# Does the sequence matter: interest rates, quantitative easing or forward guidance?*

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**Abstract**

We study the role and transmission of unconventional monetary policies during a pandemic, focusing on the implementation sequencing of policies when there is a social containment period of uncertain duration. Despite a growing literature focused on the role of unconventional policies, there remains a lack of clarity around their transmission, impact and the relative benefits, especially in small open economies during large crises. To address this gap, we use the Bank of Canada's main projection model (ToTEM) to compare the efficacy of a suite of extended monetary policies (EMPs) when the policy rate is at the effective lower bound: credit easing, forward guidance, and quantitative easing. We find that the policy mix delivering the best outcome calls for immediate implementation of forward guidance and quantitative easing, followed by credit easing when containment measures are lifted. Furthermore, implementing all available EMP options would effectively help stabilise the

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economy because each of these tools reinforces the others. We also quantify the fiscal response needed to offset the gap in gross domestic product created by the effective lower bound, given operational limitations in scaling up EMPs.

**JEL**: E3, E4, E5, E52, E58

**Keywords**: Coronavirus disease (COVID-19), Monetary policy, Monetary policy sequencing.

# 1 Introduction

The sharp impact of the global COVID-19 pandemic led to policymakers across the world taking strong accommodative measures to support their economies. Central banks in advanced economies eased monetary conditions through conventional monetary policy as well as through various other tools. The Bank of Canada, for example, cut the overnight rate from 175 to 25 basis points (bps) in March 2020. The Bank's immediate policy response also included various measures aimed at improving market functioning.[1] In parallel, the federal and provincial governments also rapidly provided extraordinary fiscal support during the pandemic.

Despite the rapid fiscal and monetary policy responses, plausible economic projections for Canada at the peak of the crisis (April 2020) suggested that real gross domestic product (GDP) could remain below pre-pandemic levels for a prolonged period.[2] While the government's fiscal stimulus and the Bank's liquidity provision offered important support, the measures were not sufficient to fully make up for the drop in activity

[1]Examples include the Commercial Paper Purchase Program, Provincial Money Market Purchase program and the Standing Term Liquidity Facility. The secondary market purchases of Government of Canada securities (https://www.bankofcanada.ca/markets/market-operations-liquidity-provision/market-operations-programs-and-facilities/government-canada-bond-purchase-program/) announced on March 27, 2020, also initially aimed at ensuring liquidity. As market functioning normalized, the program's objective shifted toward more traditional quantitative easing, as announced by the Bank in July (Macklem et al., 2020). In this paper, we use the term "quantitative easing" for such large-scale asset purchase programs aimed principally at bringing down longer-term yields.

[2]See, for instance, the Bank's central scenario presented in the July 2020 Monetary Policy Report (Macklem et al., 2020).

given the pandemic's widespread economic impacts. However, implementing additional accommodative monetary policy by continuing to lower policy rates was not feasible because it would have resulted in negative interest rates. To support the recovery, the Bank implemented extended monetary policy (EMP) tools, in particular, forward guidance, credit easing and quantitative easing.[3]

The rapid evolution of the COVID-19 pandemic and the swift response from central banks highlighted an important gap in the literature. Observers and market participants generally judge that aggressive policies helped prevent a worst-case economic collapse, but little is known about the transmission, impact and relative gains from such policies. For instance, how large are the benefits from implementing EMPs at the effective lower bound (ELB)? Which EMP sequence works best to reduce the output and inflation fallout? The context of the pandemic also raises questions on the optimal implementation of such tools, for instance, is it advantageous to delay their use until the recovery takes hold to provide continued easing and avoid a pre-emptive increase in long-term rates?[4] Rigorous assessments of policy tools and implementation options are important to inform policy-makers to help shape the best possible policy response.

While the literature provides some initial assessment of policies in the United States, the remains limited research on the mechanisms and efficacy of EMPs in small open economies such as Canada, especially using estimated quantitative models.[5] We ad-

[3]Often referred to as 'unconventional monetary policies', tools such as negative interest rates, large-scale asset purchases, quantitative easing, credit easing and forward guidance have become part of central banks' regular toolkits and in some cases remain in place for extended periods. The unconventional has become conventional, which is why we refer to them as 'extended' monetary tools.

[4]This argument may be further motivated by the fact that some tools aimed at reducing longer-term yields, including forward guidance and quantitative easing, may have had limited impact immediately following the shock because the yield curve was already flat.

[5]See, for instance, Rebucci et al. (2020) for a cross-country analysis of financial market impacts and Vissing-Jorgensen (2021) for the United States. Chung et al. (2019), while not assessing the policy response to a pandemic specifically, assess the power of the US Federal Reserve Bank's monetary policy toolkit in the 2020 environment, in response to a hypothetical large shock. Arora, Gungor, McRae and Witmer (2020) study the effect of the Bank's announcement of the Bankers' Acceptance Purchase Facility

dress this gap by assessing different EMP tools and their implementation, specifically regarding how to best sequence such tools. We use the Bank's projection model, the Terms-of-Trade Economic Model (ToTEM), to explore the effectiveness of EMPs in pandemic scenarios where the ELB constrains the policy interest rate.[6] We assess different combinations of EMP tools by their ability to help maintain demand near the economy's productive potential and inflation near the 2 percent inflation target.

This analysis contributes to a small literature that considers the importance of the sequencing and coordination of EMP tools. Potter and Smets (2019) survey the experience of policymakers using EMPs following the Global Financial Crisis finding that the coordination of EMPs is considered an important factor for their efficacy although the sequencing at the time was largely dictated by the unfolding events. Lending operations were initially used to maintain market liquidity but were then used in conjunction with asset purchases to support interest rate policy as the crisis developed and recovery began. As Potter and Smets (2019) point out, the sequencing of EMPs had barely been addressed in the literature and was not well understood. This remains largely the case although there is some recent work on both the empirics and theory. On the former, Rostagno et al. (2021) estimate a Bayesian VAR to quantify the contribution of different tools and discuss the instrument mix. Hayashi and Koeda (2019) use an estimated SVAR to discussing the timing an exit strategy from quantitative easing and find that the strategy is sensitive to developing economic conditions as an exit can be either contractionary or expansionary in different situations. Related to Potter and Smets (2019), Bernanke (2020) reviews the current wisdom regarding the use of EMPs, using the Fed's FRB/US model to assess the appropriate policy mix to implement monetary policy. On the theory, Sims and Wu (2021) present a dynamic stochastic general equilibrium model with financial frictions and a whole suite of EMPs in order to study their interactions

[6] See Dorich et al. (2013) and Corrigan et al. (2021).

and unwinding.[7]. Although our work is closely related to Sims and Wu (2020, 2021), we try to take a more agnostic view on the precise mechanisms by which EMPs operate, instead introducing the measures as directly affecting different spreads in the models.

