share for merchants

This section discusses the use of cash and cards at the POS in terms of the number and value of transactions. **Table 2** reports the payment shares of cash, debit cards and credit cards by volume and value, calculated using the total number and value of transactions reported by merchants in the

13 Costs of cash to consumers also include forgone interest for holding cash.

14 For more details about the calculation, see Kosse et al. (2017).

15 Access to cash and debit cards is almost universal. More than 98 per cent of Canadians have a bank account, which typically comes with a debit card.

16 Only 82 per cent of Canadians hold a credit card, according to the results of the 2013 MOP Survey (Henry, Huynh and Shen 2015). Some consumers may not qualify for a credit card, and some may choose not to apply for one because of annual fees or concerns of getting into debt.

Table 2: Payment shares in the 2015 RSCPM (percentage)

	Volume			Value		
	Cash	Debit	Credit	Cash	Debit	Credit
All merchants	51	31	19	24	34	42
By size						
SMBs	54	27	18	26	29	45
LBs	48	33	19	22	39	40
By industry (SMBs)						
Specialized retail stores	47	32	21	22	29	48
General retail stores	64	28	8	32	35	33
Accommodation and food places	62	22	16	38	23	38
Personal service providers	51	24	25	23	28	49
By region (SMBs)						
Atlantic	60	28	13	38	29	33
Quebec	56	27	17	25	32	43
Ontario	60	23	17	30	22	48
Prairies	50	31	20	22	34	43
British Columbia	46	31	23	21	30	49

Notes: This table presents the proportion of the total value and number of transactions by each method of payment. Percentages may not always add up to 100 per cent because of rounding. The shares by industry and region are for small and medium-sized businesses (SMBs) only. LBs means large businesses.

Source: 2015 Retailer Survey on the Cost of Payment Methods

Table 3: Median transaction value by size, industry and region (Can$)

	Cash	Debit	Credit
All merchants	8.04	28.33	43.85
By size			
SMBs	10.00	25.00	33.33
LBs	4.66	31.52	46.17
By industry (SMBs)			
Specialized retail stores	14.08	27.73	38.54
General retail stores	4.80	31.22	69.94
Accommodation and food places	5.75	16.89	25.56
Personal service providers	15.00	54.25	12.18
By region (SMBs)			
Atlantic	9.00	27.73	38.69
Quebec	10.00	29.03	41.89
Ontario	10.00	20.00	40.07
Prairies	11.17	41.29	33.35
British Columbia	7.27	19.82	23.45

Note: SMBs means small and medium-sized businesses. LBs means large businesses.

Source: 2015 Retailer Survey on the Cost of Payment Methods

2015 RSCPM.[17] Cash has the highest volume share (51 per cent) and the smallest value share (24 per cent), showing that consumers use cash mainly for small-value transactions. Merchants reported that more transactions were paid with debit cards (31 per cent) than with credit cards (19 per cent) at their stores, although the value share for credit cards was higher. The payment shares for SMBs and LBs are generally similar.

Table 3 shows the median transaction values (MTVs) for cash and cards from the 2015 RSCPM. The cash MTV for LBs (below $5) is about half of that of SMBs ($10), while the debit card and credit card MTVs for LBs are larger than those for SMBs. MTVs for cash and cards vary across sectors and locations; however, the overall pattern is similar.

These results indicate that cash is used mainly for small-value transactions, debit cards for medium-value purchases and credit cards for large-value purchases.

Making a Payment in a Two-Sided Market

We have discussed merchant acceptance and consumer adoption of payment methods as well as the actual use of cash and cards at the POS. A remaining question is "what determines which payment method is used for a given transaction at the POS?" Our analysis suggests that there is an interaction between consumers and merchants in which the value of the purchase and the size of the merchant play important roles.

17 Payment shares can also be calculated using the transaction data reported in the three-day consumer diaries in the 2013 MOP Survey. The results are similar to Henry, Huynh and Shen (2015).

First, merchants decide which payment methods they will accept. The survey results show that merchant perceptions and costs are not the only factors that influence their decisions. Indeed, merchants also consider what payment methods consumers are likely to carry and prefer. Even though credit cards are most costly to merchants, especially for SMBs, and perceived to be less reliable, less safe and slower, almost all LBs and about two-thirds of SMBs accept credit cards. Also, merchants who accept debit cards usually also accept credit cards and vice versa. This suggests that, in addition to preferences and costs, completing a sale with a payment method that consumers prefer to use is also very important for merchants.

Second, once merchants have decided which payment methods to accept, they have relatively limited influence on the use of payment methods at the POS.[18] It is mainly the consumers who decide what payment method to use. Many consumers still carry cash in their wallets. However, since cash transactions are more expensive to consumers than credit card payments, one would expect that a consumer who has a credit card would use it whenever it is accepted and use cash only when cards are not accepted.[19] Similarly, consumers would prefer to use debit cards over cash only for large-value transactions if accepted by the merchant.

Survey results, however, indicate that cash dominates cards for small-value transactions with an MTV of about $8, considerably smaller than that of cards. Consumers choose to use cash for small-value transactions, even at LBs where card acceptance is almost universal. This suggests that the cost is just one consideration for consumers; they may prefer to use cash given consumer payment habits, perceived security or the speed and convenience of using cash for small-value transactions; see, for example, Wakamori and Welte (2017).

Credit cards are the costliest to merchants, especially for small and medium-sized businesses

For large-value transactions, consumers also have a strong influence on the use of payment methods. Merchants generally prefer debit cards to cash and credit cards because they are the least expensive and most secure. Credit cards are the costliest to merchants, especially for SMBs, and the cost of accepting credit cards increases with the transaction value. Yet, our results suggest that debit cards were mainly used for medium-value transactions and credit cards for large-value purchases. Consumers prefer to pay for their large-value transactions with credit cards likely because they need only pay their card balances later when they are due and they can earn higher rewards.[20]

The above analysis points to an important interplay between consumers and merchants, which is particularly prominent with respect to credit card use. As more consumers have and prefer to use credit cards, there is a higher incentive for some merchants to accept them. LBs, which generally face a lower cost than SMBs, tend to take the preferences of consumers into consideration by accepting credit cards for all transactions.

This interaction between consumers and merchants is typical for two-sided markets. The dominance of cash for small-value transactions might be because consumers prefer to use cash. But it could also be because merchants have influenced the use of payment methods for these small

18 In the future, it would be useful to study whether SMBs attempted to steer consumers to pay with cash, for example, by offering discounts and to use credit cards only for large-value purchases; see, for example, Welte (2016).

19 Other reasons for consumer preference for using credit cards are to gain rewards or other benefits, obtain short-term credit or for record-keeping.

