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Effective Fiscal-Monetary Interactions in Severe Recessions

by Jiaqian Chen, Raphael Espinoza, Carlos Goncalves, Tryggvi Gudmundsson, Martina Hengge, Zoltan Matyas Jakab, and Jesper Linde

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Prepared by Jiaqian Chen, Raphael Espinoza, Carlos Goncalves, Tryggvi Gudmundsson,
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ABSTRACT: The COVID-19 pandemic and the subsequent need for policy support have called the traditional separation between fiscal and monetary policies into question. Based on simulations of an open economy DSGE model calibrated to emerging and advanced economies and case study evidence, the analysis shows when constraints are binding a more integrated approach of looking at policies can lead to a better policy mix and ultimately better macroeconomic outcomes under certain circumstances. Nonetheless, such an approach entails risks, necessitating a clear assessment of each country's circumstances as well as safeguards to protect the credibility of the existing institutional framework.

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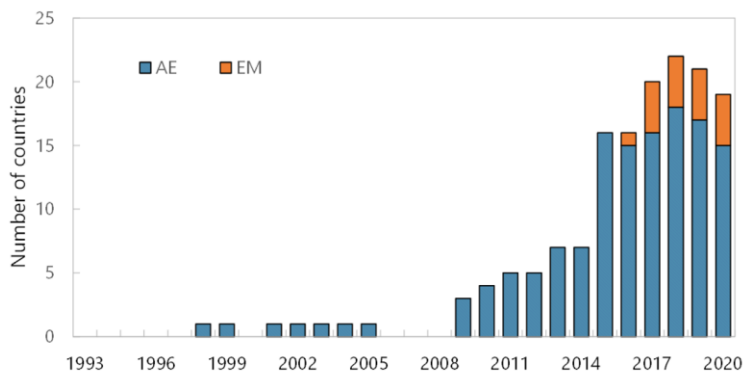
I. INTRODUCTION

The COVID crisis hit the global economy hard and necessitated an unprecedented policy response. The global economy shrunk sharply in 2020, with output 3 percent below the 2019 level and activity in consumer-facing services suffering particularly large declines. In addition to health measures, policymakers responded aggressively and creatively to cushion the blow to the real economy, notably by easing fiscal policy and monetary policy. Globally, fiscal measures to support the economy summed to US\$16.9 trillion (IMF 2021). The most far-reaching response occurred in advanced economies (AEs). In addition to traditional spending and revenue measures, various lending and loan guarantee programs were deployed to help weather the shock. Leading central banks also brought the policy rates closer to the Effective Lower Bounds (ELB) and a growing number of them started engaging in, or added to preexisting, asset purchase programs.

The current near-term outlook is highly uncertain despite an underlying ongoing global recovery. While policy has started to tighten in many countries alongside the pickup in growth and inflation, the war in Ukraine and limited policy space are complicating the appropriate policy setting. Furthermore, the varying severity of the health crisis, coupled with unequal initial conditions and diverse policy responses, has led to diverging recoveries across regions and income levels. In addition to the unevenness of the recovery across countries, the path out of the pandemic has been further complicated by the soaring commodity prices, elevated geopolitical risk, and supply disruptions related to the war.

Policy support thus remains essential in many economies to ensure a broad-based robust recovery that minimizes long-term scarring. However, providing such policy support is complicated by the fact that conventional policy space has greatly diminished. Interest rates were already low in many AEs prior to the COVID-19 crisis, and this limited the ability of central banks to reduce them further. The forceful response in emerging markets (EMs) has seen a large number of EM central banks run into similar issues (Figure 1). Fiscal policy is also facing its own set of constraints. Public debt levels have seen a sharp rise across regions during the pandemic. Most countries now have debt levels that are well above what they were in the past.

Figure 1. Number of Countries Constrained by ZLB¹



1/ Countries with policy rate at or below 0.2 percent.

Source: Fund staff calculations

In this environment, reliance on monetary policy to achieve macroeconomic objectives may reduce policymakers' ability to secure a robust recovery. Traditionally, central banks and treasuries have specific but partially overlapping mandates – sometimes referred to as the “consensus assignment” (Kirsanova,

Leith and Wren-Lewis 2009) – where fiscal policy should focus on controlling debt and deficits whilst achieving its structural objectives, including distributional outcomes, thereby playing a relatively passive role, compared to central banks, when it comes to macroeconomic stabilization. Central banks, on the other hand, have a primary mandate focused on price stability but typically have the scope to pursue some form of “flexible inflation targeting” in which they take substantial account of employment and growth and promote financial stability in framing policy. But in an environment with conventional fiscal and monetary policies increasingly likely to be constrained by the ELB and the need to finance large fiscal programs, central banks may find it difficult to fulfill their macro-stabilization mandate and fiscal authorities may face challenges to stabilize debt, especially when confronted with shocks of the magnitude observed during the COVID-19 pandemic. In this context, the strict separation between fiscal and monetary policies may fail to overcome these constraints and together fall short of providing the overall support that the economy needs.¹ While the focus of this paper is on the appropriate policy mix to address large aggregate demand deficiencies, a greater fiscal and monetary policy interaction could be relevant for countries facing rising commodity prices with increasingly limited policy space.

