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Implementation and Effectiveness of Extended Monetary Policy Tools: Lessons from the Literature

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Abstract

This paper summarizes the literature on the performance of various extended monetary policy tools when conventional policy rates are constrained by the effective lower bound. We highlight issues that may arise when these tools are used by central banks of small open economies. Tools that have already been used by various central banks include forward guidance and balance sheet policies—such as quantitative easing, yield curve targeting, credit easing, funding-for-lending and purchases of other assets. The paper also touches on the use of negative interest rates. The evidence to date suggests that such tools have allowed central banks to ease financial conditions and thereby stimulate aggregate demand. The article also considers overt monetary financing (often referred to as "helicopter money") as an additional tool if conditions require even more aggressive easing. We review the sequencing and pacing of the use of such tools, as well as spillover effects and financial stability concerns, as important aspects of implementation strategies.

Topics: Monetary policy; Monetary policy implementation; Monetary policy transmission
JEL codes: E52, E58, E63

Résumé

Ce document d'analyse fait la synthèse d'études portant sur les résultats de divers outils de politique monétaire adoptés alors que l'instrument traditionnel, le taux directeur, était contraint par sa valeur plancher. Nous soulignons les problèmes qui peuvent survenir lorsque ces outils sont utilisés par les banques centrales de petites économies ouvertes. Plusieurs banques centrales ont déjà eu recours aux indications prospectives et à des politiques d'expansion du bilan, telles que l'assouplissement quantitatif, le ciblage de la courbe de rendement, l'assouplissement direct du crédit, le financement du crédit et l'achat d'autres actifs. Nous abordons également l'utilisation des taux d'intérêt négatifs. À ce jour, les données semblent indiquer que ces outils ont permis aux banques centrales d'assouplir les conditions financières et de stimuler ainsi la demande globale. Nous nous penchons par ailleurs sur le financement monétaire (souvent appelé « hélicoptère monétaire »), un outil supplémentaire pouvant être utilisé dans les situations où des mesures d'assouplissement plus énergiques sont nécessaires. Nous examinons l'ordre et le rythme d'utilisation de ces outils, ainsi que les répercussions et les préoccupations liées à la stabilité financière, qui constituent des aspects importants des stratégies de mise en œuvre.

Sujets : Politique monétaire; Mise en œuvre de la politique monétaire; Transmission de la politique monétaire
Codes JEL : E52, E58, E63

1. Introduction

The Bank of Canada's inflation target agreement with the Government of Canada includes a process for regular review of the monetary policy framework in Canada. Through this process, the Bank has identified challenges to the framework that could limit its ability to serve the economic and financial welfare of Canadians. One challenge previously identified was the extent to which a lower bound on policy interest rates limits the ability of central banks to provide monetary stimulus in a world where interest rates are, in general, lower than in past decades.[1] For this reason, one of the public policy questions prioritized for analysis in the lead-up to the 2021 renewal was the following: "Regardless of whether we stick with inflation targeting or move to something new, what supporting policies can we bring to the table?" (Wilkins 2018).

The COVID-19 pandemic brought to the fore issues related to this question by triggering a severe economic recession. Not only did the pandemic cause a public health emergency, but related containment measures and fears of getting sick contributed to enormous damage to labour markets and people's well-being. Along with governments, central banks responded with swift and aggressive policy actions. In the spring of 2020, central banks around the world lowered policy rates to their effective lower bounds (ELBs). The pandemic also drew attention to the importance of market functioning for the transmission of monetary policy, and central banks introduced a wide range of measures to improve liquidity in key financial markets. To provide more monetary stimulus than would be possible by just lowering the policy interest rate, central banks also drew on their extended tool kits. In this context, an important question is to what extent the various monetary policy tools can provide additional easing and contribute to achieving mandated goals such as the 2 percent inflation target in Canada.[2]

This paper reviews and summarizes relevant literature on the effectiveness of various monetary policy tools in easing financial conditions, stimulating aggregate demand and returning inflation to target.[3] The analysis is informative for tool design and implementation strategies, such as sequencing and pacing tool deployment. We pay special attention to issues that may arise when these tools are used by central banks of small, open economies (SOEs). While all tools ultimately work through the same basic set of channels (for instance, monetary policy stimulus improves financial market liquidity, lowers market interest rates,

[1] This is because it is estimated that the medium- to long-run neutral rate of interest has fallen and will remain lower on average in the future, both for Canada (Carter, Chen and Dorich 2019) and abroad (Summers and Rachel 2019; Holston, Laubach and Williams 2017). The neutral rate of interest is the rate of interest that would prevail once all shocks have dissipated and the economy has reached its potential. When central banks target low inflation—such as 2 percent, as in Canada and many other inflation-targeting countries—a decline in this neutral rate of interest means that encounters with ELB episodes might become even more frequent than they were 10 or 20 years ago.

[2] For a review of monetary policy actions in Canada in response to COVID-19, see the Bank of Canada 2020b. A description of the Bank of Canada's extended monetary policy tool kit prepared in advance of the 2016 inflation-target renewal process has been published in 2015 (Bank of Canada 2015).

[3] Previously dubbed "unconventional monetary policies," tools such as negative interest rates, large-scale asset purchases or quantitative easing (QE), credit easing, and forward guidance have become a more regular part of central banks' tool kits and in some cases remain in place for extended periods. The unconventional has become conventional, which is why we label them "extended" monetary tools.

drives portfolio rebalancing, and puts downward pressure on the foreign exchange value of the domestic currency), differences emerge in the relative importance of each channel and in how each tool works.

The evidence to date suggests that such tools have allowed central banks to ease financial conditions. While some countries have provided additional monetary stimulus by reducing policy rates into negative territory, policy rate decreases may become less and less stimulative—even when rates are still slightly above zero—and may even become contractionary. A forward guidance commitment can lower longer-term yields and provide additional easing when the market-implied path of future policy rates is substantially higher than that desired by the central bank, especially if combined with quantitative easing (QE) or long-term repos. In an SOE, QE appears less potent in lowering long-term yields than in a larger economy, though it can be effective via a depreciation of the exchange rate. Though evidence to date is sparse, yield curve targeting (YCT) appears to be a useful policy to lower yields and enhance the effectiveness of other tools such as forward guidance.[4] Credit easing in the form of private sector asset purchases and funding-for-lending programs can help clear tensions in the financial system. Finally, foreign asset purchases can also be effective, though most often the intervention is to fend off appreciation pressures that are pushing the currency away from its fundamentals (rather than to provide broader monetary easing).

Even in cases where the use of the extended monetary policy tool kit has helped ease financial conditions, assessing the ultimate impact of their use on aggregate demand and inflation is challenging. This is because in situations where economic conditions were sufficiently severe that central banks deemed it necessary to ease by more than they could by only lowering the policy rate, aspects of underlying economic and financial conditions may have limited the macroeconomic impact. Examples of such circumstances could include impaired banking systems, elevated indebtedness, and situations or periods where the negative shock is widespread globally.

The choice of which monetary policy tools to use may depend on prevailing financial and economic circumstances and other factors. For instance, low interest rates at the time of the shock would generally give a more prominent role to extended monetary policy tools. When the yield curve is steep, forward guidance and QE could be most effective to flatten it. If, in contrast, the main issue is high credit spreads, credit easing could help reduce excessive liquidity and risk premia or could target impaired segments of the financial market to enhance monetary policy transmission. Country-specific circumstances (e.g., the prevalence of a bank versus a market-based financial system) and macroprudential risks (e.g., high household indebtedness) will also affect a central bank's choice of the most appropriate tools. Finally, for SOEs, the international context and spillovers from monetary easing abroad will matter for the choice and effectiveness of tools.

The rest of the paper is structured as follows. Section 2 discusses the policy options in central banks' tool kits that are most likely to be used when the policy rate is at the ELB. This includes forward guidance; balance sheet policies, such as QE, YCT, lending programs and credit easing; and more exceptional measures such as foreign asset purchases and "helicopter money." Section 3 addresses topics of implementation that policy-makers need to consider when using such tools, including questions on

[4] YCT is an alternative approach to QE where the central bank announces a target or target range for one or more yields and undertakes purchases as necessary to achieve that target.

sequencing and pacing, international spillovers and financial stability concerns. Section 4 concludes and offers some policy considerations.

2. Monetary policy tool evaluation

2.1 Changing the target for the overnight rate: negative interest rate policy

Raising or lowering the target for the overnight rate (or other short-term interest rate) is the standard first tool used by central banks to ease or tighten monetary policy. In theory, lowering the policy interest rate into negative territory is simply a continuation of this "conventional" monetary policy. However, the impact of a given policy rate change on other interest rates—and, in turn, on economic activity—may be only partial when rates are low or negative.