20 Bilyk and Peterson (2015) use 15 years of microdata from the *Canadian Financial Monitor* and find that consumers are increasingly using credit cards for payment methods relative to short-term borrowing.

transactions, for example, by applying a minimum purchase amount for card payments or by not accepting cards at all, as in the case of some SMBs. This observation is consistent with the finding in Huynh, Schmidt-Dengler and Stix (2014) that the lack of universal acceptance of payment cards is a reason consumers still hold cash.

The popular use of credit cards for large-value purchases, despite their higher costs for merchants, also points to the importance of network externalities in the payment cards market. By offering various consumer incentives, credit card companies promote the adoption and use of credit cards by consumers. As more consumers are carrying and using credit cards, more merchants are encouraged to accept credit cards, and this increases merchant acceptance, which in turn increases the benefits to consumers of carrying and using credit cards (Rysman and Wright 2014). Arango, Huynh and Sabetti (2015) find that consumers who have a credit card with rewards are committed to paying with credit cards and that merchant acceptance is a strong determinant of credit card use. So, even though the cost of credit cards is high for merchants, some, especially LBs, are willing to bear the higher cost to avoid losing sales. However, for some SMBs, the cost of a transaction may be higher than the benefits, especially for small-value transactions, so they would rather forgo the sale and not accept credit cards, or they accept credit cards only for large-value transactions.

Looking ahead, there are two important developments of note. First, the increased use of innovations such as contactless cards, especially for small-value transactions at the POS, will continue to displace cash (Fung, Huynh and Sabetti 2014; Chen, Felt and Huynh 2017). As merchant acceptance of contactless payments increases, consumers may use their debit and credit cards more frequently, accelerating the decline in the use of cash because of network externalities resulting from payment innovations. Second, the increasing popularity of Interac e-Transfer will reduce the reliance on cash for person-to-person payments.[21] Again, as more consumers use e-Transfer, the effect of network externalities could result in rapid acceleration in the use of this payment method.

As merchant acceptance of contactless payments increases, consumers may use debit and credit cards more frequently, accelerating the decline in the use of cash

Conclusion

Recent research by the Bank of Canada using consumer and merchant surveys has highlighted the continued role of cash as a popular means of payment, especially for small-value transactions. In the future, innovations in retail payments are likely to compete with and replace cash in these areas. Since the payments market is two-sided, consumers and merchants interact to determine the use of payment methods at the POS. This highlights the importance of studying both consumer use and merchant acceptance simultaneously. This paper has made a first step in that direction. A next step would be to build models of payments that further study the two-sided markets and the role of network externalities. In addition, these models could be amended to understand where consumers shop and how much they purchase given the payment acceptance of merchants. This analysis is beyond the scope of this article. The data collected from our consumer and merchant surveys will allow us to pursue this important research in the future.[22]

21 Fung, Huynh and Stuber (2015) report that cash is still used frequently for person-to-person payments and accounts for two-thirds of these transactions. This may change, however, because Interac e-Transfer (typically free to receive and now free to send from some banks) has grown significantly in recent years. For example, according to Interac, Canadians made 158 million e-Transfers worth $63 billion in 2016, an increase of more than 40 per cent from 2015.

22 This type of research will also provide information about payment efficiency and the role of credit card companies and POS steering incentives in promoting credit card use and acceptance. Rysman and Wright (2014) discuss a detailed evaluation of the theoretical and empirical results and possible policy options.

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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

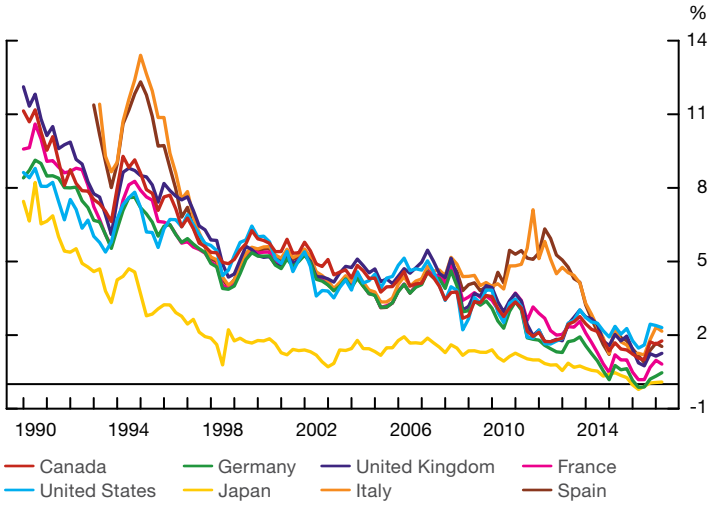
The level of output often diverges from its potential, inflation often deviates from its target, and cyclical shocks continuously influence the dynamics of the economy. Consequently, the neutral interest rate that would prevail in the absence of these conditions cannot be directly observed.

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.

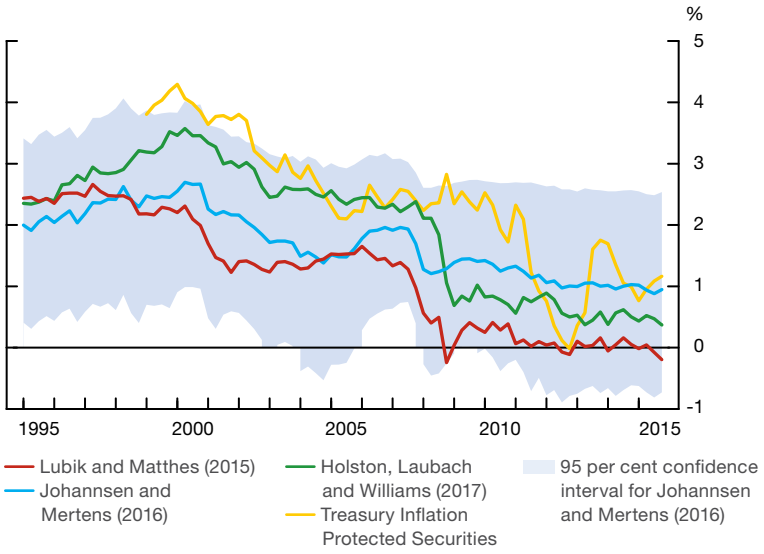
Using the US rate as a starting point is especially appropriate for Canada because the two economies share strong links and tend to move in tandem

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 come with large degrees of uncertainty