In this paper, we consider three types of EMPs: 1) *credit easing* as the purchase of short- and long-term corporate debt to compress the spread of different risky assets; 2) *forward guidance* as the commitment to keep the overnight interest rate at the ELB until the quarter-over-quarter inflation rate reaches the 2 percent target; and 3) *quantitative easing* as the purchase of long-term government debt to lower long-term interest rates and control the yield curve.[8] We also briefly discuss implementation considerations, such as estimating the fiscal gap left after we implement the suite of EMPs and whether it is possible for the Bank to scale up EMPs to reduce the need for the government to provide fiscal stimulus.

Our research provides several insights that are relevant to monetary policy in response to a shock as disruptive as COVID-19. First, the EMP sequence that delivers the best macroeconomic outcome in ToTEM begins with a combination of state-contingent forward guidance and a quantitative easing program, followed by credit easing.[9] Even though the labour supply and domestic demand do not respond to monetary policy stimulus during the containment period, quantitative easing can raise inflation through the exchange rate channel and higher inflation expectations. Second, model simulations suggest that immediately implementing the EMP tools simultaneously is a powerful option, achieving almost the same macroeconomic outcome: the tools complement each

[7]See also Blattner and Swarbrick (2021) who assess the role of asset purchases and long-term refinance operations in a monetary union.

[8]These measures are some of those listed by the Bank of Canada as possible additional tools in its monetary policy toolkit (Bank of Canada, 2015, 2020*b*). The EMP toolkit, published in 2015, also includes negative interest rates. The technical ELB that reflects a switch-to-cash rate is estimated to be approximately -50 bps (Witmer and Yang, 2016). However, Lane (2020) states this policy comes with important costs, and the Bank considered its ELB to be +25 bps (Bank of Canada, 2020*a*).

[9]Due to model limitations, the efficacy of some policy tools may be understated. In particular, credit easing can play important roles in restoring financial intermediation and reducing default risk, which are not captured in ToTEM III.

other as they work through different channels. Forward guidance helps to reduce uncertainty about the monetary policy reaction function, credit easing restores transmission channels by lowering the spread on risky bonds faced by firms, and quantitative easing lowers long-term rates and anchors the yield curve. Third, such front-loaded implementation of all EMPs could make up about 35 percent of the GDP decline and about 45 percent of the inflation decline created by the ELB under a moderate scenario of the crisis and subsequent recovery. Finally, EMPs alone cannot fully mitigate the effects of the ELB in the severe pandemic scenario. Thus, a large complementary fiscal package would be required to fully offset the impact on output and inflation.

The paper is organized as follows: Section discusses the EMP options and the calibration of their effects. Section 3 describes two underlying macroeconomic scenarios: a moderate scenario of the crisis and recovery and a severe and much more persistent scenario. This is followed by an evaluation of six different EMP sequencing options in Section 4. Section 5 discusses implementation issues and the role for fiscal policy. Lastly, we present our conclusions and discuss some avenues for future work in Section 6.

## 2 The suite of monetary policy tools

We consider four categories of monetary policy tools in this paper.[10] The first is conventional interest rate policy. We consider the instrument to be the quarterly overnight rate, subject to a lower bound (the ELB) of 25 bps. The constraint on interest rate policy reflects the view that rates below this level would become less effective in providing stimulus as they start to impair market functioning. We thus rule out negative interest rate policy.

The second tool, and the first of the extended toolkit, is state-contingent forward guidance. Under this policy, we assume the central bank commits to holding interest rates

[10]These correspond to the strategies outlined by the Bank of Canada in 2015 (Bank of Canada, 2015).

low, conditional on the inflation outlook (e.g., until quarter-over-quarter inflation reaches 2 percent).[11]

The next tool is quantitative easing which describes the central bank purchase of long-term government bonds, funded by increases in central bank reserves (or settlement balances in the case of the Bank of Canada). This bids up the price of the government securities, thereby lowering their yields. Through arbitrage and asset substitution, these reduced yields transmit to lower borrowing costs more broadly, increase asset prices and depreciate the currency. To implement quantitative easing in ToTEM, we directly model yield curve control. In other words, central bank asset purchases are conditional on a target for the long-term yield spread. Equivalent necessary purchases can then be backed out with simple estimates from the literature. In small open economies, quantitative easing has a more limited impact on long-term yields.[12] In order to quantify the purchases, we use the following estimate: $5 billion weekly purchases of five-year government bonds (i.e., $260 billion per year, or around 10 percent of GDP) reduce the five-year term premium by 30 bps.[13] Corporate spreads at the five-year horizon are assumed to fall by 60 percent of the compression in government bond yields. Given the

[11]The statement may be conditional on other economic variables or on inflation but with a different level target. Exploring time- dependent forward guidance is left for future work.

[12]This is because quantitative easing is unlikely to affect the global term premium, given the high substitutability between home and foreign assets (see Kabaca, 2016; Diez de los Rios and Shamloo, 2017).

[13]This estimate is based on several considerations. First, international experience of small open economies suggests that purchases of 10 percent of GDP have been able to reduce 10-year yields by about 30 bps (an average of estimates in Diez de los Rios and Shamloo (2017); De Rezende et al. (2015); Joyce, Lasaosa, Stevens and Tong (2011); Joyce, Tong and Woods (2011); Breedon et al. (2012); and Meaning and Warren (2015) for Sweden, Switzerland and the United Kingdom). Second, upon announcement on March 27, 2020 of the Government of Canada Bond Purchase Program in Canada, 10-year government yields declined about 15 bps within two days (Fontaine et al., 2021). Third, quantitative easing can be interpreted as an offset to government debt issuance. Laubach (2009) estimates 10 percent of GDP debt issuance increases the forward rate by 30 to 40 bps. Finally, the impact of quantitative easing is state-contingent in the sense that quantitative easing is less powerful in compressing long-term yields when the yield curve is already flat. Immediately following the COVID-19 shock, achieving a greater impact would be difficult given the already compressed term premium; we thus consider 30 bps to be the maximum. Note that while the Bank of Canada's large-scale program was initially implemented with $5 billion weekly purchases in March 2020, which we use here in the simulations, the Bank recalibrated the quantitative easing purchases in October 2020 toward long-term bonds. The recalibration reduced the amount to $4 billion a week, although it did not reduce its impact.

importance of terms-of-trade shocks in ToTEM, the exchange rate is a key channel for quantitative easing, in line with the literature on small open economies (Kabaca, 2016; Drought et al., 2018; Fontaine et al., 2017).