One reason for this is that, while policy interest rates can go negative, there is still a limit to how negative they can go. The policy rate cannot be sustainably lowered below the negative rate where the costs of holding reserves exceed the costs of holding cash (i.e., the "switch-to-cash" rate). As a result, an asymmetry limits the downward response of expected future policy rates to a decrease in the policy interest rate, and no evidence is available on whether "low-for-longer" negative rates can fully offset this asymmetry on market rates.

In addition, the effectiveness of negative interest rates may be limited because interest rate cuts have two offsetting effects on banks' net worth. First, to the extent that the negative rates are not fully passed on to the banks' funding costs, the cut can shrink the banks' net interest margin and therefore reduce banks' net interest income. Second, due to maturity mismatch, banks make capital gains on their bond holdings. As the interest rate decreases, at some point the first effect will begin to dominate. At this point, known as the reversal rate, an interest rate decrease lowers bank profits and has a contractionary effect on bank lending (Brunnermeier and Koby 2018). Thus, at a policy rate close to zero, banks may respond to lower policy interest rates by increasing borrowing rates or increasing fees on borrowing. As a result, further policy rate decreases may act to suppress the economic impacts of the monetary policy stimulus (Eggertsson et al. 2019). In a more sophisticated calibrated model, the efficiency of a policy rate cut in negative territory in terms of welfare is still found to be relatively high, though less so than a "conventional rate cut" (between 60 percent and 90 percent) below a certain tipping point (Ulate 2019).

In a calibration of a New Keynesian model for the euro area, Brunnermeier and Koby (2018) find the reversal rate to be close to -1 percent. In contrast, in a dynamic banking model for the US economy, Wang et al. (2019) find the reversal rate to be around +2.3 percent. While some of this may be due to differences in their model specifications, a lower reversal rate can arise if: (i) banks hold more longer-term fixed income assets (i.e., a larger maturity mismatch); (ii) banks are more capitalized or have looser capital constraints; and (iii) the deposit supply elasticity is lower (e.g., this can occur if banks have more wholesale deposits).

Mixed evidence shows that the pass-through of overnight-rate changes to other interest rates declines as rates become low or negative (e.g., Eggertsson, Juelsrud and Wold 2017), supporting the idea of a reversal rate. In Europe and Japan, decreases in the overnight interest rate into negative territory have been mostly passed on to money market rates (e.g., Viñals, Gray and Eckhold 2016; Eisenschmidt and Smets 2019; Jackson 2015). Nonetheless, bank retail deposit rates seem to be constrained by the zero lower

bound, given switch-to-cash incentives for depositors (e.g., De Sola Perea and Kashongo Kashama 2017). As a result, the pass-through of interest rate changes to lending rates depends largely on bank funding models, namely their share of retail deposits. For SOEs, evidence of the pass-through of policy rate changes to lending rates is also mixed. In Switzerland, for example, mortgage rates increased following the initiation of negative rates (Danthine 2018). In Canada, the policy rate has not been lowered into negative territory. Even so, when policy rates were below 1 percent in 2008 and subsequent years, banks did not fully pass reductions of the overnight rate to the prime rate.[5] For SOEs, as with QE, negative rates may operate more importantly through an exchange rate channel, as evidenced in Sweden and Denmark.[6]

The switch-to-cash rate is estimated to be -50 basis points (bps) in Canada (Witmer and Yang 2016). However, the reversal rate is likely higher, and a negative policy rate would come with important costs (Lane 2020). Canadian banks are well-capitalized and have relatively high return on equity targets, suggesting a reluctance to allow their net interest margins to compress. As well, Canadian banks have a relatively heavy reliance on retail deposits for funding. These characteristics of the banking system suggest the reversal rate may be closer to (or even slightly above) zero. Taking all of these considerations into account, the Bank announced in 2020 that it considered +25 bps to be its effective lower bound in practice (Bank of Canada, 2020a).

In practice, implementation of negative policy rates often needs to be accompanied by a tiering system for reserve remuneration to alleviate pressures on bank profitability (for an overview, see Jobst and Lin 2016). This may allow the accommodative effects of negative rates to be maintained while mitigating the downward pressure on bank profitability stemming from the negative remuneration of excess liquidity holdings (Boucinha and Burlon 2020). The design of tiering arrangements in several central banks also disincentivizes the switch-to-cash (Boutros and Witmer 2020). Targeted long-term repo operations can also be designed to amplify stimulus from negative rates and as a safeguard against the side effects of negative rates.[7] Finally, complementary QE policy may lower the ELB since it supports credit supply by reducing the amount of government bonds held by banks. This counteracts the contractionary effects of low or negative interest rates, triggering capital outflows (Cavallino and Sandri 2018).

However, it has proven to be very difficult in practice to reverse a policy of negative interest. The Danmarks Nationalbank exited from negative interest rates for a few months in 2014. Sweden's Riksbank exited in December 2019; but with the inflation outlook worsening since the rate increase, the central bank considered reverting to a negative regime or implementing alternative policies.

[5] The prime rate is used as a reference rate for variable rate mortgages, home-equity lines of credit (HELOCs) and some small business loans, meaning that rate cuts did not fully pass through to some consumer and business rates.
[6] For example, negative rates over the past five years in Sweden kept the monetary policy stance more expansionary than in the euro area, and thereby reduced the value of the Swedish krona by about 13 to 20 percent (Andersson and Jonung 2020), raising inflation by up to 1 percentage point. Similarly, negative rates over that period allowed the Danmarks Nationalbank to deter pressures on the krone and defend its peg to the euro (Krogstrup, Kuchler and Spange 2020; Khayat 2018).
[7] For instance, the European Central Bank's TLTRO-IIs offered even lower borrowing rates if banks increased net lending, so that banks could reduce their lending rates without suffering large compression of their lending margins (Rostagno et al. 2019).

2.2 Forward guidance

Forward guidance can be loosely defined as central bank communication about future policy actions. Forward guidance can simply be a statement about the path of the policy rate that is part of the central bank's economic outlook (also known as "Delphic" forward guidance). Such practice is better characterized as part of central banks' communications policies rather than as a monetary policy tool. Publishing the path is one way to provide information on the central bank's reaction function during normal times.

Central banks can also use forward guidance to commit to a future path for the policy rate, potentially indicating a departure from the central bank's previous reaction function (frequently referred to as "Odyssean" forward guidance). This form of forward guidance is a monetary policy tool and likely to have larger effects on yields. When the policy rate is at the ELB, forward guidance can provide additional policy accommodation by reducing long-term yields through lower expectations of the policy rate path or reducing uncertainty about the path and thereby lowering term premia. Forward guidance may be intended to maintain a path for a certain period (calendar-based forward guidance) or until specific economic conditions are met (state-based forward guidance).

The Riksbank, the Norges Bank, and the Reserve Bank of New Zealand all published policy paths with their economic projections prior to the global financial crisis. During the crisis, other central banks started using forward guidance with time-dependent or state-dependent statements when their policy rates were constrained by their ELBs (e.g., Bank of Canada, Federal Reserve). Central banks have assessed that forward guidance at the ELB worked reasonably well at lowering market expectations of the policy path and keeping those expectations low for longer than they would otherwise have been. Such policies have also tended to reduce the sensitivity of market expectations to data surprises as long as markets view the time or economic conditions in the forward guidance to be sufficiently far off. However, some central banks have expressed concerns about the over-reliance of private sector agents on central bank communications (BIS 2019b).

Empirical evidence indeed corroborates that forward communication on the policy path influences both expectations of future policy rates and term premia (e.g., Gürkaynak, Sack and Swanson 2005). For instance, Sutherland (2020) found that each forward guidance announcement moves one-year-ahead interest rate forecasts by an average of 5 bps in a study of forward guidance use by eight central banks over a 30-year period. In the United States, a 5-bps flattening in the slope of the term structure of interest rate uncertainty associated with statements on the path of the federal funds rate leads to a reduction in the level of the 10-year term premium by about 3 bps (Bundick, Herriford and Smith 2017). Results also show that forward guidance about near-term policy rates is more powerful (in terms of macroeconomic impacts) than forward guidance about policy rates at longer time horizons (Galí 2020b; Brubakk et al. 2019).[8]

Forward guidance that is viewed as a commitment to keep policy rates low is more powerful than simply offering forecasts of likely future policy (Woodford 2012). Empirical evidence suggests that explicit forward guidance has been effective at lowering yields—with most use of such guidance taking place at

[8] Although intuitive, this result contrasts with a theoretical result in New Keynesian closed economy models, in which the power of forward guidance is found to increase with its horizon. This feature is known as the "forward guidance puzzle."

the ELB and in the years following the global financial crisis (Moessner 2013; Swanson 2020; Hubert and Labondance 2018). In the United States, forward guidance has been found to be more powerful in reducing uncertainty during ELB periods (Bundick, Herriford and Smith 2017). Leombroni et al. (2019) find that the effects of the European Central Bank's (ECB's) forward guidance were strongest on the yields of bonds with intermediate maturities.