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

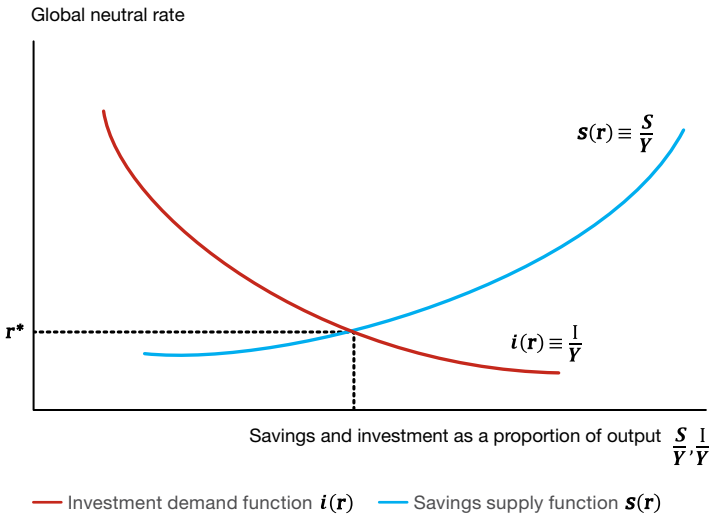
Based on these trends, policy-makers also expect interest rates to remain low relative to their average values in the past two decades in the long term (Bernanke 2016). The median of the long-term projections of the nominal federal funds rate by members of the Federal Open Market Committee has been declining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

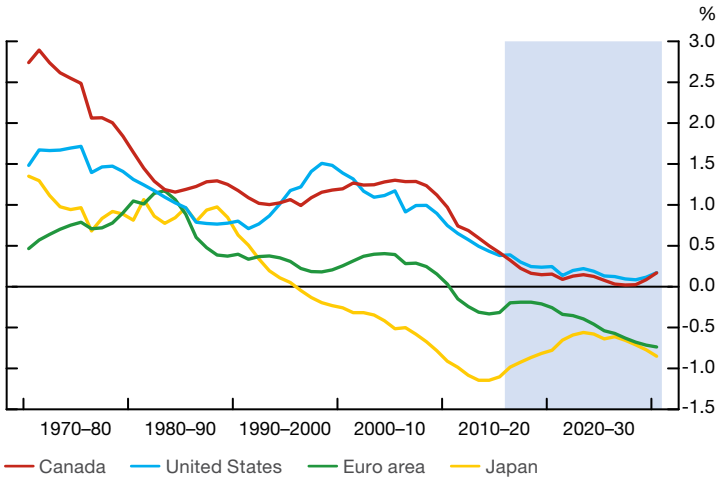
Total factor productivity (TFP) growth has slowed in advanced economies. For example, **Chart 5** shows that TFP growth in the United States has come down to the levels prevalent in the 1980s and early 1990s. As discussed in Reza and Sarker (2015), there are conflicting views about the prospect for productivity 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.

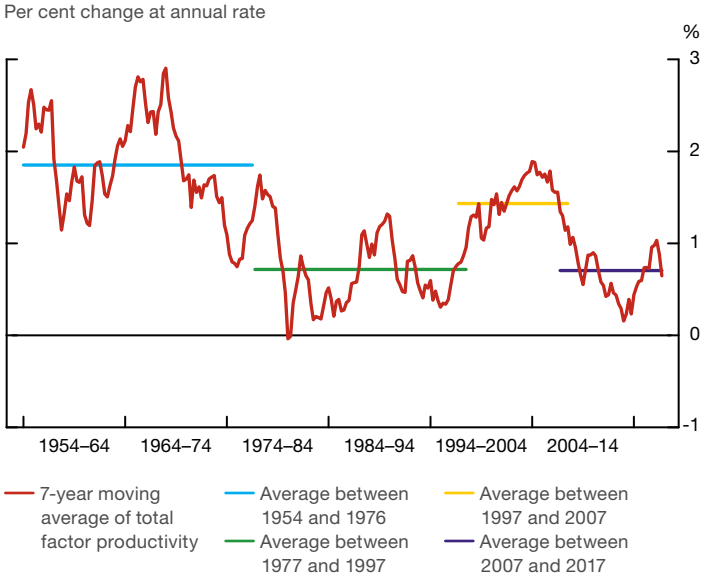
Chart 4: Working-age population growth in advanced economies



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.

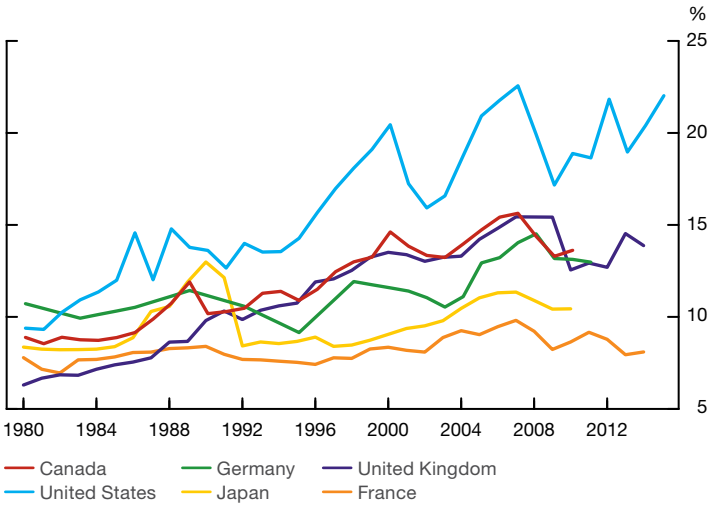
Rise of superstar firms and corporate savings

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

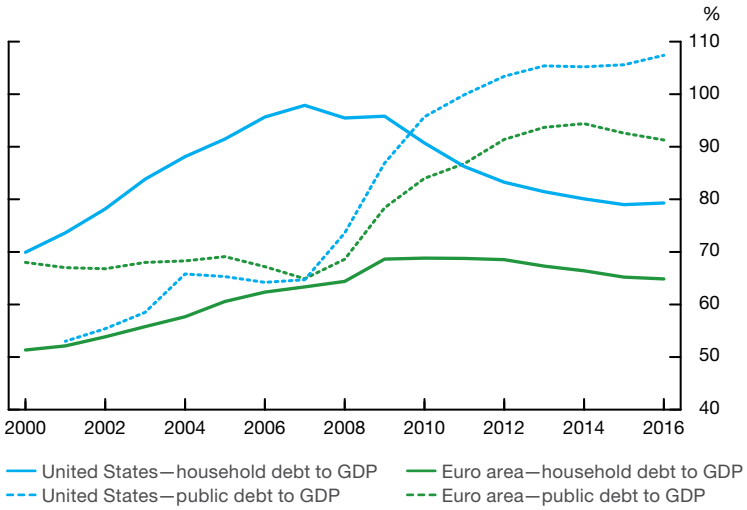


Source: World Wealth & Income Database

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

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**).