This paper argues that interactions between fiscal and monetary policy have become more central in advanced and emerging market economies with credible monetary and fiscal frameworks under the aforementioned conditions. The concept of fiscal-monetary interaction can refer to a range of issues. A traditional interpretation of this wording focuses on the policy mix, and how different combinations of fiscal and monetary loosening or tightening affect output, interest rates, the current account, and prices, as in the basic Mundell-Fleming model. As economic thinking evolved to better integrate the role of expectations of policy regimes in the determination of inflation, the concept of interaction between fiscal and monetary policies started to account for how expectations on the future conduct of one policy could affect the other policy, highlighting in particular the risk of fiscal dominance, as in the models of Sargent and Wallace (1981) and Krugman (1979). With the advent of independent central banks that have a well-defined price stability objective, the risk of fiscal dominance was reduced dramatically, and the question moved to whether central banks should *cooperate* with the fiscal authority to achieve better macroeconomic outcomes (as opposed to follow their own separate objective function and accept the outcome of the Nash equilibrium). This question was addressed in models with different assumptions on whether fiscal and monetary decisions are taken simultaneously or in a certain sequence (Dixit and Lambertini, 2003). Institutional arrangements tended to converge towards the “consensus assignment”, which had delivered a period of stable inflation and growth pre-GFC. More recently, the perceived inability of central banks to hit their targets from below and the slow recovery following the GFC have shifted the debate towards a greater balance in the roles taken by monetary policy and fiscal policy. In particular, the argument that fiscal policy should do more to achieve macroeconomic stability when the central bank is constrained has gained prominence (see e.g., Shambaugh 2019, and Klein and Winkler, 2021). The pandemic has brought renewed attention to the role of fiscal policy as a tool of macroeconomic stabilization (see e.g., Deb et al., 2021). Public spending is likely to increase again in response to the challenges posed by the war in Ukraine; and central banks are likely to face difficult tradeoffs between the need to contain the accelerating inflation and to support the domestic economy.

In this paper, “interactions between fiscal policy and monetary policy” refer to the direct or indirect effects that an action by the central bank has on the fiscal authority, and vice versa. In particular, we focus on how these actions alter the extent of policy space that the other policy lever has, and how these actions can enhance the effectiveness of the other policy lever. In that sense, the central bank may internalize that

¹ See Bartsch et al (2019) for a clear discussion of the benefits of greater interactions at a time of low neutral interest rates.

its actions can boost the effectiveness of fiscal policy, while the fiscal authority may internalize that expansionary fiscal policy can raise the neutral rate and hence help to relax constraints on monetary policy when the policy rate is at the ELB. Furthermore, expansionary monetary policy can create more fiscal space by boosting tax revenues, raising GDP, and by increasing the fiscal multiplier, including by addressing self-fulfilling tensions in sovereign debt markets when debt is high. While this focus on interactions involves looking at the two levers of fiscal and monetary together, and to a greater extent than what is done in the “consensus assignment”, it stops well short of some approaches according to which the two policies are effectively considered a single, joint, instrument (see e.g., Leeper (2022) for a critique of such ideas).

The benefit of greater fiscal-monetary interactions is particularly large when constraints on policies are frequently binding, since this is when one policy instrument can create space or improve the effectiveness of the other policy lever. It should be noted at the outset that these interaction effects, and the benefits they may bring, do not supplant, or take priority over traditional policy objectives and mandates, including the central bank independence and its primary focus on inflation and growth, and the need to ensure that debt is sustainable. Instead, the argument is that positive interactions can be harnessed within the traditional policy settings, under a certain set of conditions, as discussed below.