Several studies have shown that time-based forward guidance may have more influence on yields than state-based forward guidance (Jain and Sutherland 2018; Sutherland 2020; Coenen et al. 2017). In a multi-country study, Ehrmann et al. (2019) point out that time-dependent forward guidance needs to occur over a sufficiently long horizon (more than 1.5 years) to effectively mute the market responsiveness to news and reduce professional forecasters' disagreement. Open-ended forward guidance is found to have little effect.

In the case of Canada, forward guidance in April 2009 affected interest rate expectations (see Chehal and Trehan 2009; Woodford 2012) and likely reduced market interest rates relative to where they would have been based on fundamentals (He 2010). While in 2009 the Bank of Canada committed to a path of the policy rate, in July 2020 the Bank's forward guidance was stronger. It used state-contingent statements to indicate that the policy rate would be held at the ELB for longer than historical behaviour would suggest (such as in Eggertsson 2003). In particular, reflecting the severity of economic impacts of the COVID-19 pandemic, the Bank announced it would maintain the policy rate at its 25-bps lower bound until "economic slack is absorbed so that the 2 per cent inflation target is sustainably achieved" (Bank of Canada 2020a). This commitment contrasts with historical behaviour, which would have suggested that the policy rate would be increased off its low point *prior* to the output gap closing.

Other central banks also implemented forward guidance after the onset of the COVID-19 pandemic in 2020. The Federal Reserve announced that they would keep the target range for the federal funds rate at 0 to 0.25 percent until maximum employment is reached and inflation rises to 2 percent and is on track to moderately exceed 2 percent for some time. The reserve banks of Australia and of New Zealand committed to keeping policy rates at current levels until mandated goals were met (Australia) or for a year (New Zealand). Several other central banks, including the ECB, have used language that is less committal though still aimed at influencing market expectations.

While forward guidance at the ELB has been shown to be effective at reducing both the expected path of future policy rates and the level of the term premium in longer rates, this effectiveness is dependent on the starting state of the yield curve. If the market-implied path of future policy rates diverges materially from that desired by the central bank, forward guidance is likely to be effective. If, however, longer-term rates already embed expectations that policy rates will remain low for long, the ability of forward guidance to provide further stimulus is limited. It is possible that by reducing the sensitivity of the expected path of policy rates to economic news, forward guidance may still be effective at keeping yields lower than they otherwise would be by reducing uncertainty and term premia. Finally, the ability of forward guidance to positively affect macroeconomic variables, such as inflation and gross domestic product (GDP), is less clear; a few researchers find evidence that forward guidance did have real effects by influencing agents' expectations (Campbell et al. 2020 and references therein). Forward guidance is also found to work via a depreciation of the exchange rate as expected in theory (Galí 2020b), a finding that is relevant for the open economy setting of many small advanced economies.

In practice, forward guidance has often been implemented in conjunction with other policies—such as QE or YCT—that mutually reinforce effectiveness, in particular if time horizons and related communication are closely aligned.[9] Also, term repo operations can, beyond their primary objective of addressing market functioning, be used as a signalling mechanism to reinforce forward guidance.

2.3 Balance sheet policies

2.3.1 Quantitative easing

QE is defined as the purchase of longer-term government bonds by the central bank, funded by increases in central bank reserves (or settlement balances), to provide a form of monetary policy accommodation.[10] Intuitively, central bank purchases bid up the price of the government securities, thereby lowering their yields. QE also reinforces communications about low policy rates made using forward guidance. Through arbitrage and asset substitution, QE contributes to reduce borrowing costs more broadly, to raise asset prices and to depreciate the domestic currency. QE is accompanied by announcements on the *quantity* of purchases (the flow and/or the target stock), as opposed to a target for a specific yield in YCT (see next section).

Broad evidence drawing on analyses of large economies shows that QE is effective in lowering government yields, primarily by reducing term premia (see, e.g., Bhattarai and Neely 2016 for an overview).[11] In comparison to QE conducted in large economies such as the United States, QE in SOEs is unlikely to affect the global term premium. This limits the impact on long-term yields.[12] The relatively small size of SOEs means that there are more highly substitutable assets for sovereign bonds issued by an SOE than for sovereign bonds issued by a large advanced economy—that is, sovereign bonds issued by an SOE are a smaller share of the asset pool. Thus, the ability of QE in SOEs to lower term premia is relatively limited (Kabaca 2016; Diez de los Rios and Shamloo 2017). A few studies have documented measurable impacts on yields of QE in SOEs. For the United Kingdom, studies point to an impact of about 35 bps on the 10-year term premium for purchases of 10 percent of GDP.[13] In Sweden and Switzerland, the term premia on 10-year bonds were estimated to have fallen by 33 bps and less than 10 bps, respectively, in response to similar-sized QE programs.[14] Such estimates are roughly half the size of the estimated impact on the term

[9] For example, aligning forward guidance with the target yield in YCT should reinforce expectations that rates will remain low for long.

[10] Christensen and Krogstrup (2019) show that it is possible to design a QE program, where institutional or market factors inhibit outright large-scale purchases of long-lived securities. Specifically, the Swiss National Bank's announcement to expand central bank reserves gave rise to a reserve-induced portfolio balance channel to reduce yields.

[11] Examples include Krishnamurthy and Vissing-Jorgensen (2011), Gagnon et al. (2011), etc. For a review of empirical work on how QE in the United States and the euro area works though portfolio rebalancing, see Priftis and Vogel (2016). Hohberger, Priftis and Vogel (2019) review the model-based assessments.

[12] The literature points to a high degree of correlation between, or influence of, the United States on Canadian interest rates and term premium; see Vasishtha and Maier (2013) and Lange (2014 and 2015).

[13] This is the average of term premium effects estimated in Diez de los Rios and Shamloo (2017); Joyce, Tong and Woods (2011); Meaning and Warren (2015); Breedon, Chadha and Waters (2012) and Christensen and Rudebusch (2012), all of which are normalized to 10 percent of a GDP-sized program.

[14] For Sweden, we average over estimates in Diez de los Rios and Shamloo (2017) and De Rezende (2017). For Switzerland, estimates are from Diez de los Rios and Shamloo (2017).

premium for the United States (e.g., in their meta study, Andrade et al. [2016] report an average term premium impact of 73 bps in the United States for a QE program of 10 percent GDP).[15]

Although the effect on yields through portfolio rebalancing may be weaker in SOEs, the exchange rate effect may be of higher relative importance.[16] The high substitution between domestic and foreign bonds at longer maturities means that QE conducted by SOEs contributes to a larger depreciation of the currency—generating a trade-off between the relative size of impacts on term premia versus the exchange rate (Kabaca 2016; Fontaine, Suchanek and Yang 2017; Drought, Perry and Richardson 2018). There is some empirical evidence of impacts on exchange rates. Joyce et al. (2012) and Arai (2017) find modest effects on exchange rates from the Bank of England and Bank of Japan QE announcements, respectively, although Rogers, Scotti and Wright (2018) find more significant effects for the same countries (see also Neely 2015; Kenourgios, Papadamou and Dimitriou 2015 and Fratzscher, Duca and Straub 2016). De Rezende and Ristiniemi (2020) find that exchange rates do depreciate, but by less than in response to conventional monetary easing—which they relate to previous research that commonly finds exchange rates responding more to short-term rates than to long-term rates.

Through arbitrage and portfolio rebalancing, QE can also affect prices of assets other than sovereign bonds. QE announcements by the Federal Reserve, the ECB and the Bank of England were associated with quick price reactions for medium- and long-term government bonds (i.e., in one- to two-day windows around QE announcements) but with impacts on equity that occurred over several weeks (Mamaysky 2018). While the effects of the ECB's announcement of its asset purchase program boosted equity prices around the world, the euro area equity markets benefited more (Kenourgios, Papadamou and Dimitriou 2015).[17] To sum up, reasonable evidence exists that QE is effective in reducing market interest rates and weakening exchange rates in SOEs.