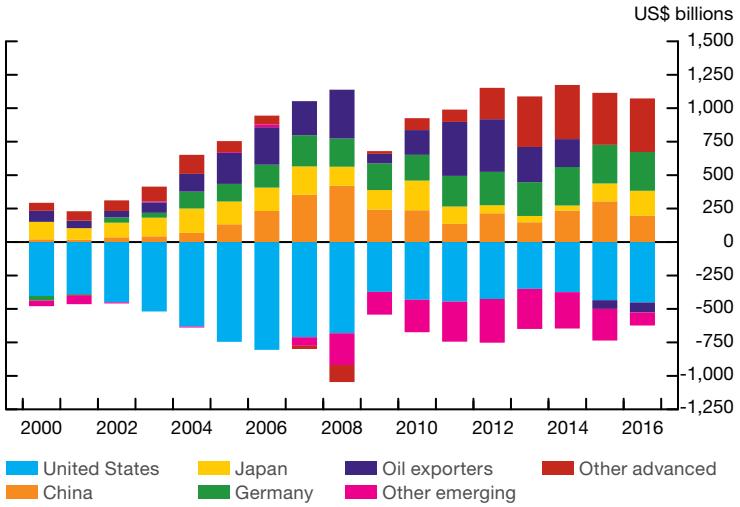
Savings glut from emerging-market and other surplus economies

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

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.

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.

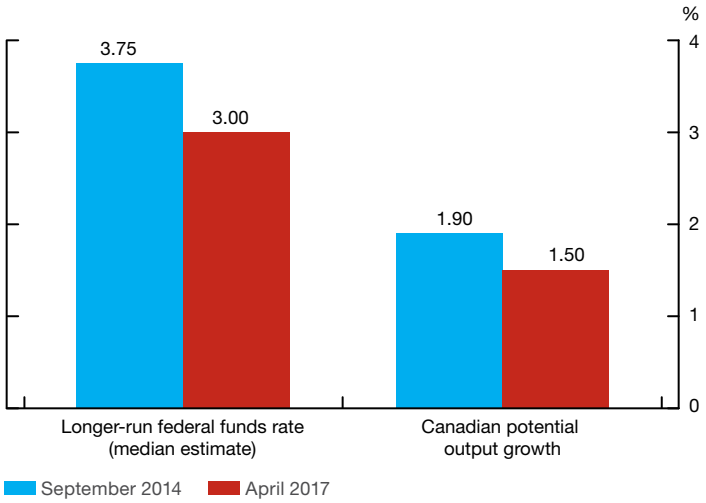
Using these approaches, Bank staff estimated in April 2017 that the real neutral policy rate in Canada is 1.0 per cent (in a range of 0.5 to 1.5, see **Table 1**).[11] This point estimate is 50 basis points lower than the 2014 estimate. This reduction of the neutral rate is mainly explained by a lower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

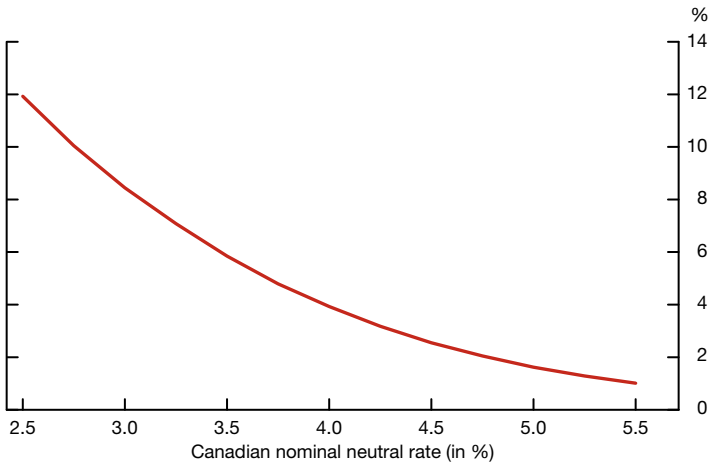
The neutral rate of interest is a key determinant of the probability of being constrained by the ELB. To get a better sense of the practical importance of the relationship between these two variables, we follow Dorich et al. (forthcoming) and run simulations using ToTEM, the Bank of Canada's main policy 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

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.

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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An Initial Assessment of Changes to the Bank of Canada's Framework for Market Operations

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- In 2015, the Bank of Canada completed a comprehensive review of its framework for market operations and liquidity provision to take into account lessons learned from the global financial crisis and the evolving market environment.
- Although the overall framework was found to be generally effective, changes were made to several of its tools to help the Bank better achieve its objectives of reinforcing the target for the overnight rate and supporting the well-functioning of Canadian financial markets under normal market conditions.
- A preliminary review suggests that these changes have helped the Bank to better achieve its monetary policy and financial stability objectives.

Central to the Bank of Canada achieving its monetary policy and financial stability objectives is its framework for market operations and liquidity provision (the operational framework). The operational framework is designed to reinforce the target for the overnight rate, support well-functioning financial markets and provide liquidity to the financial system. This article provides a preliminary assessment of the changes made to the operational framework under normal market conditions. It also updates the Autumn 2016 Review article describing those changes (De Guzman 2016).

The article consists of two sections. The first gives an overview of the Bank's operational framework and its associated objectives. The second provides a preliminary assessment of the changes made to the existing operational tools and the new tools that were introduced following a comprehensive review conducted in 2015. The assessment covers changes made to the Bank's method of acquiring assets for its balance sheet, the intervention threshold for the Securities-Lending Program and modifications to the process for distributing funds in overnight open market operations.

Objectives of the Operational Framework

As part of its mandate "to promote the economic and financial welfare of Canada," the Bank is responsible for conducting monetary policy to maintain a low and stable rate of inflation and, in co-operation with other agencies, promoting the stability and resilience of Canada's financial system.[1]

In the course of executing its monetary policy and financial system responsibilities, the Bank undertakes a range of financial market operations. Each of the tools in the Bank's operational framework is designed to achieve one or both of the specific objectives listed below:

- Implement monetary policy by reinforcing the target for the overnight rate
- Support financial stability by facilitating the efficient functioning of Canadian financial markets and by providing backstop liquidity under extraordinary circumstances

Under normal conditions, the Bank prefers to intervene as little as possible in financial markets to minimize the effects of its activities on the market. It uses its tools only when necessary and relies on its counterparties, the primary dealers for Government of Canada securities, to redistribute central bank liquidity to the broader financial system.[2]

Reviewing the Bank's operational framework

In response to the changes in market functioning observed since the global financial crisis, as well as the lessons learned from the extraordinary monetary policy measures it implemented between 2008 and 2010, the Bank conducted a comprehensive review of its operational framework, which was completed in 2015.[3] Although the overall framework was found to be generally effective in achieving its objectives, changes were made to several of the tools.[4] These changes took effect on October 1, 2015. The following section provides a brief overview of the Bank's operational tools used under normal market conditions and is geared toward readers who already have a general understanding of the Bank's operating framework. More information on these tools and the framework are available on the Bank of Canada's website or in De Guzman (2016).