The final tool is the credit easing policy which aims to restore the transmission channel by purchasing impaired assets. In this paper, we only consider purchases of short-term corporate debt (e.g., commercial paper or corporate bonds) with the aim to reduce spreads and improve liquidity.[14] There are two credit spreads in ToTEM that are subject to asset purchase programs: long- and short-term corporate spreads. The five-year, long-term corporate spread in ToTEM is constructed based on the weighted average of a basket of three- to seven-year Canadian investment-grade bonds. A degree of uncertainty surrounds the precise quantitative effects, but recent experience of similar purchase programs offers some benchmarks. The effect of a purchase program on credit spreads depends on how much of the spread results from heightened default risk versus a higher liquidity premium. Based on the assumption that 50 bps of the 150-bps spike at the start of the COVID-19 pandemic was due to higher default risk,[15] we estimate that $40 billion in purchases could lower the five-year corporate spread by up to 80 bps.[16] Short-term spreads in ToTEM correspond to short-term commercial paper. We assume that commercial paper purchases reduce the short-term (three-month) corporate spread by about 80 bps.[17] Based on the literature and the Bank's experience with its Commercial

[14] In addition, funding for lending schemes can boost lending. This topic is left to be considered in future work.

[15] This rough estimation is based on the methodology in Leboeuf and Hyun (2018).

[16] For example, the Bank of Canada's Banker's Acceptance Purchase Facility is estimated to have compressed bankers' acceptance yields by 15 bps upon announcement and by up to 70 bps over the following weeks (Arora, Gungor, McRae and Witmer, 2020). Moreover, the effect of a $30 billion sale of corporate bonds in a stress scenario is estimated to increase corporate spreads by about 90 bps (Arora, Bèdard-Pagè, Leblanc and Shotlander, 2020). Evidence from recent corporate bond purchase programs at the European Central Bank (ECB) (Santis et al., 2018; European Central Bank, 2016; Zaghini, 2019; Abidi and Miquel-Flores, 2018; Cecchetti, 2020) and the Bank of England (Belsham et al., 2017; Boneva et al., 2018) suggests that purchasing 10 percent of outstanding corporate bonds can reduce the spread by 69 bps. This translates into up to 90 bps for $40 billion in Canada, or 13 percent of corporate bonds outstanding.

[17] The actual compression depends on the current spread. In the first quarter of 2020, the spread is reduced by around 80 bps, but it falls to about half of this by the first quarter of 2021.

Paper Purchase Program, such a reduction in spread would require purchases of about $3 billion to $6 billion of commercial paper.[18]

# 3 Description of scenarios

We conduct our analysis using ToTEM (version III), a large-scale New Keynesian macroeconomic model that features optimizing agents in a dynamic stochastic general equilibrium (DSGE) framework with rational expectations.[19] The simulation for EMP sequencing options is done in two steps. First, we use two scenarios of pandemic development, one moderate and one severe. In the second step, we introduce six different EMP sequence plans that can be implemented to stabilize the economy during the three years after the onset of the pandemic.

## 3.1 Short description of the Terms-of-Trade Economic Model

ToTEM contains several key ingredients that are empirically relevant for explaining Canadian data. The model features more disaggregation than in prominent DSGE models used in the literature, such as Christiano et al. (2005) and Smets and Wouters (2007). ToTEM includes producers of four distinct types of final products: core consumption goods, business investment goods, government goods and non-commodity export goods. ToTEM also contains a separate commodity-producing sector because of the importance of commodities in the Canadian economy.

The standard New Keynesian model has no role for quantitative easing. The household side of ToTEM is defined in a similar spirit to André et al. (2004) and Chen et al.

[18] In Canada, since the announcement of the Commercial Paper Purchasing Program, spreads have dropped sharply, declining by around 80 bps on an average volume-weighted basis for Canadian corporate issuers. The decline happened amid a peak size of the program of $3 billion, or 5 percent of outstanding commercial paper ($62 billion in February 2020). The literature for the Bank of England (Bank of England, 2019), Bank of Japan (Hirose and Ohyama, 2010) and the United States Boyarchenko et al. (2020); Adrian et al. (2011); Duygan-Bump et al. (2013) suggest a somewhat smaller impact of about 64 bps on average for purchases of 10 percent of outstanding commercial paper.

[19] For details on ToTEM, see Dorich et al. (2013) and Corrigan et al. (2021).

(2012), introducing a particular type of asset market segmentation. This allows for the long-term interest rate to affect aggregate demand distinct from the expected path of short-term rates. A fraction of restricted households can trade only in long-term bonds.[20] A fraction of the remaining households is unrestricted because they trade in both short- and long-term bonds. The final fraction is current-income households that neither borrow nor save but live hand-to-mouth.

The asset market segmentation in ToTEM allows aggregate household spending to depend on both short- and long-term interest rates. In ToTEM, conventional monetary policy is governed by a Taylor rule with interest rate smoothing that reacts to both the expected year-over-year inflation four quarters ahead and the output gap. To match the data, the model contains 33 structural shocks.

Importantly, ToTEM includes features that make it less susceptible to the so-called forward guidance puzzle—the fact that standard New Keynesian models exhibit excessively large reactions to anticipated monetary policy shocks. The model allows for rule-of-thumb (ROT) price setters (as in Galí and Gertler, 1999) and habit persistence in consumption.[21] This significantly dampens the responses of output and inflation to these shocks. ToTEM is thus well suited to analysis involving forward guidance.[22]

### 3.2 Step 1: Identifying two scenarios driven by the global COVID-19 pandemic

We begin by creating an environment featuring a deep downturn. This downturn results from a global pandemic shock hitting the Canadian economy. To provide a context, we rely on the Bank's scenario analysis in April 2020, as published in its Monetary

[20] These households could be motivated by a preferred habitat. See Vayanos and Vila (2009) for details.

[21] ROT price setters choose their prices based on either lagged inflation or a constant inflation target. The estimated share of RoT price setters in the consumption goods sector is 54 percent; see Corrigan et al. (2021).

[22] Ths is further demonstrated in Dorich et al. (2018).