The literature has indeed noted that higher fiscal spending can increase the equilibrium real interest rate (see e.g., Erceg and Linde (2014) and Rachel and Summers (2019)) thereby making monetary policy more effective and increasing the scope for lowering interest rates. Similarly, the possibility of an expectation-driven rise in borrowing costs can constrain fiscal space or lead to debt crises. In such a situation, the central bank can prevent the bad equilibria from materializing by offering a credible backstop to government debt, as long as its price stability mandate is not threatened, which in turn facilitates greater countercyclical fiscal response. In addition, by committing to keeping interest rates low for longer, the central bank can enhance the effectiveness of fiscal stimulus, since fiscal multipliers have been found to be larger when monetary policy is accommodative.² The resulting improvement in economic outcomes, such as higher output and inflation, reduces the budget cost of a fiscal expansion. In this vein, the low interest rate environment as well as heightened uncertainty on the macroeconomic outlook call for policymakers to pay greater attention to fiscal-monetary interactions.

Closer interaction between policy levers raises several institutional considerations. The most important one is that, even though fiscal-monetary interaction requires policymakers be acutely aware of the impact of their own policy on the scope and effectiveness of the other policy lever, policymakers continue to be operationally independent to pursue their own objectives.³ The paper focuses on this “arms-length” interaction rather than explicit coordination or cooperation. Nonetheless, fiscal-monetary interactions can take different forms and have different objectives. They can be explicit or implicit, refer to a narrow or broad area of cooperation, and be either conditional or unconditional in terms of timing and scope. In addition, these interactions can range from the understanding of the indirect effects (e.g., of traditional monetary policy on fiscal space via the conventional effect that lower interest rates have on government’s interest burden), to the internalizing of these effects in decision making.

² See Woodford (2011) for theoretical underpinnings and Cloyne, Jorda and Taylor (2020) for empirical evidence. Auerbach et al (2021) also provide empirical evidence for the Covid-19 recession.

³ Whelan (2022) discusses a concrete example of these considerations, namely the implementation of the ECB’s balance sheet policies and its sovereign debt holdings, as well as the possible effects that the specific institutional setup may have on the effectiveness of the ECB’s policies.

Greater interactions are, however, not a risk-free approach. The traditional separation of assignments of monetary and fiscal objectives was in part introduced to improve policy credibility. A large literature has effectively argued that monetary policy decisions should be left in the hands of independent policymakers who are relatively more averse to inflation than the average member of society (see Thompson and Zuk, 1982, and Rogoff, 1985). Central bank independence is therefore a prerequisite to prevent fiscal dominance, and safeguards in policy design can further help mitigate such risks. If greater interaction is desirable when policy space is constrained, the challenge is therefore to ensure that it does not come at the cost of losing credibility. In particular, should conflict arise between a central bank's ability to anchor inflation, on the one hand, and the creation of fiscal policy space, on the other, the former is expected to take precedence within our framework.

Country-specific factors are also crucial to determine the appropriate scope for interaction. To highlight this, we complement the general analytical framework developed in this paper with several country case studies which focus on the practical considerations of closer fiscal-monetary policy interaction. These considerations include institutional aspects, such as financial market structure, as well as countries' inflation history and monetary policy credibility.

It should be noted that the paper does not argue that policies should be coordinated, but rather that fiscal and monetary authorities take externalities by one policy lever on the effectiveness of the other one into account. These externalities—or policy interactions—change with economic conditions and are more important when one policy lever is constrained. The notion of policy awareness is different from policy coordination. Coordination requires joint planning and analysis, which is difficult to achieve, including due to transmission- and implementation lags. Rather, the paper argues that overall policy effectiveness can be improved unilaterally by FP and MP authorities by taking state-dependent differences in the impact of one policy on the other into account.

The paper proceeds as follows. Section II discusses the context and the constraints at the onset of the pandemic on policymaking. It argues that the current environment differs substantially from that when the current policy orthodoxy was developed. Section III introduces the analytical framework, based on the open economy model of Erceg and Linde (2013), and shows how closer interaction of policies can improve macroeconomic outcomes. Section IV explores country cases and discusses some of the practical considerations involved with closer interaction. Section V concludes.

II. CONTEXT – LIMITED POLICY SPACE AND LOW DEMAND

Even before the COVID-19 pandemic, a number of factors were increasing the appetite for the use of fiscal policy to complement monetary policy. In the aftermath of the GFC, several central banks faced with increasingly limited scope for using conventional monetary policy instruments. In addition, structural factors such as demographic changes and low productivity growth have pushed down the real equilibrium interest rate over the last decade, leaving central banks little room to react to even moderate adverse shocks. At the same time, demand remained weak in many countries, and inflation, notably in the euro zone, continued to be below the target. In turn, these central banks created a range of new instruments through which they effectively engaged in more direct and targeted activities, including large-scale purchases of various asset classes. At the same time, there has been an increasing debate on the return of fiscal policy as a lever of business cycle policy (Schmidt 2017).

The COVID-19 crisis further exacerbated this trend. The economic impact of the COVID-19 pandemic has been unprecedented, with both output and inflation falling sharply on the onset (IMF 2020 WEO).