The portfolio balance effect of QE may be stronger for QE purchases of longer-duration bonds. Specifically, some theoretical models show that it is the removal of aggregate duration risk from private sector portfolios that leads to a reduction in the term premium (King 2019a; Vayanos and Vila 2009). Several empirical studies find some evidence of the effect of changes in aggregate duration supply on the term premium. Most of these studies are in the context of the Federal Reserve's maturity extension program (MEP), where the Federal Reserve used the proceeds from selling or redeeming shorter-term Treasury securities to buy longer-term Treasury securities. These studies estimate that the MEP's removal of aggregate duration risk reduced the 10-year term premium from about 15 to 25 bps (Hamilton and Wu 2012; Li and Wei 2013; Gagnon et al. 2011) up to 67 bps (D'Amico at al. 2012). However, King (2019b) suggests that the effect of aggregate duration on bond yields could be lower at the ELB, since the ELB reduces the range of interest rate outcomes and hence lowers duration risk.

As was the case with forward guidance, the impact of QE on yields may depend on economic and financial conditions at the time of the policy intervention. Evidence from the United Kingdom suggests that QE programs may be more effective when an economy is weaker, the financial market is more segmented

[15] Interestingly, Fabo et al. (2020) show that research papers by central bankers, as opposed to academic researchers, tend to report larger effects of QE on output and inflation.

[16] Hohberger, Priftis and Vogel (2019) show that the exchange rate channel may, however, be diminished if the central bank purchases eligible assets from non-residents, as the extent of portfolio rebalancing taking place domestically is reduced.

[17] Breedon, Chadha and Waters (2012), however, find that pass-through of UK QE on other assets is less clear.

and the transmission mechanism is impaired (Diez de los Rios and Shamloo 2017). This is likely why some studies find that subsequent QE programs in the United Kingdom—amid improving financial conditions, market functioning and macroeconomic conditions—had a smaller effect.[18] That said, McLaren, Banerjee and Latto (2014) find that *unexpected* announcements of the Bank of England's bond purchases were associated with similar reductions in yields under both QE1 and QE2. Finally, it is conceivable that if long-term rates are already very low to start with, there is less scope for QE to reduce them (Carlson et al. 2020).

While a great deal of literature estimates the effect of QE on financial market variables, assessing the impact on economic activity and inflation is more challenging. In the aftermath of the global financial crisis, several studies examining macroeconomic effects used models that were estimated or calibrated to a historical period when policy rates were not constrained; financial markets were not impeded; and debt levels of households, firms and governments were lower. But these features can all be relevant in assessing the impact of interest rate changes (Borio and Zabai 2016; Hashem, Pesaran and Smith 2016; Baumeister and Benati 2013).

Some studies of the UK experience account for changing conditions, with mixed results. QE was found to have measurable effects on the real economy of the United Kingdom using models adapted to account for the fact that empirical estimates of parameters would reflect "normal times" and not crisis periods (Kapetanios et al. 2012; Weale and Wieladek 2016; Baumeister and Benati 2013). In contrast, Hashem, Pesaran and Smith (2016) allowed for the policy change to alter the parameters of the underlying model and found much smaller effects that were short-lived and not statistically significantly different from zero. In other work, subsequent rounds of QE were found to have had smaller effects on GDP and inflation than the initial QE (Churm et al. 2018).[19]

Because SOEs tend to have greater exposure to trade, the boost to net exports, output and thus inflation associated with a currency depreciation could be larger (see, e.g., Kabaca 2016). Some note, however, that the benefits to trade from a QE-engineered depreciation may be constrained by the prevalence of dominant currency pricing. For instance, the US dollar has become the dominant currency for Canada, implying that changes in the Canada–US exchange rate would tend to have very limited effects on Canadian exports.[20] However, an offset exists, particularly for Canada and other major commodity exporters, as a depreciation will still increase profits of exporters, supporting production and exports (Schembri 2019). Moreover, large and persistent exchange rate depreciations may, even with US-dollar pricing, ultimately lead exporters to reduce their US-dollar prices to expand sales.

The legacy effects of asset purchase policies have not yet been fully explored. Even though several central banks have begun tapering their asset purchases, no central bank has yet returned its balance

[18] See for instance Dell'Ariccia, Rabanal and Sandri (2018); Goodhart and Ashworth (2012); Neuenkirch (2019); Filardo and Nakajima (2018).

[19] Note that beyond aggregate effects on macroeconomic variables, the literature to date is ambiguous on possible distributional effects. For a review, see Hohberger, Priftis and Vogel (2020) and references in Macklem (2020) and Colciago, Samarina and de Haan (2019). Finally, note that QE, as well as other extended monetary policy tools, may have important confidence effects. They are, however, hard to capture or distinguish from macroeconomic effects. For instance, Coibion, Gorodnichenko and Weber (2020) find that policy announcements by the Federal Reserve during the COVID-19 pandemic did not alter the beliefs of households.

[20] More than 80 percent of Canadian imports and more than 90 percent of Canadian exports are priced in US dollars (see Devereux, Dong and Tomlin 2017; Gopinath 2017; Schembri 2019).

sheet to pre-QE levels. Carrying an elevated balance sheet for a prolonged period of time has several potential unintended consequences, including on market functioning, on meeting Basel III requirements, and on the behaviour of banks, market participants and governments. Elevated balance sheets can also limit the room for manoeuvre in future emergencies (Bailey 2020). In a model with financial frictions, Karadi and Nakov (2020) show that an optimal central bank exit from a QE program is optimally slow. This is because QE has unintended consequences on bank profits, which slows down the process of rebuilding banks' balance sheets. In light of these costs, an exit from a QE policy should therefore be calibrated prudently and reflect the state of the economy, expectations of future crises, and the availability and strength of parallel fiscal policies (QE and fiscal policies can interact in a complementary manner).[21]

2.3.2 Yield curve targeting

YCT regained interest in the policy debate during the COVID-19 pandemic, when the scope of the negative economic consequences led central banks to consider new tools and approaches to ease monetary policy and support its transmission. Bowman, Erceg and Leahy (2010) outlined three possible price-oriented strategies to guide central bank purchases of sovereign securities when the short-term rate is at the ELB: (i) a policy-signalling approach, in which yields on securities that mature during a given period are capped; (ii) an incremental approach, whereby a target is set at the short end of the yield curve and moves out in steps; or (iii) a long-run approach that directly targets a long-term rate.

Similar to QE, YCT operates by implicitly signalling or reinforcing views about future policy rate intentions, by lowering interest rates and by leading to portfolio rebalancing. Given its similarities in affecting financial and macroeconomic variables, YCT can enhance the effectiveness of alternative monetary policy tools if used in parallel. For instance, it may enhance the effect of reducing short-term rate expectations through forward guidance or may reduce the amount of government bond purchases to achieve the same effects on yields as QE. However, the policy is not without risks. It may require substantial balance sheet expansions to meet the commitment to the announced target, potentially resulting in capital losses and macroeconomic volatility.

Although less frequently used than other monetary policy tools, YCT has historical precedent. The Federal Reserve employed YCT from 1942 to 1951 to assist the financing of the Second World War by the Treasury.[22] While the policy was successful in maintaining the target on Treasury yields, this was achieved with, at times, significant purchases of outstanding Treasury bills. The effect on the rates of private assets was also more mixed (Chaurushiya and Kuttner 2003).[23]

More recently, the Bank of Japan adopted YCT in 2016 by committing to keep the yield on 10-year government bonds around 0 percent. After an initial rapid expansion in its balance sheet, the target was met with little additional adjustment to the bank's balance sheet and notably less than during the prior QE regime. Japan benefited from the credibility of the program combined with the fact that many private holders of government bonds did not appear to be price-sensitive (Bernanke 2020). In terms of

[21] For a detailed discussion on the complementarities between fiscal and monetary policies, see Dong et al. (forthcoming).

[22] The Bank of England also focused on long-term interest rates following the recommendations of the 1959 Radcliffe Report (Reis 2018).

[23] In current times, it is unclear whether transmission would be as effective, given market interconnectedness and increases in arbitrage opportunities.

transmission, Hattori and Yoshida (2020) find that YCT in Japan operated through portfolio rebalancing. Still, even with YCT, inflation remained persistently low. Moreover, the Bank of Japan held around 50 percent of outstanding government bonds.