Policy Report Poloz et al. (2020). This analysis allows us to concretely mimic the range of outcomes that policy-makers considered plausible at the time and based on the information available when they decided whether to implement EMP tools.[23] The two resulting environments serve as the starting point for analyzing the impact of the EMP sequencing:[24] a *moderate scenario* in which the conventional monetary policy under the historical rule calls for the overnight rate to be cut sharply and held at the ELB of 25 bps over the near term; and a *severe scenario* with a prolonged duration of the overnight rate at the ELB.

The COVID-19 shock is characterized by a significant global and domestic demand contraction, decline of oil prices and sharp decline of the labour supply. In the moderate scenario, output and core inflation fall by about 4 percent and 1 percent, respectively (Charts (a) and (b) in Figure 1). The widening of the output gap in the severe scenario is far more pronounced, reaching a peak contraction of 10 percent, and is accompanied by a persistent decline in inflation.

### 3.3 Step 2: Introducing extended monetary policy tools in sequence

In the second step, we consider the implementation of EMP tools. To mimic the economic context at the onset of the COVID-19 crisis, we restrict specific transmission channels of low policy rates to the real economy in the short term—the assumed containment period. Although EMPs can lower borrowing costs faced by firms and households, both domestic

[23]The chosen economic scenarios were considered among the range of possible outcomes at the Bank of Canada when the COVID-19 crisis struck. The first scenario corresponds approximately to a profile in the middle of the range presented in the Bank's April 2020 Monetary Policy Report (Poloz et al., 2020), while the second scenario approximates the more severe and prolonged profile. This choice of scenarios is relevant because it represents the information Canadian policy-makers considered plausible when they decided which EMP tools to implement. In reality, containment measures varied by province, re-opening was often partial and sector-specific, and consumption patterns were affected through both restrictions and voluntary social distancing (see e.g. Dahlhaus et al., 2022). For clarity, we focus only on full lock-downs of differing durations.

[24]The first scenario corresponds approximately to a profile in the middle of the range presented in the Bank's April 2020 Monetary Policy Report, while the second scenario approximates the more severe and prolonged scenario.

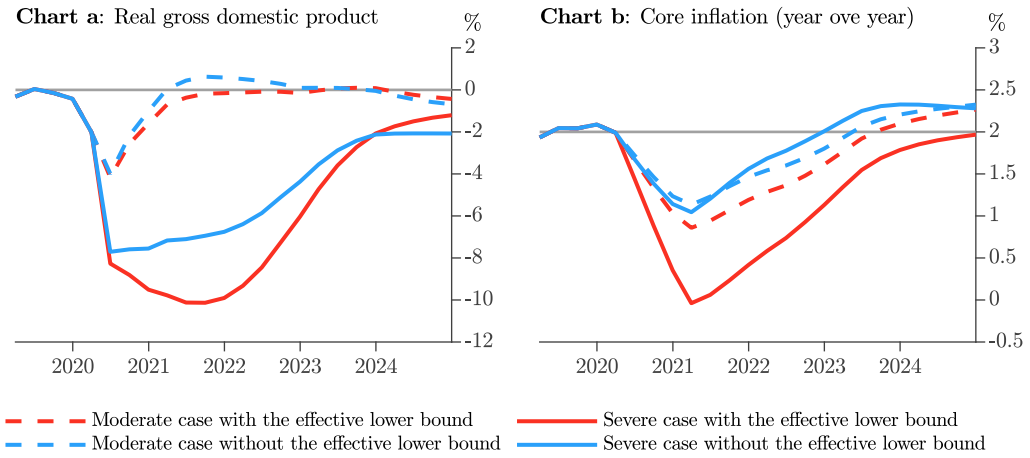


**Figure 1:** Real GDP and inflation without using the extended monetary policy toolkit. Source: Bank of Canada calculations.

demand and labour supply remain unresponsive during the containment period in the simulation.[25] This assumption models the reality that consumers and firms either cannot or do not want to spend during the containment period, even though interest rates are low. In the moderate scenario, we assume the containment period limits transmission from the second quarter to the third quarter of 2020, whereas in the severe scenario, containment measures get lifted only in the first quarter of 2021.

We consider six different sequence plans as summarized in Table 1. In all sequence plans, the central bank commits in the second quarter of 2020 to holding interest rates at the ELB until quarter-over-quarter inflation reaches 2 percent.[26]. The sequence plans are then as follows:

1. In addition to implementing forward guidance, the central bank starts one EMP

[25] In addition, the labour supply is also held fixed to capture the fact that labour input does not change during the containment period.

[26] In our simulations, all the sequencing of EMP tools is known in the first quarter, including interest rate lift-off conditions, because agents are forward-looking. Forward guidance is therefore implemented in the first quarter in all simulations; it does not matter when it is actually implemented because agents know it is coming. Note also that, as announced in the Bank's July 2020interest rate announcement, the Bank did indeed implement forward guidance: "The Governing Council will hold the policy interest rate at the effective lower bound until economic slack is absorbed so that the 2 percent inflation target is sustainably achieved" Bank of Canada (2020*a*). The specific lift-off dates in the moderate and severe scenarios are conditional on the set of future unexpected shocks to the Canadian economy.

tool immediately and the second tool after two quarters; once the containment period under the moderate scenario is over. Both policies are in place for two years from their respective implementations. We consider two versions of sequence 1: a) start credit easing first and delay the start of quantitative easing until the two-quarter containment period is over; and b) start quantitative easing first and delay the start of credit easing until the two-quarter containment period is over.

2. The central bank delays the implementation of both credit easing and quantitative easing for two quarters. This sequence is motivated by a desire to boost the recovery only after it kicks in. We consider no EMP policies during the containment period and implement the same two variations as in sequence 1, starting only in the fourth quarter of 2020.

3. The central bank implements all EMP tools at once, either immediately or after the containment period is over.

# 4 Evaluating sequence plans of extended monetary policy tools

We evaluate the marginal impact of each sequence plan on GDP and core inflation relative to the benchmark cases, which feature no lower bound on the policy interest rate. This allows us to weigh the benefits and economic costs of different EMP sequence plans.