Supporting the well-functioning of Canadian financial markets

The Bank uses the assets on its balance sheet to facilitate the implementation of its tools within the operational framework. The amount of the Bank's holdings of financial assets is driven by the value of bank notes in circulation. To offset liabilities created by bank notes and other operations, the Bank acquires assets denominated in Canadian dollars. Before the regular term repo program was introduced in 2015, these assets had typically been acquired through the purchase of Government of Canada securities in the primary market.[5]

1 As defined in the *Bank of Canada Act*.

2 A list of current primary dealers can be found on the Bank's website.

3 For further details on the lessons learned and changing market dynamics, see Lavoie, Sebastien and Traclet (2011).

4 For more information on the changes, see the Bank's website.

5 The Bank primarily acquires Government of Canada nominal bonds and treasury bills for its balance sheet outright through non-competitive bids at government securities auctions; it may also acquire them in the secondary market. These holdings are structured to broadly reflect the composition of the federal government's stock of nominal domestic marketable debt. A small amount of the assets consists of foreign assets, primarily shares in the Bank for International Settlements.

A liquid and transparent market for Government of Canada securities is important for the efficient functioning of Canadian financial markets because it helps the government and other borrowers in their financing activities and supports the Bank's objectives in the transmission of monetary policy. However, because the Bank's balance sheet will continue to grow in line with the value of bank notes in circulation, there were concerns that this would further increase the Bank's presence in the market for Government of Canada securities over time, affecting the tradeable float of securities and, potentially, the well-functioning of this market.

To facilitate the well-functioning of Canadian financial markets, including the market for Government of Canada securities, the Bank made the following changes:

- ***It introduced regular term repo operations, allowing the Bank to reduce its purchases of Government of Canada bonds at auction.*** The Bank competitively auctions cash in exchange for marketable securities denominated in Canadian dollars for terms of approximately one and three months. These operations were included as part of the Bank's routine operations beginning on October 1, 2015, to help manage the Bank's balance sheet.[6] They allow the Bank to reduce the amount of Government of Canada bonds (benchmark or soon-to-be benchmark) it needs to purchase in the primary market, helping bolster the bond's liquidity. It is important that benchmark bonds remain liquid, given their vital role in the functioning of domestic fixed-income markets as key pricing and hedging references for a variety of cash and derivative instruments. In addition to supporting the liquidity of Government of Canada bonds, the term repo program also allows the Bank to more directly monitor liquidity conditions in term funding markets.[7]
- ***It lowered its intervention threshold for lending Government of Canada securities at low interest rates.*** Created in 2002, the Securities-Lending Program supports the liquidity of Government of Canada securities by providing a temporary secondary source of securities to the market. Under this program, the Bank can lend a portion of its holdings of Government of Canada securities to primary dealers when it judges that a specific bond or treasury bill is trading below a set threshold or is unavailable in the repo market. In those situations, the securities are loaned through a tender process for a term of one business day. The threshold was lowered to the target rate minus 50 basis points when the overnight rate is at or below 1 per cent to provide participants with greater incentives to trade competitively before triggering the Bank's program. It had previously been set at half of the overnight target rate.

Further information on the Bank's regular term repo operations and Securities-Lending Program, including their terms and conditions, is available on the Bank's website.

6 In the past, ad hoc term repo operations were used to manage the Bank's balance sheet during periods of high seasonal demand for bank notes. These operations were short term (generally under a month), and the eligible collateral was limited to Government of Canada securities.

7 When similar term repo operations were conducted during the financial crisis, the rates provided a useful gauge of funding conditions and a warning of upcoming stresses. To date, the operations have cleared at rates relatively close to the minimum bidding rate set by the Bank, demonstrating the lack of significant stress in Canadian funding markets since the program was introduced.

Reinforcing the target for the overnight rate

The Bank conducts monetary policy by setting and reinforcing the target for the overnight rate through its market operations. This directly influences the interest rates at which banks and other financial system participants borrow and lend funds for one business day. The level of the overnight rate and expectations about its future path also influence other longer-term interest rates and a broader range of asset prices. The Bank can reinforce the target overnight rate by adjusting the level of overnight settlement balances and conducting overnight open market operations.

To help reinforce the target for the overnight rate, the Bank made the following change:

- ***It now conducts overnight repo and reverse repo open market operations through a competitive auction process.*** When transactions in the general collateral overnight market are taking place at rates above the Bank's target rate, the Bank can inject intraday liquidity through overnight repos (ORs) by purchasing Government of Canada securities from primary dealers for one business day.[8] Conversely, if transactions are taking place at rates below the Bank's target rate, the Bank may withdraw liquidity through overnight reverse repos (ORRs) by selling some of its holdings of Government of Canada securities (typically treasury bills) to primary dealers for a term of one business day. Following the changes made in October 2015, these operations are now conducted through a competitive auction process with larger participant limits, which helps to chanel more funds directly to those who need them. Further information on the Bank's OR and ORR operations, including the terms and conditions, can be found on the Bank's website.

The Bank's operating band also provides incentives for market participants with direct access to the Bank's balance sheet (the direct participants in the Large Value Transfer System) to settle surplus and deficit cash positions with each other over the course of the day near the Bank's target rate (the midpoint of the operating band).[9]

Assessing the Impact of the Changes

Market conditions are dynamic and depend on many factors that may not be closely linked to the Bank of Canada's operations

Assessing the impact of changes to market operations is never straightforward. Market conditions are dynamic and depend on many factors that may not be closely linked to the Bank's operations, such as regulatory changes, changes in investor demand for Government of Canada securities and other supply and demand dynamics in fixed-income markets. Such factors are outside the Bank's direct control and may reduce the comparability of the two frameworks across the time periods examined in this article. As well, the changes to the framework have been in place for a relatively short period. For that reason, the results discussed below are considered preliminary.

Nevertheless, we have found some evidence that the fine-tuning of operational parameters has improved the effectiveness of the Bank's operational framework. A summary of these changes and their expected effects, as well as the objectives they support, is provided in **Table 1**.