The Reserve Bank of Australia is the latest central bank to implement YCT. In March 2020 they announced a target of 0.25 percent for the three-year government bond yield. Although it is early to formally evaluate the merits of YCT in Australia, the three-year government bond yield has been trading around the target and the entire yield curve has shifted down since the announcement. This suggests that YCT can be implemented with relative ease when the target maturity is short, and the target yield does not deviate far from global yields. That said, similar to QE, YCT may be more challenging in an SOE—especially when targeted at longer-term yields—because of the high correlation of domestic with foreign yields.

2.3.3 Funding-for-lending programs

Funding-for-lending programs are policies in which the central bank provides longer-term funding to financial institutions at concessional rates, conditional on the financial institutions, in turn, increasing their lending to targeted groups.[24] The intention is that the availability of funds will enable banks to supply more credit, which should then translate to a boost in consumption and investment by households and businesses (Havrylchyk 2016; Churm et al. 2012). Targeted lending programs can thus complement QE/YCT and credit easing policies, strengthening the transmission of monetary policy (Drought, Perry and Richardson 2018). In practice, funding-for-lending programs need to account for government lending programs.[25]

Funding-for-lending programs are more likely to be effective in economies that rely heavily on bank financing and that are subject to banks with elevated funding costs or are constrained in their ability to obtain offshore funding, as well as in cases where the credit transmission through the banking sector is impaired (Drought, Perry and Richardson 2018). Impaired credit transmission is related to the health of the banking system: if banks are short of capital, their lending may be constrained or their incentives to make good loans distorted, notwithstanding the availability of low-cost funding. In addition, the success of programs in their ability to expand credit will depend on whether households and businesses are interested in taking on new debt.

[24] This section abstracts from crisis measures [aiming/aimed?] at providing "untargeted" sources of funds, such as term repos.

[25] For instance, in response to the global COVID-19 pandemic in 2020, governments have put in place programs such as the Canada Emergency Business Account (CEBA) in Canada and the Paycheck Protection Program in the United States. While central bank lending facilities can be designed to facilitate banks' funding for lending, there may be less need for central bank funding of lending programs if businesses already have ample access to low-cost funding through governmental programs.

Funding-for-lending programs were used during the global financial crisis by the Bank of England, the ECB and the Bank of Japan.[26] They have also been used in response to the COVID-19 pandemic.[27] Evidence on the effectiveness of such programs is limited, however, because lending programs were typically implemented in conjunction with other monetary easing strategies, making the impacts of the programs in isolation less clear. In general, the literature indicates that funding costs fell notably following the implementation of lending programs (see, e.g., Churm, Kapetanios and Theodoridis 2018). Several recent papers also estimate a positive measurable impact on macroeconomic outcomes for both the Bank of England's and the ECB's programs.[28] However, using funding-for-lending programs to target loan growth for specific institutions and firms has proven to be more challenging.[29]

2.3.4 Credit easing

Credit easing refers to the outright purchase of assets other than government debt, including mortgages, bank debt, non-financial debt such as corporate bonds, and exchange traded funds. Credit easing puts upward pressure on the prices of the purchased assets. Thus, for instance, purchases of corporate bonds put downward pressure on their yields and credit spreads. In turn, new issuance tends to benefit from lower borrowing costs. In addition, similar to QE, credit easing can ease financial conditions more generally through portfolio reallocation, including to foreign-currency-denominated assets. This tends to lead to price appreciation for risky assets and a positive wealth effect, as well as domestic-currency depreciation. Finally, by improving liquidity and market functioning in dysfunctional markets, asset purchases can enhance or restore transmission channels of monetary policy.

When such targeted policies were implemented during the global financial crisis, they were effective in their immediate goal to improve market liquidity, lower spreads and increase issuance.[30] However, these policies were primarily introduced when financial markets were impaired. As a result, those episodes may not be informative on the extent to which such policies could spur real activity via higher lending more generally. In particular, during the financial crisis many banks chose not to increase lending (Hausken and Ncube 2013). Assessing the effectiveness of past use of credit easing policies is further complicated by the fact that such policies were often implemented simultaneously with easing provided using other monetary policy tools.

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[26] For instance, the ECB's targeted longer-term refinancing operations in 2014 and 2016 extended loans at concessional rates well below the marginal cost of term funds for many euro zone banks (Drought, Perry and Richardson 2018). The Bank of England used a Special Liquidity Scheme in 2012 that allowed banks to swap high-quality mortgage backed securities, and a Term Funding Scheme in 2016 that encouraged pass-through of policy rate to lower lending rates.

[27] In addition to central banks reinstituting programs from the global financial crisis, Australia introduced a new Term Funding Facility, for instance. New Zealand's Term Lending Facility, Switzerland's SNB COVID-19 refinancing facility, and the US Paycheck Protection Program Liquidity Facility and Main Street Lending Program similarly extend funding to banks conditional on them increasing lending, but in their case lending is targeted through existing government programs. The Bank of Canada has not implemented a funding-for-lending program so far.

[28] Churm et al. (2018) estimate that Bank of England's lending scheme reduced banks' wholesale funding spreads and boosted GDP by up 0.8 percent, and inflation by 6 percentage points (with a lag of a year). See also Andrade et al. (2019); Mouabbi and Sahuc (2019); and Cahn, Matheron and Sahuc (2017).

[29] Havrylchyk (2016) found that, despite the extension of the United Kingdom's funding-for-lending scheme that incentivized lending to SMEs, lending growth did not increase more for SMEs relative to larger firms.

[30] For a summary of the earlier crisis literature, see Table 1 in Kozicki, Matheron and Sahuc (2011).

That said, recent studies find that credit policies were effective in restoring functioning of targeted markets, thereby enhancing the effectiveness of conventional and QE policies (Berkmen 2012; Ryuzo and Okimoto 2017; D'Amico and Kaminska 2019). For the euro area, Beirne et al. (2011) find that the Covered Bond Purchase Programme eased financial conditions for financial and non-financial firms. Aggressive policies such as exchange traded funds purchases under Japan's quantitative and qualitative monetary easing (QQE) were found to lower the risk premium in asset prices and reduce the cost of the equity capital (Harada and Okimoto 2019; Charoenwong, Morck and Wiwattanakantang 2019) and help Japan escape deflation (Okimoto 2019). As is the case with QE, the relative strength of the various channels by which credit easing has an impact depends on the structure of financial markets and may differ in SOEs.

More recently, in response to the global pandemic, several central banks have revived or expanded programs initiated in the global financial crisis, with early encouraging evidence on achieving their goals (e.g., Haddad, Moreira and Muir 2020).[31] The Bank of Canada has introduced a number of new programs, all of which were initially intended to improve market functioning. The Provincial Bond Purchase Program and the Corporate Bond Purchase Program are credit easing programs, although at the time of writing the size of both was quite small. The programs were designed as a backstop, implying that their use is driven by security holders' desire to sell rather than by the central bank's demand to purchase. Programs whose primary objective was to improve market functioning included the following: the Provincial Money Market Purchase Program, the Commercial Paper Purchase Program and the Bankers' Acceptance Purchase Facility. In all cases, measures of liquidity in targeted markets improved after program announcements. The Bankers' Acceptance Purchase Facility was successful in compressing bankers' acceptance yields by 15 bps upon announcement, and by up to 70 bps over a longer period (Arora et al. 2020).

2.3.5 Foreign asset purchases / Exchange rate policy

Instead of purchasing domestic securities issued in the domestic currency, central banks could purchase securities of other countries. Traditionally, this is viewed as foreign exchange intervention and is most often done to weaken the domestic currency or reduce its volatility.[32] As a form of monetary policy stimulus, the accumulation of foreign assets would be funded by the issuance of some form of central bank liability, that is, the monetary base expands at any given level of policy rate.

Though the types of assets purchased are different, the implications for the balance sheet and channels of transmission are similar to other balance sheet policies such as QE or credit easing (Borio and Disyatat 2010).[33] However, the impact on the currency is likely to be relatively more important. In this context, depreciation is more likely to be large enough to directly and rapidly push up import prices. Trade effects

[31] Examples of new or reintroduced programs include the Bank of England's Corporate Bond Purchase Scheme and the ECB's Corporate Sector Purchase Programme, both primarily focused on monetary stimulus.

[32] This differs from foreign exchange policy in fixed exchange rate regimes using intervention to counter abrupt reversals of capital flows.

[33] Purchases of foreign assets may ease financial market conditions by signalling easier monetary policy conditions ahead to market participants (Badescu 2016). The portfolio balance effect is typically hard to detect given the high degree of substitutability among major currencies (e.g., Sarno and Taylor 2001; Disyatat and Galati 2007). Finally, this tool can be effective by influencing inflation expectations: if agents believe that intervention will help the bank achieve its target (rather than drifting into deflation) and keep inflation expectations positive, this will lower *real* interest rates.

are also likely to be more important: with a lag, real volumes of imports and exports would adjust to improve the trade balance, which would boost GDP and feed through the labour market.