## 4.1 A hypothetical base case: no effective lower bound

This benchmark is a best-case (albeit unrealistic) scenario where the policy rate can fall as far below zero (and transmit normally) as needed. The path of the policy rate is determined by the Taylor rule to stabilize output and inflation, ignoring the ELB. This

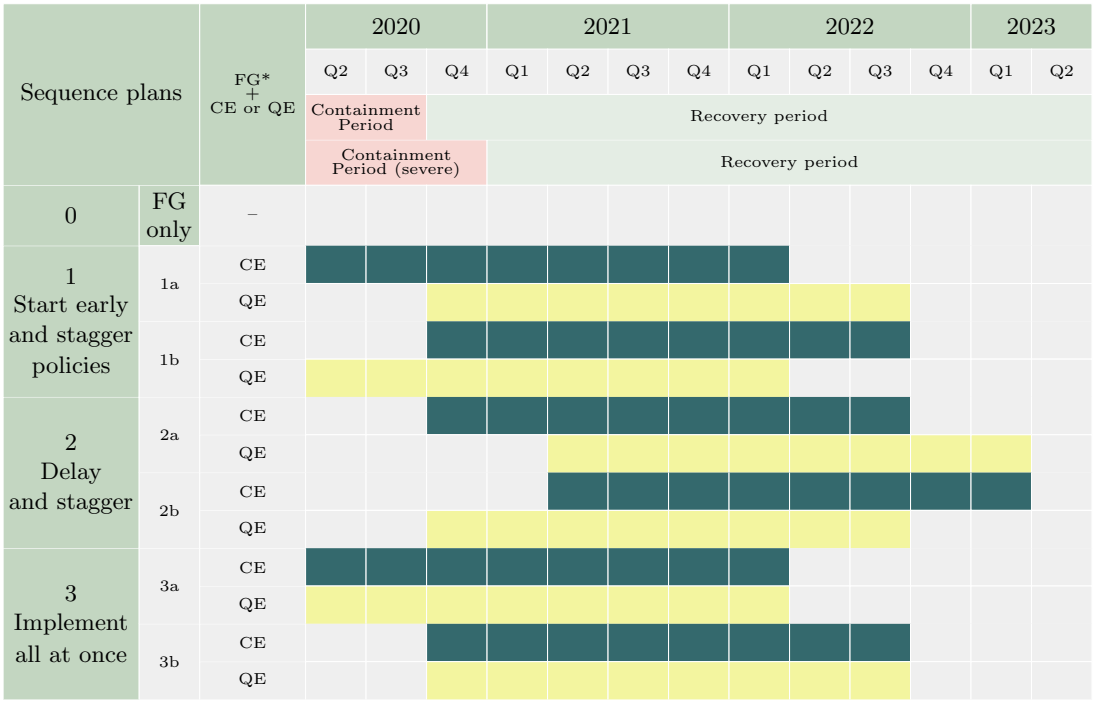


**Table 1:** Sequence plans for extended monetary policy tools in response to the COVID-19 shock

*Forward guidance is applied throughout all simulation periods in each sequence plan.
Note: FG is forward guidance; CE is credit easing; QE is quantitative easing.

option, a benchmark monetary policy rate cut, is shown by the solid green line in figure 2, charts (a) and (b). In this scenario, short- and long-term corporate rates fall along with the policy rate below the lower bound constraint, as do household and mortgage rates. The real and nominal effective exchange rates depreciate sharply and rapidly by as much as 5 percent each in 2021 (relative to the case where the ELB binds), which triggers a faster improvement in Canadian exports and thus the current account balance than when the ELB binds.

Compared with the ELB case, total hours worked also improves more rapidly from the negative pandemic shock, reaching its pre-pandemic level faster, i.e., early 2021. This is accompanied by a moderate wage growth, boosted by more than 1 percent at its peak in early 2022. Together, the faster recoveries in hours and wages boost real disposable

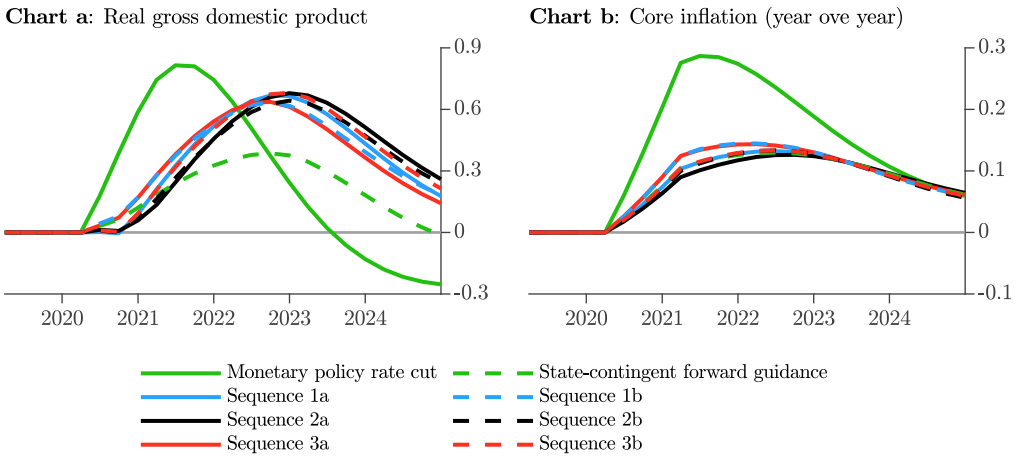


**Figure 2:** Comparison of macroeconomic improvement from extended monetary policy sequence plans (Percentage difference relative to outcomes under an effective lower bound, no extended policy scenario)

income by up to 1.5 percent toward the end of 2021. Finally, in addition to supporting aggregate demand, the wealth channel of accommodative monetary policy is also at play: financial wealth increases and real house prices rise sharply in 2020. Taken together, the economy returns to pre-pandemic levels within a year from the time COVID-19 struck in early 2020, driven largely by a bounce back in consumption that supports the closing of the output gap in early 2021. Year-over-year core inflation is boosted by more than one-quarter percentage point at peak (early 2021), though its return to target is sluggish until early 2023.

Finally, the speedy recovery of the economy also yields a more favourable fiscal outcome: the debt-to- GDP ratio, spiking with the hit of the crisis, improves much faster in a world where the policy rate can go deeply negative. Note that the path of fiscal policy variables (such as government expenditure and the income tax rate) in all sequencing options remains unchanged at the levels in the "no ELB" case to abstract from differential responses in these fiscal policies.

Certainly, a world without a binding ELB is an unrealistic scenario, but it serves as a useful comparison. The area below the green line in figure 2, charts (a) and (b), indicates

the improvement of GDP and inflation, respectively, relative to the case where the ELB is binding.