8 A repo is a financial contract that resembles a collateralized loan in which one party lends cash and earns interest on it and the other party borrows the cash and pays interest. The repo market is a core funding market because it is important for supporting the funding needs of financial institutions and is a source of liquidity for cash markets. For further details on the Canadian repo market, see Garriott and Gray (2016).

9 See the Bank's website to learn more about Canada's major payment systems.

Table 1: Summary of the 2015 changes to the Bank's operational framework

Supporting the well-functioning of Canadian financial markets		
Operational tool	**New features**	**Expected impact**
Regular term repo operations	▪ high-quality assets from dealers acquired by the Bank for cash ▪ 1- and 3-month terms ▪ competitive auction (multiple price)	▪ allow the Bank to reduce its purchase of Government of Canada securities at auction, increasing their tradeable float ▪ greater insight into conditions in the term funding market
Securities-Lending Program	▪ lower the intervention threshold to target less 50 basis points for when the target overnight rate is 1 per cent or less from 50 per cent of the target rate	▪ increase the incentive for market participants to trade Government of Canada securities competitively in the repo market without the Bank's intervention
Reinforcing the target for the overnight rate		
Operational tool	**New features**	**Expected impact**

Overnight repos
Overnight reverse repos
	▪ competitive auction (uniform price)
	▪ increase in individual participant limits
		▪ enhanced efficiency in distributing funds to market participants by
		  ▪ allowing competitive bidding to better ensure that funds are channelled to participants who need them most; and
		  ▪ ensuring that more funds are available to those who need them the most by increasing participant limits
		▪ greater transparency on the level of settlement balances for market participants

The impact of reducing Government of Canada purchases in the primary market

The introduction of the term repo program has enabled the Bank to purchase a smaller share of Government of Canada bonds at auction for its balance sheet. Specifically, a fixed share of 20 per cent of each nominal bond at auction has been reduced to its current level of 14 per cent. To date, this change has resulted in approximately $12 billion of additional bonds being made available to the market, increasing the tradeable float of benchmark bonds for market participants and thereby supporting their liquidity.

Since the Bank reduced its purchases of Government of Canada bonds, Canadian bond trading volumes—75 to 80 per cent of which are Government of Canada bonds—have increased by approximately 34 per cent compared with the year before the Bank reduced its purchases.[10] Further, the number of settlement fails in Government of Canada benchmark securities has decreased, with monthly benchmark fails declining by around 43 per cent over the past two years.[11]

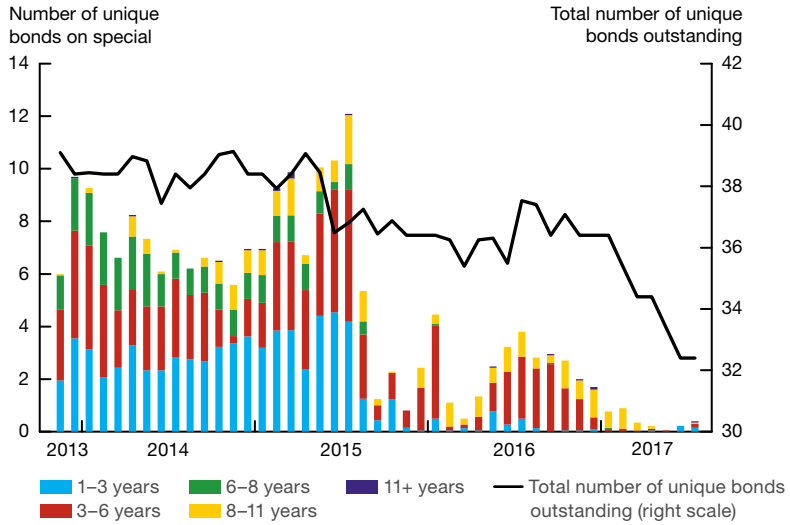
Moreover, the number of daily specials of Government of Canada bonds in the repo market, defined in this example as bonds trading 25 basis points below target, has also declined significantly since October 2015 (**Chart 1**). As such, the number of securities-lending operations conducted by the

10 Based on *Bank of Canada Banking and Financial Statistics* and staff calculations.

11 A settlement fail occurs on the settlement date of the trade when either the seller does not deliver the securities in due time or the buyer does not deliver the funds in the appropriate form. A certain number of settlement fails is normal in any market because of operational difficulties (e.g., the borrower may be experiencing operational difficulties with its systems and is physically unable to transfer possession of the security). However, the frequency has tended to increase as the tradeable float decreases. A bond market with many and persistent fails might be less effective in supporting liquidity because it can discourage security holders from participating (see Fleming and Garbade 2005). For further discussion on fails, see Fontaine, Pinnington and Walton (forthcoming).

Chart 1: Daily number of unique Government of Canada bonds on special

Monthly average, daily data



Sources: Canadian Depository for Securities (2009–15), Market Trade Reporting System 2.0 (2016) and Bank of Canada calculations (Bulusu and Gungor 2017)

Last observation: July 31, 2017

Table 2: Number of securities-lending operations and bids placed since 2010

	Number of securities-lending operations	Number of bids for securities-lending operations
2017[a]	0	0
2016	11	16
2015	135	319
2014	122	225
2013	108	193
2012	9	11
2011	12	17
2010	5	10

a. As at August 31, 2017

Bank (which are triggered by lower repo rates) also declined, with only 15 operations occurring since October 2015. This represents a significant decrease from 2013 to 2015 when the number of operations averaged 122 per year and the number of bids placed in these operations averaged 246 per year (**Table 2**).

As part of the operational review, changes were also made to the Bank's Securities-Lending Program. The intervention threshold for triggering an operation under the program was lowered for interest rates at or below 1 per cent to provide holders of Government of Canada securities with a greater financial incentive, at lower interest rates, to lend their securities. The addition of the term repo program as well as changes made to the Securities-Lending thresholds appear to have helped support the liquidity in Government of Canada securities and may also have contributed to the noted reduction in fails and the decline in the number of securities-lending operations. However, they are likely only two of many contributing factors that have led to the improved conditions in the Government of Canada securities market. For example, cyclical factors, such as changes in foreign

ownership of Government of Canada bonds, changes in the activities of financial institutions in the repo and securities-lending markets and changes in demand for high-quality assets may have also played a role.

While the reduction from 20 to 14 per cent in Government of Canada bond purchases has contributed to the improved well-functioning of the market for Government of Canada bonds, as discussed above, the reduction cannot be looked at in isolation and needs to take into account changes made to the government's debt strategy. For example, in Budget 2016, the government increased its target benchmark bond ranges for 2-, 5- and 10-year bonds and reintroduced the 3-year bond, which now matures on the same date as the 5-year bond. The target benchmark ranges for these bonds were also increased and are now anywhere from $2 billion to $6 billion higher, which has also helped support the liquidity and well-functioning of these bonds. As well, over this period, the government increased its bond issuance, resulting in a 10 per cent rise in the outstanding amount of Government of Canada bonds and making more bonds available for market participants to trade.