Academics have long been skeptical that foreign exchange intervention can be used as a separate monetary policy tool (Truman 2003). However, the number of "official floaters" in open economies that have intervened in foreign exchange markets, regardless of their official position, increased following the global financial crisis (Lízal and Schwarz 2014), particularly in countries highly dependent on international trade and affected significantly by the exchange rate (Flug and Shpitzer 2014).[34] In addition, policies undertaken with an objective to affect currency valuations have become common in smaller jurisdictions neighbouring the euro area, including the Czech Republic, Denmark, Sweden and Switzerland (Jordan 2016). In response to the COVID-19 crisis, exchange rate intervention in advanced SOEs has not been as widespread, because exchange rates have moved relatively less or reversed initial movements.[35]

In theory, a central bank of an SOE can devalue the domestic currency to stabilize inflation and the real economy at the ELB (McCallum 2000; Svensson 2001).[36] Empirical assessment of exchange rate intervention since the Great Recession is thin, though several researchers document market impacts on the exchange rate. In a cross-country study, foreign exchange intervention is found to be successful in influencing the direction of exchange rates in about 80 percent of cases (Fratzscher et al. 2019); however, interventions in floating regimes need to be very large and accompanied by clear communication to be that effective.[37] Intervention by Israel's central bank in 2008, for instance, depreciated the shekel by 6.75 percent (Flug and Shpitzer 2014). Note that although the literature documents important impacts in emerging markets, exchange rate interventions may have a smaller effect in advanced economies (Adler, Lisack and Mano 2019). This is because portfolio rebalancing effects tend to be weaker, reflecting that the degree of substitutability between domestic and foreign assets is higher in advanced economies (Miyajima and Montoro 2014).

Assessment of macroeconomic effects is quite limited but points to measurable effects.[38] For SOEs, exchange rate intervention may thus provide a useful tool if the exchange rate substantially deviates from

[34] Examples include Brazil (2008), Chile (2011), Indonesia (2008), Israel (2008–09), Mexico (2009), New Zealand (2007), Poland (2010, 2011), South Korea (2008–09) and Japan (1991–2011). Intervention has also been prevalent in countries where QE is less practical because of small domestic debt markets, such as Switzerland (Jordan 2020). The Bank of Canada limits the possibility of intervention to situations of "a serious near-term market breakdown," "extreme currency movements seriously threaten[ing] the conditions that support sustainable long-term growth," and in practice has only rarely done so (see Bank of Canada, Foreign Exchange Intervention).

[35] The exception is Switzerland, where the central bank has again intervened heavily to stem appreciation pressures amid flight-to-safety inflows. Other central banks in SOEs stated they are ready to intervene to limit depreciation (Norway) or appreciation (e.g., Sweden, New Zealand).

[36] Svensson (2001) suggests currency devaluation is a "foolproof" way of escaping from a liquidity trap for an open economy. His policy recipe consists of a price-level target path accompanied by a devaluation of the currency and a temporary exchange rate peg, followed by a return to a floating exchange rate and a switch to standard price-level or inflation targeting. In practice, such an approach would be difficult to implement, especially if the desire for additional policy stimulus crosses international boundaries.

[37] This finding is mirrored in evidence for Japan, where large, infrequent and sporadic interventions such as in 2010–11 are found to be effective in moving the exchange rate in the desired direction (Pontines 2018).

[38] Potjagailo (2017) documents an increase in industrial production in European countries outside the euro area but depreciation pressures in central and eastern European countries. Flug and Shpitzer (2014), using elasticities

fundamentals; in the case of severe volatility; or if other monetary policy measures are exhausted and further easing is required to achieve the inflation target (Jordan 2020).

A central bank policy to purchase foreign assets must carefully manage a few implementation issues. First, clear communication is necessary to explain consistency with the inflation targeting regime (Lízal and Schwarz 2014; Alichi et al. 2015). Second, foreign asset purchases intended as monetary policy stimulus should be unsterilized and would entail an increase in the monetary base (Sarno and Taylor 2001; Fratzscher et al. 2019). [39] Third, exchange rate policy implies the central bank increases its exposure to foreign exchange risk in addition to other sources of financial risk (compared with interest rate risk and credit risk in the cases of QE and credit easing) and thus reputational risk (Borio, Galati and Heath 2008). Finally, intervention clashes with G20 countries' commitment under the Seoul Action Plan to refrain from competitive devaluation of currencies and enhance exchange rate flexibility (G20 2010; IMF 2020).

More generally, a central bank's ability to influence the domestic currency also hinges on the country's safe haven status. For instance, the Bank of Japan and the Swiss National Bank have had limited success with their QE (Japan) and exchange rate policy (Switzerland)[40] in sustainably reigning in appreciation pressures because of safe haven flows (Lam 2011; Ueda 2012; Berkmen 2012).

2.4 Overt monetary financing or "helicopter money"

Overt monetary financing (OMF), often referred to as "helicopter money," is generally defined as an increase in the government deficit that is financed by a corresponding permanent increase in non-interest-bearing central bank liabilities (fiat base money). The term was first raised by Milton Friedman as a thought experiment (Friedman 1969) and then discussed by Bernanke as a possible tool to prevent deflation in the United States (Bernanke 2002, 2016) and as a policy option for Japan to escape deflation (Bernanke 2017). While there is a relatively large body of literature discussing the potential effectiveness and risks of OMF, it is all model-based. There has been no review of the effectiveness of an actual OMF program, as no advanced economy has launched such a program; or, put differently, QE programs launched so far were, ex ante, not aimed at financing government deficits. Therefore, its effect on boosting growth and inflation remains theoretical.

When the state can issue irredeemable base money with a zero nominal interest rate that can be produced at zero marginal cost and is held in positive amounts by private sector agents, there always exists a combined monetary and fiscal policy action (OMF) that boosts private nominal demand (Buiter

from the central bank's model, estimate that foreign exchange purchases during the Great Recession increased growth in Israel by 0.7 percent over one year.

[39] If the central bank seeks to manage the exchange rate separately from the policy rate, it needs to make sure that induced changes in bank reserve holdings do not have an impact on the market reference interest rate, for example, via paying interest rates on reserves (Borio and Disyatat 2010). This is opposed to "conventional" foreign exchange intervention in *fixed* exchange rate regimes, where the central bank engages in offsetting transactions that sterilize the impact of the operations on the amount of reserve balances.

[40] The Swiss National Bank intervened massively in 2010, 2011 and 2015 to limit the appreciation of the Swiss franc. In January 2015, the currency's safe haven status aggravated appreciation pressures and intervention failed to counter the effects of a weakening euro resulting from the ECB's QE program (Drought, Perry and Richardson 2018).

2014). This is the case irrespective of whether Ricardian equivalence holds.[41] Since OMF does not rely on stimulating private sector leverage, it may generate additional nominal aggregate demand without worsening private financial imbalances. Under some circumstances (such as interest rates at the ELB and a debt-constrained fiscal authority), OMF may be the only effective means by which to stimulate nominal demand (Turner 2013).

Arguments against the use of OMF tend to fall into two categories.

The first argument is that, assuming interest rates do not remain at zero in perpetuity, OMF is ultimately equivalent to any other type of debt-financed fiscal expenditure (Borio, Disyatat and Zabai 2016). This is because a necessary pre-condition of OMF is that the state can fund the fiscal expenditures with irredeemable liabilities that carry a zero nominal interest rate. Realistically, this liability is central bank reserves or settlement balances. (Notwithstanding the helicopter drop analogy, OMF is not funded by cash.) When the central bank raises its policy rate, it will have to pay interest on those excess reserves or settlement balances. As such, OMF just becomes another fiscal expenditure funded by perpetual floating rate debt. Carter and Mendes (2020) thus find that there is no advantage to monetary financing over a simple (debt-financed) fiscal expansion, accompanied by a commitment to a sufficiently accommodative interest rate path (e.g., using forward guidance).

This issue could be addressed by having the central bank impose a non-interest-bearing mandatory reserve requirement equivalent to the amount of the OMF operation. While this would be equivalent to a tax on the banking system, it would be a tax that would only come into effect once the economy has recovered and interest rates move off the ELB. As well, the level of the tax would be proportionate to the level of interest rates (and, therefore, the level of nominal GDP growth).[42] The ultimate incidence of the "bank tax" would depend on whether banks are able to pass on these additional costs to their customers and also on how OMF funds are allocated. It is thus possible that the public would see OMF as preferable to QE. This could be the case if the benefits of OMF were seen as being widely dispersed or targeting those more in need, with the costs being imposed on an already profitable industry. For comparison, QE is often seen by the public as disproportionately favouring financial institutions and wealthy individuals.