### 4.2 The impact of sequencing options when the effective lower bound binds

We can now evaluate the different policy options against the base case of no ELB. The remaining lines in 2(a) and 2(b) show the degree to which each of the six EMP sequencing options (from Table 1) can improve GDP and inflation outcomes, respectively, that would arise under the moderate scenario, compared with a case with no policy intervention where the ELB is binding. For example, the grey line shows the GDP improvement under sequence 1b.

Sequence plans that immediately implement quantitative easing and forward guidance (1b, 3a) yield the fastest response of GDP and the best inflation outcomes. Even though the short-term rate is constrained at the ELB, these policies immediately decrease long-term interest rates effectively through both the term structure of the future path of short-term rates and the term premium. Lower effective interest rates faced by both households and firms support consumption, residential investment and business investment more than in scenarios where EMP policies are absent.

As a result of postponing credit easing for two quarters in sequence 1b, the decline of long-term corporate rates under 1b is less pronounced. Nevertheless, this has little real impact on investment in the short term because the economy and labour supply are constrained by containment measures. This also explains why sequence 1a, which starts with credit easing, is among the least effective sequences in terms of stimulating GDP and inflation: it effectively and immediately lowers corporate rates but fails to lift consumption by as much as quantitative easing does. Lifting consumption has a more widespread impact on interest rates in the economy. Also, sequence 1a does not lead to

a more front-loaded response of investment.

Finally, sequences that delay the implementation of EMPs (2a, 2b) yield sub-par outcomes for GDP and inflation. Saving monetary policy power for later does not improve the overall outcome, it simply delays its beneficial effects. In sequences 2a and 2b, interest rates relevant for agents' decisions, such as the corporate rate and mortgage rates, only fall in the fourth quarter of 2020 and the second quarter of 2021, delaying and limiting the impact of lower rates on consumption. Moreover, the delayed response of interest rates also means the exchange rate depreciates only slightly and late in the game compared with more front-loaded sequences. As a result, these sequences do little to help export performance or only do so in 2022 and 2023, whereas more front-loaded sequences result in an earlier boost to exports, thereby supporting the recovery.

To provide an alternative metric to quantify the degree of improvement in macroeconomic outcomes delivered by different sequencing options, we also report and compare how cumulative GDP and the average inflation improve after implementing each sequence plan at the ELB. This comparison allows us to measure the efficacy of each EMP sequence. Details of this comparison can be found in Table 2 in the Appendix.

### 4.2.1 Key Quantitative Results

We find that starting forward guidance and quantitative easing early and staggering credit easing policies (sequence 1b) or immediately implementing all EMP options (sequence 3a) stabilizes GDP and inflation better in the near term than the delayed sequence plans.

In the moderate scenario, the maximum effect of EMPs reduces the GDP loss due to ELB by about 35 percent and inflation loss by about 45 percent.[27] In contrast, the same EMP package in the severe case would reduce the GDP loss due to ELB by about 15

[27]This translates to about a 0.9 percent impact on quarterly GDP and an increase of about 14 percentage points in the year-over- year inflation (for more details, see Table 2 in the Appendix).

percent and that of year-over-year inflation by about 16 percent. What this means is that even if all EMP options are implemented immediately, about 65 percent of the GDP loss remains in the moderate scenario and 85 percent in the severe scenario. Therefore, iscal policy would need to fill this loss to completely offset the COVID-19 shock.

In the moderate scenario, state-contingent forward guidance by itself (sequence 0) reduces nearly 25 percent of the GDP loss and 38 percent of the inflation loss due to the ELB. In contrast, in a severe macroeconomic scenario, forward guidance can only make up about 10 percent of the GDP loss and about 13 percent of the inflation loss that rate cuts below the ELB could deliver. By introducing state-contingent forward guidance, the ELB duration is prolonged in both the moderate and severe scenarios.

As shown in figure 2 and table 2, one of the most effective strategies is a front-loaded approach (sequence 1b) where quantitative easing is enacted immediately and credit easing is delayed until the containment period (for two quarters) has ended. Using the credit easing policy in the near term does not achieve a reduction in the overall macroeconomic loss relative to the ELB. It is important to note that our simulations in ToTEM may underestimate the potential importance of credit easing given model limitations. Credit easing is assumed to work only through the credit channel by focusing on lowering firms' borrowing costs. In practice, credit easing may also have important effects by restoring financial intermediation, reducing default risk and lifting consumer and business confidence, which are not captured in ToTEM. In addition, due to the containment measures, both business and residential investment are unresponsive in the near term, thereby limiting some of credit easing's immediate effect.[28] The elevated uncertainty and labour supply contraction during the containment period also greatly limit the effect of the credit easing policy on household spending.

[28]In ToTEM firms seek credit to make capital purchases only. Credit easing may have a greater role in a model with heterogeneity, fixed costs and default because in such a model firms may seek additional credit to cover running costs as well as capital purchases. In practice, credit easing can have important effects by limiting firm defaults and helping firms bridge the containment period.

We also find that a delayed all-at-once strategy (sequence 3b) reduces the potential benefit delivered by sequence 1b because the exchange rate adjustment is postponed. Importantly, if monetary policy delays implementation so that it can ease policy support for when the economy recovers, as in sequence 2, the marginal impact of EMPs on GDP is also smaller than it is when measures are implemented earlier, such as in sequence 1. This suggests that there are some costs to not acting aggressively when the shock hits, particularly on stabilizing inflation.

Lastly, we find that when forward guidance is implemented first, EMPs can improve macroeconomic outcomes even in the severe scenario. This is an important takeaway. Our results demonstrate that, because uncertainty around how the COVID-19 shock resolves itself remains high, having a mechanism that helps to anchor inflation expectations is effective.

### 4.3 Robustness analysis

To analyze the robustness of our findings, we investigate how sensitive results are to a variation in the parameter that determines the degree of rule-of-thumb (ROT) behaviour of price setters in the consumption goods sector.[29] Intuitively, a higher share of ROT price setters in the consumption goods sector would be expected to dampen the economic impact of sequence options that delay policy implementation. When there are fewer forward-looking firms, expected future economic activity has a reduced role in current inflation and, thus, policies that are delayed will have a weaker impact.

In this robustness analysis, we vary the share of ROT price setters around a 90 percent confidence interval based on its posterior distribution. We obtain two results: first, when the share of ROT price setters in the consumption goods sector increases by approximately 7 percent, all sequencing options lead to a relatively worse economic outcome.

[29] As discussed above, this is the share of firms that following a simple rule to set prices, similar to inflation indexation.