Impact of the term repo program on the term funding market

The Bank's term repo program, which has grown to around $7 billion outstanding, represents only a small portion of the overall term repo market. To date, the effect of the program on the market's development and liquidity has been mixed. Data from the Canadian Depository for Securities (CDS) indicate that there was a noticeable increase in term repo volumes shortly after the program was introduced, but this change appears to have been short-lived because activity has since slowed to around the levels before the term repos were introduced.

Numerous factors can influence repo activity, however, making it more difficult to directly link any changes to the Bank's term repo program. For example, because market participants have more recently attached higher probabilities of changes in the policy rate on the Bank's fixed-announcement dates, they may have become more reluctant to conduct trades around them. Alternatively, market participants may also have gained greater access to other forms of term funding in order to diversify funding sources at potentially more competitive rates. Finally, current and upcoming changes to prudential liquidity requirements may have contributed to firms seeking funding at longer terms than those available in term repo markets, capping the potential observable increase in market activity.[12]

As outlined in **Box 1**, the main type of securities pledged by primary dealers against term repo operations has been securities issued by provincial governments. According to CDS data, term repo trading activity for provincial securities has generally increased since the introduction of the program. Some of the rise may be attributed to the Bank's new term repo operations, but activity may also have increased because of higher outstanding provincial debt or other factors. In contrast, term repo trading activity for Government of Canada securities declined over this two-year period.

12 See the website of the Office of the Superintendent of Financial Institutions or of the Basel Committee on Banking Supervision for additional information on the Liquidity Coverage Ratio and the Net Stable Funding Ratio.

Box 1

Term Repo Operations: Summary Statistics

The regular term repo program has generated strong demand by primary dealers, based on robust bidding behaviour and broad participation. As at August 31, 2017, the Bank had conducted 74 regular term repo operations—50 in the 1-month term and 24 in the 3-month term. Auction sizes ranged between $500 million, when the program was first introduced in October 2015, and $2 billion and $1 billion in the 1- and 3-month tranches, respectively, in August 2017. Currently, the program stands at its minimum target size of $7 billion outstanding, which was reached at the end of March 2016. Cumulatively to date, the Bank has auctioned almost $115 billion across both maturity tranches.

Participation across the 1- and 3-month tranches has been robust, with all of the government's 11 primary dealers participating in at least one operation and 10 primary dealers regularly winning an allotment. The bid-to-cover ratio, which is the number of times the dollar value of bids received at auction is greater than the amount issued, has also been strong for both terms, averaging 1.97 and 2.20 for the 1- and 3-month terms, respectively. As well, the rate received at auction as a weighted average spread to the minimum bid rate set by the Bank averaged 3.72 and 4.63 basis points for the 1- and 3-month terms, respectively, and ranged between 2 and 8 basis points.[1] The higher bid-to-cover ratio and the relatively wide spread of the minimum bid rate indicate good demand for this type of term liquidity.

The securities pledged by primary dealers through the term repo operations have primarily been dominated by bonds issued by provincial governments, at around 85 per cent for both terms. Bonds that are federally or provincially guaranteed account for the majority of the remaining collateral pledged, at close to 15 per cent. Overall, the majority of the securities pledged by primary dealers through the term repo program are rated A+ or higher by Standard & Poor's.

1 The Bank sets a minimum bid rate at each operation to ensure that funds are loaned at market rates. The minimum bid rate is derived from rates from overnight index swaps (OIS) with durations similar to those of the term repo operations. An OIS is an over-the-counter derivative in which two parties agree to exchange, or swap, for a specified period, a fixed interest rate (determined at the time of the trade) for a floating rate that will vary over time. The distinguishing feature of the OIS is that the floating rate is the Canadian Overnight Repo Rate Average (CORRA) over the period.

A competitive basis for overnight open market operations

Before October 1, 2015, participants in OR (ORR) operations received cash (securities) at the Bank's target rate, subject to their individual limits.[13] These limits accounted for a relatively small portion of each participant's overall daily funding requirement, around 13 per cent on average.[14]

During the 2015 review, the effectiveness of these open market operations in reinforcing the target rate was found to have declined. The decline was attributed to both the small participant limits relative to the daily funding requirements and changes in market functioning arising from regulations and reduced risk appetite, which together resulted in less liquidity redistribution between primary dealers and the broader financial market.[15] As a result, these operations were moved to a competitive auction format with larger individual participant limits, which helped to chanel more funds directly to those who need them. **Table 3** compares the outcomes for the two formats, which are described in greater detail below.

13 Before October 1, 2015, ORRs were called sale and repurchase agreements (SRAs) and ORs were called special purchase and resale agreements (SPRAs).

14 Funding requirements for large financial institutions are collected daily through a survey conducted by the Bank. These figures generally represent the bank's overnight funding requirements, which may be met several ways, including overnight repos, foreign exchange swaps and deposits. This represents only a subset of a bank's overall funding needs, which are typically met through retail and commercial deposits and wholesale funding instruments (Truno et al. 2016)

15 The changing market structure has affected the market's capacity to channel funds to entities that are in need of liquidity since direct counterparties of the Bank seem to have become less willing to borrow extra liquidity and redistribute it to other counterparties. Rather, decisions by institutions on whether to participate in these transactions when the Bank offers them seem to be based mostly on whether they themselves need the liquidity.

Table 3: Comparison of the old and new frameworks for overnight open market operations[a, b]

	Special purchase and resale agreements (old)	Overnight repos (new)
Number of operations	48	59
Number of multiple-round days	6	4
As a percentage of total operations	13 per cent	7 per cent
Average operation size	$992 million	$1,400 million
As a percentage of maximum operation size	66 per cent	93 per cent
Average number of participants	6	4
Individual bidding limits	$35 million to $225 million	$150 million or $500 million
Average winnings per participant	$150 million	$360 million
Average clearing rate as a spread to target	0 basis points	3 basis points (1–6 basis-point range)
Average spread above LVTS target setting on days with operations	$490 million	$690 million

a. The data used here are based on the two-year period before and after October 1, 2015.

b. OR/ORR operations are conducted on a "cash basis," meaning that the maximum operation size and participant limits are based on the cash value of the proceeds exchanged. Each counterparty now has a fixed cash limit. This contrasts with SPRAs/SRAs, where the limits were based on a "par" or "nominal" value of the securities pledged, with the par value representing the securities' value at maturity. In the case of SPRAs/SRAs, participants had a fixed par limit but could pledge securities that had a cash or market value at a premium to their par value and thus receive more cash than their par limit. For comparison purposes, all SPRA/SRA figures have been converted to their approximate cash value. Since participants generally pledged higher-coupon longer-dated securities as collateral in SPRA operations, the cash value of the operations tended to be around 50 per cent higher, on average, than the par value over the sample period.