The second argument against OMF is based on governance and political risk (Bernanke 2016; Turner 2015). OMF, by its nature, requires coordination between the monetary and fiscal authorities. As such, the central bank loses a significant amount of its operational independence. If this coordination is unsuccessful, the OMF will fail to achieve its objective, and the credibility of both the central bank and the government are at risk. If the coordination is successful, the risk is that legislators may be inclined to "overuse" this policy tool. The risks of excessive use of monetary financing are well-known (and, as a result, it is illegal in some jurisdictions). However, it should be possible to design a framework that preserves a degree of institutional independence yet allows for OMF when appropriate.

[41] Similarly, Galí (2014, 2020a) uses a New Keynesian model to show that, in the presence of realistic nominal rigidities, OMF-funded fiscal stimulus has very strong effects on economic activity.

[42] To put the magnitude into perspective, an OMF of $40 billion (roughly 2 percent of GDP) that would be funded by non-interest-bearing required reserves would cost the banking system $1 billion if the overnight rate were to rise to 2.50 percent. This compares with the approximately $60 billion in profit the big six earned in 2018 (a tax of 1.7 percent).

The risks associated with OMF are significant. Using this tool would likely require changes to the monetary policy operational framework and to how central banks' balance sheets are managed (e.g., the introduction of unremunerated required reserves). OMF would necessitate the creation of a robust governance framework to support the required level of coordination between the government and the central bank and to ensure that the most severe implementation risks are managed. For these reasons, Bernanke (2016) suggests that OMF should only be considered when other options are proving ineffective.

3. Implementation issues

3.1 Sequencing and pacing

Sequencing of extended monetary policy tools will depend to a large extent upon the nature of the shock. For instance, sequencing may depend on whether monetary policy tools are used to respond to a disruption in the transmission channel, or whether policy is constrained by the effective lower bound (BIS 2019b). In theory, when credit spreads increase because of increased asset liquidation costs, credit policy should be exhausted before interest rate cuts are taken (Tristani and De Fiore 2019). Brunnermeier and Koby (2018), in contrast, suggest interest rate policy should be fully expended before conducting asset purchases, since QE increases the reversal rate by removing long-term fixed income holdings from bank balance sheets. More generally, Bernanke and Reinhart (2004) argue that appropriate sequencing depends on the perceived costs of the different policy actions.

Research suggests there may be some interactive effects between forward guidance and asset purchases. Ehrmann et al. (2019) and Brubakk et al. (2019) provide evidence that forward guidance is more effective when the central bank is purchasing assets.[43] This empirical result is justified from a theoretical perspective since these policies reinforce each other by affecting expectations in the same way (see also Bundick, Herriford and Smith 2017; Bauer and Rudebusch 2014).

Few papers so far have examined how to optimally calibrate tools in the extended monetary policy tool kit. The combination of optimal QE with optimal interest rate policy has been examined by Harrison (2012 and 2017) and more recently by Karadi and Nakov (2020) in a framework that allows for frictions in the banking sector. Implementing both policies in parallel lifts the economy away from the ELB faster than only using an optimal interest rate policy with forward guidance. A jointly optimal policy to allow a monetary union to exit from a recession and an ELB regime would have the central bank allocate more QE purchases to assets from the region with stronger portfolio frictions, and in parallel commit to keeping the policy rate low for long (Kabaca et al. 2020).

The main result on pacing is that a pre-emptive and aggressive lowering of interest rates when approaching the ELB could have advantages (Bernanke and Reinhart 2004; Adam and Billi 2006). The basic intuition is that frontloading policy easing by more than suggested by historical policy rules could offset the negative consequences of lower inflation and output expectations that would otherwise occur (i.e., under a less rapid easing followed by an ELB constraint on the policy rate). Simulations suggest that macroeconomic outcomes could be slightly improved by such a policy (Chung et al. 2019). Nonetheless,

[43] Santor and Suchanek (2016) discuss how, when more than one monetary policy tool is used simultaneously, they can be mutually reinforcing, though effects may not be cumulative. De Rezende (2017) finds that the use of a combined program, such as by the Swedish Riksbank, makes it possible to lower yields across the full maturity spectrum.

this type of action would create communication challenges: the public would have to understand the policy's asymmetric nature and not misinterpret the action as a more negative signal of the economic outlook (BIS 2019b).

Pacing issues upon exit may also be relevant for considerations related to financial stability. In particular, when indebtedness is elevated among households and corporations, rapid increases in interest rates could cause financial stress. Thus, there may be advantages to adjusting rates upward slowly. Considering policy objectives, slower adjustments could mean starting rate increases earlier than would be optimal in a lower-debt environment and extending them over a longer period of time.

3.2 International spillovers: How is one country's implementation strategy affected by the actions of other countries?

Implementation of monetary policy depends on the international context—and, in the case of an SOE, on financial spillovers from policies implemented in large trading partners.[44] For instance, easing in the euro area through the lowering of policy interest rates and the use of other tools certainly had positive spillover effects by lowering long-term yields in neighbouring open economies including Switzerland, Sweden, the Czech Republic and Denmark. Specifically, ECB policies that lower the path of policy rates (as opposed to changes to the target rate) are found to generate *persistent* spillover effects on Norwegian and Swedish interest rates. This implies that monetary policy in SOEs will have limited power over the longer end of the curve, largely determined by the monetary policy stance of dominant large neighbouring countries. The more integrated the SOE is with the country/area of the larger central bank, the less effective domestic monetary policy may be. Still, extended monetary policy tools in SOEs can affect the shorter end of their domestic yield curve (Ter Ellen, Jansen and Midthjell 2020).

While imported easing of monetary policy may be beneficial to SOEs, managing monetary conditions in those countries subsequently became significantly more difficult as their currencies appreciated with the ECB's use of extended monetary policy tools (Jordan 2016; Fratzscher, Duca and Straub 2016).

The net macroeconomic impact of spillovers is a priori ambiguous, an example being the European experience (Dahlhaus, Hess and Reza 2014; for a discussion of the theoretical spillover channels, see Potjagailo 2017). In general, empirical evidence points to positive spillover for GDP growth but smaller or mixed effects on prices (Bluwstein and Canova 2016; Chen et al. 2016; for a review, see Potjagailo 2017).

[44] Falagiarda and Reitz **(**2015) and Mircheva et al. (2016) find strong impacts on sovereign bond yields. Varghese and Zhang (2018) find that spillovers to the non-euro-area financial markets are largely transmitted through the portfolio rebalancing channel, resulting in statistically significant appreciation of local currencies and lowering of sovereign bond yields, particularly during the ECB's QE phase. Fratzscher, Duca and Straub (2016) estimate lower yields via spillover from ECB asset purchases only for emerging European Union countries, but positive stock price effects as well as appreciation for most countries. As for Canada, Dahlhaus, Hess and Reza (2014); Bauer and Neely (2014); and Ilabaca (2018) estimate that US QE lowered Canadian bond yields and supported asset prices. While a popular view states that extended monetary policy tools have larger spillover than conventional easing, Curcuru et al. (2018) find evidence to the contrary.

While evidence on the international spillovers of US forward guidance is mixed, growth in Canada and the United Kingdom are estimated to have on net benefited from aggressive US monetary policy.[45]

The monetary policy responses of SOEs critically depend on the net impact of spillovers. The beneficial effects of importing monetary policy easing from neighbouring trading partners would suggest a less accommodative monetary policy stance. In practice, however, SOEs in Europe (but outside the euro area) were faced with a substantial weakening of foreign demand when ECB easing led to an appreciation of their currencies, and their central banks had to respond aggressively to avert deflation.

3.3 Financial stability concerns

Irrespective of the nature of the policy tools employed, substantial evidence shows that aggressive monetary easing (in terms of both size and duration) can raise financial stability issues. Hayek (1939), Schumpeter (1939) and other Austrian economists have long argued that "artificially" low interest rates make credit artificially cheap, which leads to mis-investment and mal-investment.