In contrast, when we lower the share of ROT price setters, the economic outcome under all sequencing options improves because the expectation channel is stronger. Second, a front-loaded sequence plan continues to be the most effective strategy regardless of the degree of ROT behaviour. More specifically, sequence plans 1b and 3a continue to yield the best responses of GDP and inflation outcomes.

# 5 Policy considerations for implementation

This section discusses the complementarity of fiscal policy and EMPs as well as their implementation limits.

## 5.1 The role of complementary fiscal policy

We have shown that an immediate deployment of all EMP tools offsets 35 percent of the GDP gap created by the presence of an ELB on interest rates. This leaves about 65 percent of the gap to be potentially filled by fiscal policy if the objective is to completely offset the COVID-19 shock. Importantly, these estimates hinge on the underlying scenarios and could vary significantly should the economy evolve differently. Nevertheless, for illustrative purposes, we can quantify the increase of fiscal stimulus required to complement the EMP tools at the ELB in order to fully offset the loss the ELB creates. We find that under the moderate scenario, $7 billion of additional fiscal stimulus would be required for the first year to fill the gap. Under the severe scenario, however, the gap left for fiscal spending is much bigger: about 87 percent of the GDP loss, or $28 billion.[30] In addition, under the severe case, if we use universal transfers

[30]This assumes a fiscal multiplier of 1 in the moderate scenario and 1.2 in the severe scenario. Fiscal multipliers are generally higher in recessions and when the nominal interest rate is constrained by the ELB (Office of the Parliamentary Budget Officer, 2016). Note that the estimates of required fiscal measures are in addition to amounts already committed to and integrated into the scenarios at the time of the April Monetary Policy Report (Poloz et al., 2020), amounting to roughly $120 billion. Since then, the government enacted additional measures for a total of about $400 billion (International Monetary Fund, 2021).

to fill the remaining GDP loss due to the ELB, we would need up to $113 billion, or up to $68 billion if we consider targeted transfers to borrowers and hand-to-mouth households. The moderate scenario would require between $30 billion and $113 billion of fiscal stimulus to fill the remaining 65 percent of the GDP loss due to the ELB. This amount depends on the type of fiscal instrument used once the EMP package has had its maximum effect. For details of the estimated magnitude of fiscal policy, see Table 3 in the Appendix.

### 5.2 Scalability of extended monetary policy tools

Given that the sequences we present can reduce the gaps in GDP created by the ELB by up to only 35 percent under the moderate scenario, we now discuss if it is possible to implement even more aggressive EMPs and scale the stimulus.

*Forward guidance*

Rather than conditioning the guidance on reaching the 2 percent inflation target, the Bank could temporarily commit to holding rates at the ELB until inflation reaches a higher target. While this should provide more monetary easing in the short term, there is a trade-off. On the one hand, a temporarily higher target would result in an overshoot of inflation above that target, which would provide stimulus by lowering the real interest rate. On the other hand, as inflation increases above the Bank's core target, the Bank would need to bring inflation expectations back to 2 percent by quickly raising interest rates.

*Quantitative easing*

In practice, quantitative easing has diminishing returns and price and quantitative limits. It is also likely that sizable programs would increase costs beyond the benefits they generate.

First, in the context of an already flat yield curve at the onset of the crisis, it is reasonable

to assume that quantitative easing would be unable to compress yields by more than 30 bps. While in practice the yield curve could steepen as the recovery takes hold, simulations show only a slight increase in the term premium, suggesting that quantitative easing could have only small additional effects on long-term rates even later.

Second, there is a quantitative limit to how much the central bank wants to buy before it becomes too dominant in the government debt market.[31] For Canada, the quantitative easing assumption (weekly purchases of $5 billion each) implied holdings of government bonds of about 40 percent of outstanding marketable government bonds by the end of the fiscal year 2020–21.[32] To the extent that marketable debt continued to increase thereafter, the assumption of a two-year quantitative easing program was not expected to result in issues in the government debt market. However, liquidity issues could start to arise if purchases were expanded further to reach or surpass a certain quantitative limit in terms of percent of outstanding debt.

*Credit easing*

Purchases of corporate bonds and commercial paper could be further scaled up and expanded to other asset classes. Beyond the purchases considered in the simulations, the Bank could also scale up purchases of other impaired assets, such as provincial government bonds. That said, the amount and effectiveness of scaled-up purchases are also subject to limits.

First, returns to scale are decreasing. In fact, spreads can likely not be compressed beyond a certain point. If we assume that 100 bps of the 150-bps spike at the peak

[31] See Santor and Suchanek (2016). From international experience, dominance in debt markets causes liquidity strains. For example, the Bank of Japan owns 45 percent of the Japanese Government Bond market (Sano and Uetake, 2018) and the Sveriges Riksbank owns up to 45 percent of the Swedish Government Bond market, causing some liquidity strains. If the United Kingdom experience is a guide, purchases of up to 40 percent of government bonds should not materially hamper market functioning (Reuters staff, 2018).

[32] The government's July Economic and Fiscal Snapshot 2020 projects domestic bonds outstanding to increase to $915 billion by the end of the fiscal year 2020–21. The Bank's holdings of government bonds increased to about $350 billion by March 2021, given the purchases of $5 billion per week.

of the crisis in spreads are due to a higher liquidity premium (as opposed to default risk), further asset purchases would not be able to reduce spreads more than that. Our simulations already assume the risk spread declines by 80 bps, which implies that asset purchases could be scaled up to achieve an additional 20 bps. In practice, credit easing also becomes less effective as market functioning improves. This would limit the efficacy of credit easing once spreads fall back as the recovery kicks in.

Second, even if it were possible to scale up CE, the credit risk on the Bank's balance sheet would increase. Concerns about the exposure to such risk or even actual losses could potentially affect credibility and public perception of central bank independence if the nature of purchases is not well communicated to and fully understood by the public. This, in turn, could affect the Bank's ability to steer inflation toward its target.

## 6 Discussion and conclusion

Using ToTEM simulations of two scenarios (moderate and severe) in response to a large pandemic shock, our analysis suggests that EMPs can help improve economic outcomes when the policy rate is constrained at the ELB. Gradual sequencing of EMP tools, including forward guidance, credit easing and quantitative easing, can provide some support to inflation and GDP at the ELB. However, more front-loaded packages where quantitative easing is implemented immediately (starting in the second quarter of 2020) achieve a larger reduction of the economic loss. Indeed, quantitative easing supports the economic recovery through both broader interest rate channels and the exchange rate channel. Quantitative easing provides stimulus to both firms and households, the latter benefiting from lower effective long-term mortgage rates. The relative speed and magnitude of the additional exchange depreciation generated by quantitative easing also play a vital role in considering appropriate sequencing options. Due to containment measures, implementing credit easing to lower borrowing costs faced by firms and households offers

limited advantages in the short term. Credit easing can, however, provide some support when used after the containment period.