Under the new auction format, the Bank has conducted 59 OR and 3 ORR operations as at August 31, 2017. This is in contrast to the 45 SPRA operations and 2 SRA operations conducted over the two years before October 1, 2015. Because intervention in the overnight market is dependent on overall money market funding conditions, **Chart 2** provides a perspective on overnight money market funding conditions over the assessment period, as indicated by the Canadian Overnight Repo Rate Average (CORRA). Since the new framework was introduced, CORRA has averaged 0.6 basis points above target, compared with 0.4 basis points for the two previous years. However, because overnight funding conditions are dynamic and are affected by numerous factors that may not be closely linked to the format of the Bank's operations (e.g., regulatory changes and balance-sheet requirements), it is difficult to draw any conclusions on the effectiveness of the Bank's operations by comparing CORRA over the two time periods.[16]

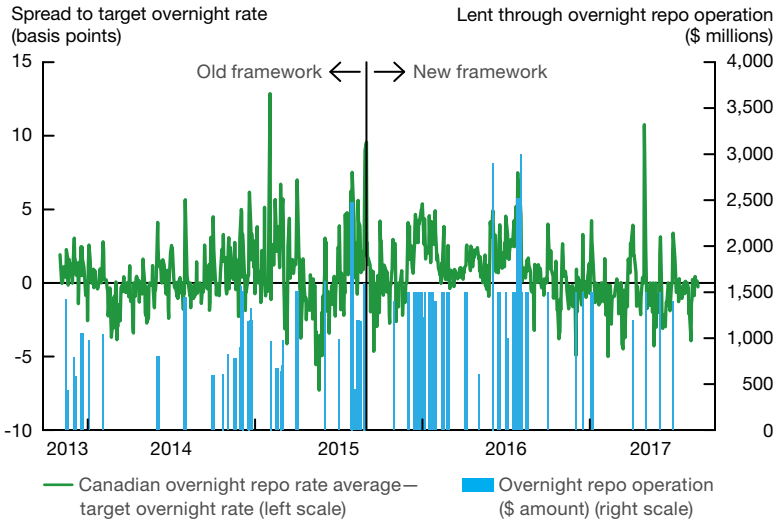
Implications of the revised open market operational framework

To enhance distributional efficiency, the new framework injects (removes) liquidity through a competitive auction process in which primary dealers bid for the amount of cash (securities) they wish to borrow at a rate at or above target for a term of one business day.[17] When the bidding is for cash (OR operations), where the highest bids are accepted and allocated first, the competitive nature of the auction format allows participants to bid aggressively (i.e., above target) if they have greater funding needs. The improved distributional efficiency is evident by the number of times OR operations have cleared above target (56 per cent of the time).

16 Overnight money market funding conditions can be affected by a broad array of factors, including market participants' funding requirements and practices, increased flows in the payment system and uncertainty around funding forecasts.

17 The Bank has conducted only three ORR operations since October 2015, which does not provide enough data for a clear assessment of these operations. As such, this section will focus on OR operations.

Chart 2: Overnight funding market conditions since November 2013[a]



a. CORRA is a weighted average of rates on overnight general collateral (non-specific Government of Canada securities) repo transactions conducted through designated interdealer brokers between 6:00 and 16:00. CORRA is one of the measures of the collateralized overnight rate that the Bank of Canada uses as a proxy for the overall average cost of overnight collaterized funding.

Source: Bank of Canada and staff calculations Last observation: August 2017

Furthermore, since the distribution of these funds is more targeted, typically only a single round of intervention on any given day is required to ease the temporary funding pressure. For example, of the 59 OR operations conducted, only 4 were multiple rounds, compared with the previous framework, when 6 dual rounds were conducted in 48 operations. A longer time frame shows periods where occurrences of two and three rounds of liquidity injections were used to significantly ease funding pressures.

The notional amount made available by the Bank at each operation is subject to pre-specified limits for each eligible participant. Depending on the counterparty, individual limits were raised by anywhere from 100 to 450 per cent under the new framework, which increased the average winnings per participant by 150 per cent. These higher limits also represent a greater proportion of the daily funding needs of each participant (around 36 per cent).

Given the higher individual limits and the revised allocation format, the amount allocated has also increased, to $1,400 million on average at OR operations, compared with only around $990 million under the old framework. This represents a 40 per cent increase in funds distributed. These funds have also been distributed to a more targeted number of participants, with an average of four participants receiving funds compared with six under the old framework.

With higher participant limits increasing the amount of funds distributed by the Bank, settlement balances have also grown, by about $200 million on average on days when an OR operation has taken place. These additional balances provide further incentive to participants who have extra cash to conduct transactions in the overnight market at or very close to the overnight rate target because any cash balances at the end of the day must be left at the Bank, with participants receiving the target rate less 25 basis points on these deposits.

One of the additional benefits of these changes is the system-wide efficiency gains arising from the greater transparency of settlement balances. Since the total cash value of the operation is published on the Bank's website following the operation (compared with only the par value under the old framework), LVTS participants are better able to assess the potential impact of the operation on the cash setting at the end of the day and can therefore manage their cash balances more effectively.

A preliminary examination of the rates on overnight repo trades using Government of Canada securities as collateral in the Market Trade Reporting System 2.0 (MTRS 2.0)[18] has shown a decline in these rates on a weighted average basis for trades conducted after an OR operation has taken place.[19] This implies that these operations have been effective at reinforcing the target for the overnight rate, steering overnight repo rates downward following an operation. In the future it may be possible to provide a more in-depth analysis of the impact of these new operations on the overnight market as the MTRS 2.0 becomes fully operational and has a longer sample period.

Conclusion

Enhancements to the Bank's framework for market operations and liquidity provision were generally found to help the Bank better achieve its objectives of reinforcing the target for the overnight rate and supporting the well-functioning of Canadian financial markets under normal market conditions. That said, the Bank will continue to regularly monitor the effectiveness of its operations, as well as any developments within the broader financial market environment, and will prudently consider appropriate enhancements to its framework as required.

18 MTRS 2.0 is a database of all over-the-counter debt market transactions executed by Investment Industry Regulatory Organization of Canada dealer members.

19 These results were found to be statistically significant at a 99 per cent confidence interval.

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