Concerns about monetary policy actions having "unintended consequences" for financial stability over the medium and longer-terms pre-date the global financial crisis and the subsequent aggressive easing. White (2006) maintains that price stability alone is not sufficient to ensure macroeconomic stability. Indeed, White suggests that the aggressive use of monetary policy to avoid deflation can have longer-term costs that exceed the near-term benefits. Specifically, persistently easy monetary conditions can create a series of imbalances—such as high public and private debt levels, asset price bubbles and credit bubbles (Goodhart, Schulze and Tsomocos 2020). When these imbalances unwind, the resulting macroeconomic costs can be severe.

Monetary policy easing influences aggregate demand through three possible effects: interest rates, foreign exchange rates and asset prices (including credit spreads). Each of these channels can pose financial stability risks.

First, regarding the interest rate channel, monetary policy easing reduces the costs of borrowing and the return to saving. This can pull forward future consumption and support higher business investment. It does, however, result in an increase in private sector indebtedness. Beyond a certain threshold, this can generate excess private sector leverage or a "credit boom." An extensive literature argues that demand driven by a credit boom leads to greater macroeconomic instability over the medium to longer-term.[46]

[45] Haldane estimates that the impact of US QE on UK GDP and inflation may be as large as the impact on US economic activity, while Dahlhaus, Hess and Reza (2014) similarly find that US QE benefited Canada almost to the same extent as it did the US domestic economy. MacDonald and Popiel (2017) also find Canada benefited on net. In contrast, Jones, Kulish and Rees (2020) find that a two-quarter expansionary US forward guidance shock leads to a *fall* in Canadian output of around 0.4 to 1.0 percentage point. US forward guidance triggers an appreciation of the Canadian real exchange rate of between 0.5 and 2 percentage points, which reduces Canadian inflation by 0.1 percentage point. Horvath and Voslarova (2017) estimate positive impacts on GDP and inflation from the ECB's extended monetary policies on central European countries, while spillover impacts are found to increase with trade openness and financial market integration (Potjagailo 2017) and the share of domestic banks (Bluwstein and Canova 2016).

[46] Cecchetti and Kharroubi (2012), for example, conclude that private credit to GDP ratios are related to economic growth in an inverse U function—beyond a certain threshold, high private sector credit has a negative impact on productivity growth. Other work citing the risks associated with excess credit growth includes Minsky (1977), Hume and Sentence (2009) and Schularick and Taylor (2009, 2012).

Excessive credit growth is now widely regarded as indicating a heightened risk of a financial crisis in the future. Given the structural changes in the economy and the current very low level of yields, Summers and Stansbury (2019) question whether further lowering of interest rates could provide any further aggregate demand stimulus. The prolonged low interest environment has also led to a significant increase in the share of zombie firms in Canada (Grieder and Ortega 2020) and globally (Banerjee and Hoffman 2018). This can weigh on productivity growth and increase financial stability risks, as their defaults would trigger significant losses.

Second, by lowering the return available on investments in the local currency, monetary policy easing can also weaken the exchange rate. While this can be an effective tool in supporting aggregate demand in SOEs, it also poses financial stability risks if there are material currency mismatches on the balance sheets of either the borrowers (sovereign or corporate) or the end investors (Hofmann, Shin and Villamizar-Villegas 2019; Carstens 2019; Georgiadis and Zhu 2020). If the mismatch is on the borrowers' balance sheets, currency depreciation can result in higher debt burdens and associated servicing costs. However, if the imbalance is on the investors balance sheet, currency weakness could amplify portfolio outflows.

Finally, monetary easing leads to higher prices for risky assets. This is due in part to a lower discount rate for future cashflows, but it is also driven by cheaper funding levels and "reach for yield" behaviour (i.e., increased demand by investors who are forced to take on more risk to achieve a targeted level of return). White (2012) highlights several possible risks associated with such asset price appreciation. First, higher asset prices simply reflect a bringing forward of future returns, pulling forward investment income from the future. Second, rising asset prices can encourage looser lending standards (by raising the value of collateral) and more risk-taking. Finally, rapid asset price appreciation has distributional consequences, as the benefits disproportionately fall to the wealthy. Of particular concern is the effect of a sudden reversal in asset prices should risk premia move higher. This was identified as a key risk in Canada in the Bank of Canada's 2019 *Financial System Review*. Mishkin (2008), among others, maintains that a sudden unwinding of a leverage-driven asset bubble is one of the largest threats to financial stability that central banks face.

4. Conclusions and policy considerations

What supporting policies can central banks use when the policy rate is at the ELB and economic and financial conditions could justify additional easing? The growing literature and evidence suggest that in such a situation, central banks can tap into an extended monetary policy tool kit to provide more monetary stimulus and enhance market functioning to facilitate the transmission of monetary policy.

The transmission and effectiveness of various monetary policy tools may differ in SOEs. In addition, while all the tools ultimately work through the same basic set of channels, the relative importance of each and the detailed mechanisms by which each works differ. That said, the evidence to date suggests that such tools have allowed central banks in SOEs to effectively ease financial conditions, which should help strengthen aggregate demand and, in turn, contribute to return inflation to target.

The choice of which monetary policy tools to use may depend on prevailing financial and economic circumstances and other factors. Some of the more important considerations are as follows:

- **Level of interest rates at the time of the shock**. If interest rates are significantly above the estimated ELB, cuts to the nominal target rate may be sufficient. If, however, the policy rate is already close to the ELB, other tools may be needed.
- **Steepness of the yield curve**. If cuts to the policy rate are not being adequately transmitted throughout the yield curve and there is a desire to lower longer-term rates, tools such as forward guidance and QE could be used. However, if the yield curve is flat (or even inverted) and longer-term yields are already very low, these tools would likely have minimal effects on yields.
- **Level of credit spreads**. If private sector borrowers are facing elevated credit spreads (and therefore borrowing costs) that are not justified by their economic fundamentals, credit easing could help reduce excessive liquidity and risk premia. This could improve the monetary transmission mechanism and loosen financial conditions.
- **Health of the monetary policy transmission mechanism**. If the monetary policy transmission mechanism is impaired, policy easing may not be effectively transmitted to other asset prices. In such circumstances, tools that specifically target impaired segments of the financial market may improve liquidity, market functioning and policy transmission. Further, the scope and size of QE and credit easing programs should also account for the impact that those programs have on asset scarcity and, hence, the monetary policy transmission mechanism (BIS 2019b).
- **Financial structure**. Tools that focus on direct market interventions may be more appropriate in those jurisdictions that have a predominantly market-based system, such as the United States. For more bank-based systems, such as those in Europe, funding-for-lending programs may be more appropriate (Borio and Disyatat 2010).
- **Household indebtedness**. Reducing interest rates stimulates aggregate demand in part by encouraging the private sector to take on more debt, either to pull household consumption forward in time or to encourage business borrowing and investment. If households are already highly indebted, they may be reluctant to take on further debt, irrespective of lower interest rates. In addition, the effectiveness of rate decreases may be constrained if the lower rates do not get passed on to the interest rates being paid on existing debt. In such cases, tools that rely less on encouraging additional private sector indebtedness may be more effective.
- **Low-for-long interest rates and household behaviour**. Model assessment of how households respond to interest rate changes tends to put more emphasis on intertemporal substitution; that is, when rates are lowered households pull forward their consumption. However, this type of behaviour accompanies a reduction in interest rates that is viewed to be temporary. When interest rate changes are viewed to be permanent, or highly persistent, income effects may become more important and lead households to want to increase their savings.
- **Macroprudential concerns**. Aggressive monetary policy easing can exacerbate financial stability concerns. Policy easing generally encourages increased indebtedness—either for the public sector or for the private sector. In cases where the private sector is already highly indebted, policy tools that reduce the cost of public sector borrowing may raise fewer macroprudential concerns. However, if the public sector is highly indebted, encouraging private sector leveraging may pose fewer risks to financial stability.

- **Monetary policy actions in other jurisdictions and spillovers**. While Canada has in the past economically benefited by importing easing from an aggressive US monetary policy response, this need not always be the case. The experience of SOEs in Europe demonstrates that appreciation pressures resulting from aggressive monetary easing in neighbouring countries may require a more aggressive response tailored to counter exchange rate pressures.
- **Considerations related to exit**. Some facilities designed to improve liquidity have been set up so that when market functioning improves, their pricing becomes less attractive and use of the facilities automatically declines. Experience with other programs is less complete and there is limited experience with exit. If the policies slow down bank recapitalization because of a flattening of the yield curve and a reduction in profitability, optimal exit should be gradual (Karadi and Nakov 2020 argue optimal exit from QE is gradual for this reason). One risk associated with the programs is that large central bank presence in a market could fundamentally alter the market: for example, with the participation of some private sector roles falling off, potentially permanently. Design of programs and sequencing would ideally take such factors into account.

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