Several caveats warrant mentioning. First, the modelling framework we use has some important limitations. ToTEM has no endogenous precautionary savings channel such as in heterogeneous agent New Keynesian models. Therefore, our analysis may underestimate the importance of labour market adjustments. Following a pandemic with a global impact, precautionary savings motives could potentially amplify the shock and further reduce aggregate output.

Also, the results may understate the benefits of credit easing. This EMP tool can play a key role in restoring financial intermediation and reducing default risk. ToTEM III does not capture either of these channels. Moreover, the scope of our analysis has some limitations. For example, the estimated effects of EMPs rely on an assumption of perfect foresight in which the sequence of policies is known to agents; i.e., agents know that the central bank will implement additional measures (e.g., credit easing) in a subsequent quarter. This implies that the Bank would need to announce the sequence before implementing it for it to achieve the documented benefit. In the absence of perfect foresight (or Bank communication informing the public of the policies it will implement), the quantified effects could be smaller.[33]

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[33]In addition, forward guidance will be less effective if the markets incorrectly expect inflation to return to target earlier than projected.

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# Appendix

| Scenario | Detail | Cumulative GDP impact over the first 5 quarters (pp) | Relative GDP improvement to offset ELB (%) | Average y/y inflation impact over the first 5 quarters (pp) | Relative inflation improvement to offset ELB (%) |
|---|---|---|---|---|---|
| *ELB* | No additional policy | (0, 0) | (0%, 0%) | (0, 0) | (0%, 0%) |
| *No ELB* | Impact of allowing interest rates below ELB | (2.71, 9.37)* | (100%, 100%) | (0.19, 0.75) | (100%, 100%) |
| *0* | FG only | (0.64, 0.79) | (23%, 8%)† | (0.07, 0.1) | (38%, 13%) |
| *1 Start early and stagger* | 1a: First FG and CE, then QE | (0.62, 0.82) | (23%, 9%) | (0.07, 0.1) | (37%, 13%) |
| | 1b: First FG and QE, then CE | (0.94, 1.20)‡ | (35%, 13%) | (0.09, 0.12) | (45%, 16%) |
| *2 Delay and stagger* | 2a: First FG, then CE, then QE | (0.46, 0.65) | (17%, 7%) | (0.06, 0.09) | (33%, 12%) |
| | 2b: First FG, then QE, then CE | (0.50, 0.74) | (19%, 8%) | (0.07, 0.1) | (36%, 14%) |
| *3 Implement all at once* | 3a: All options (immediate) | (0.93, 1.17) | (35%, 13%) | (0.09, 0.12) | (45%, 16%) |
| | 3b: All options (delayed) | (0.63, 0.85) | (23%, 9%) | (0.07, 0.1) | (37%, 14%) |

**Table 2:** A comparison of marginal improvement of using policy options at the effective lower bound (Moderate scenario, severe scenario)

Note: These numbers are based on simulations around a proxy of moderate and severe scenarios in the April 2020 Monetary Policy Report (Poloz et al., 2020). Options in green font denote the best performing policy options. FG is forward guidance; CE is credit easing; QE is quantitative easing. GDP is gross domestic product, and ELB is the effective lower bound.

* The first entry of 2.71 indicates the percent improvement in the level of GDP if the rate is allowed to go below the ELB, under the moderate case.

† The effect of 23 percent means that, by itself, forward guidance can achieve 23 percent of the gain that is delivered by a rate cut (second row); i.e., forward guidance can compensate for nearly 25 percent of the GDP loss due to the ELB.

‡ The GDP effect in the moderate scenario would be about 0.8 percent if evaluated over the next four quarters.

| Scenario | Detail | Economic Impact of different sequence options | | | Additional fiscal policy required | | |
|---|---|---|---|---|---|---|---|
| | | Cumulative GDP impact over the first 5 quarters (pp) | Relative GDP improvement to offset ELB (%) | % GDP improvement required from fiscal to offset ELB (%) | Government spending required to offset ELB ($bn/year) | Universal transfers required to offset ELB ($bn/year) | Transfers to hand-to-mouth households required to offset ELB ($bn/year) |
| *ELB* | No additional policy | (0, 0) | (0%, 0%) | (100%, 100%) | (11, 32) | (56, 129) | (22, 77) |
| *No ELB* | Impact of allowing interest rates below ELB | (2.71, 9.37) | (100%, 100%) | (0%, 0%) | (0, 0) | (0, 0) | (0, 0) |
| *0* | FG only | (0.64, 0.79) | (23%, 8%) | (77%, 92%) | (9, 30) | (43, 118) | (17, 71) |
| *1 Start early and stagger* | 1a: First FG and CE, then QE | (0.62, 0.82) | (23%, 9%) | (77%, 91%) | (9, 30) | (43, 117) | (17, 70) |
| | 1b: First FG and QE, then CE | (0.94, 1.20) | (35%, 13%) | (65%, 87%) | (7, 28) | (36, 112) | (15, 67) |
| *2 Delay and stagger* | 2a: First FG, then CE, then QE | (0.46, 0.65) | (17%, 7%) | (83%, 93%) | (9, 30) | (46, 120) | (19, 72) |
| | 2b: First FG, then QE, then CE | (0.50, 0.74) | (19%, 8%) | (81%, 92%) | (9, 30) | (45, 119) | (18, 71) |
| *3 Implement all at once* | 3a: All options (immediate) | (0.93, 1.17) | (35%, 13%) | (65%, 87%) | (7, 28) | (37, 113) | (15, 68) |
| | 3b: All options (delayed) | (0.63, 0.85) | (23%, 9%) | (77%, 91%) | (9, 29) | (43, 117) | (17, 70) |

**Table 3:** Estimated amount of fiscal policy required to make up for the GDP loss due to the effective lower bound (Moderate scenario, severe scenario)

Note: Note: Forward guidance is applied throughout all simulation periods in each sequence plan. Options in green font denote the best performing policy options. FG is forward guidance; CE is credit easing; QE is quantitative easing. GDP is gross domestic product. ELB is the effective lower bound.