Heightened uncertainty may have also further pushed down the equilibrium real interest rate. Many central banks have turned to unconventional measures, including to ensure orderly market conditions, keep a lid on government bond yields and provide guidance on central banks' intentions going forward.

At the same time, fiscal policy was also called upon to actively contribute to macro stabilization. Fiscal policy has been particularly well suited to respond to the pandemic shocks given that it can address stress in specific parts of the economy. Indeed, fiscal authorities have responded forcefully, going beyond the traditional spending and taxation measures. To ease firms' and households' burdens, many governments have resorted to guarantee programs and subsidized loans. However, with the strong recovery in commodity prices as well as the ongoing supply disruptions, inflation has accelerated, and whether it remains well anchored will be critical to policymaking going forward (IMF 2021 WEO).

III. THE DYNAMICS OF CLOSER INTERACTION

In this section, the channels through which monetary and fiscal policies interact are illustrated using a fully-fledged DSGE macroeconomic model of Erceg and Linde (2013) augmented with discounting to address the forward guidance puzzle (see Del Negro, Giannoni and Patterson, 2015). A modeling approach is helpful in shedding light on mechanisms at work, capturing general equilibrium effects that are not easy to anticipate, and showing how those depend on economy-wide conditions and parameters of choice.

The model features two countries that are connected via trade links and capital flows. The home economy is calibrated to resemble a typical small, open EM, while the foreign country is set to be a large, and relatively closed AE. The usual ingredients of the NK-DSGE tradition are embedded in the model: habit in consumption, convex adjustment costs in investment, a cycle-magnifier financial accelerator *a la* Bernanke-Gertler-Gilchrist, and nominal rigidities in import and consumer prices and in wages. There are both permanent, trend-like productivity shocks as in Altig et al. (2005) and standard, mean-reverting, shocks to productivity. The central bank follows a Taylor rule but is subject to an effective-lower-bound (ELB) constraint on the policy rate. In addition, the model allows the central bank to resort to unconventional monetary policy strategies (e.g., forward guidance and average inflation targeting). It is worth noting, that in our scenarios, we always assume that exchange rates are flexible and countries are not part of a currency union.

The fiscal authority raises revenues via distortionary taxes and spends for public consumption. Although government spending does not directly affect economic agents' welfare nor improve total factor productivity (as it does in Baxter and King, 1990), public expenditures affect economic activity via the aggregate demand channel. This channel is very important when the policy interest rate is stuck at the ELB for a protracted period and the central bank cannot provide sizeable economic stimulus, but fiscal multipliers are higher (Woodford, 2011). Moreover, the fiscal authority can issue long-term government debt to finance its deficit. More details on the model, including how it is calibrated and solved, are provided in Appendix A.

In the following, we first construct a baseline that starts with a severe recession. To pick a recent relevant case, we work with the IMF World Economic Outlook (WEO) projections as of April 2020, when the emergence of the COVID-19 virus caused a sharp and persistent deterioration of the economic outlook in both AEs and EMs. However, we emphasize that our model analysis is not COVID-specific, so it can apply also to other recessions.

After having constructed a baseline projection, which entails a persistent large negative output gap and below-target inflation, we first study what monetary policy alone can do to boost the outlook through

unconventional tools. The scenario assumes that there is limited monetary policy space because the central bank's policy rate is predicted to be at the ELB for an extended period, which also compresses long-term yields. This also limits the effectiveness of unconventional monetary policy (UMP) tools such as quantitative easing and forward guidance. Given the limited effectiveness of UMP tools, we next study what fiscal policy can do to boost the economic recovery and nudge inflation closer to the central bank's target. We present the effects of fiscal stimulus under two alternative assumptions for monetary policy. First, we study a benchmark case when the central bank follows a flexible inflation targeting monetary policy rule. An important feature of such a strategy is that in any given period, the central bank strives to bring inflation back to target, but it does not make up for the sustained below target inflation episode by allowing higher inflation in the future. Second, we consider an average inflation targeting monetary policy strategy, which partially makes up for past and predicted shortfalls of inflation relative to target. As a reference point, we also provide results for a hypothetical case when monetary policy is unconstrained by the ELB and hike the policy rate in response to the fiscal stimulus. We can think of this experiment as a situation in which inflation is close to target and the economy is operating close to potential, so the central bank does not welcome the fiscal stimulus. The last set of simulations present the effects of central bank QE on sovereign spreads, growth, and the debt-to-GDP ratio when self-fulfilling risk premia raise the government's borrowing costs and thus constrain fiscal policy.

III.1 A Severe Recession Scenario

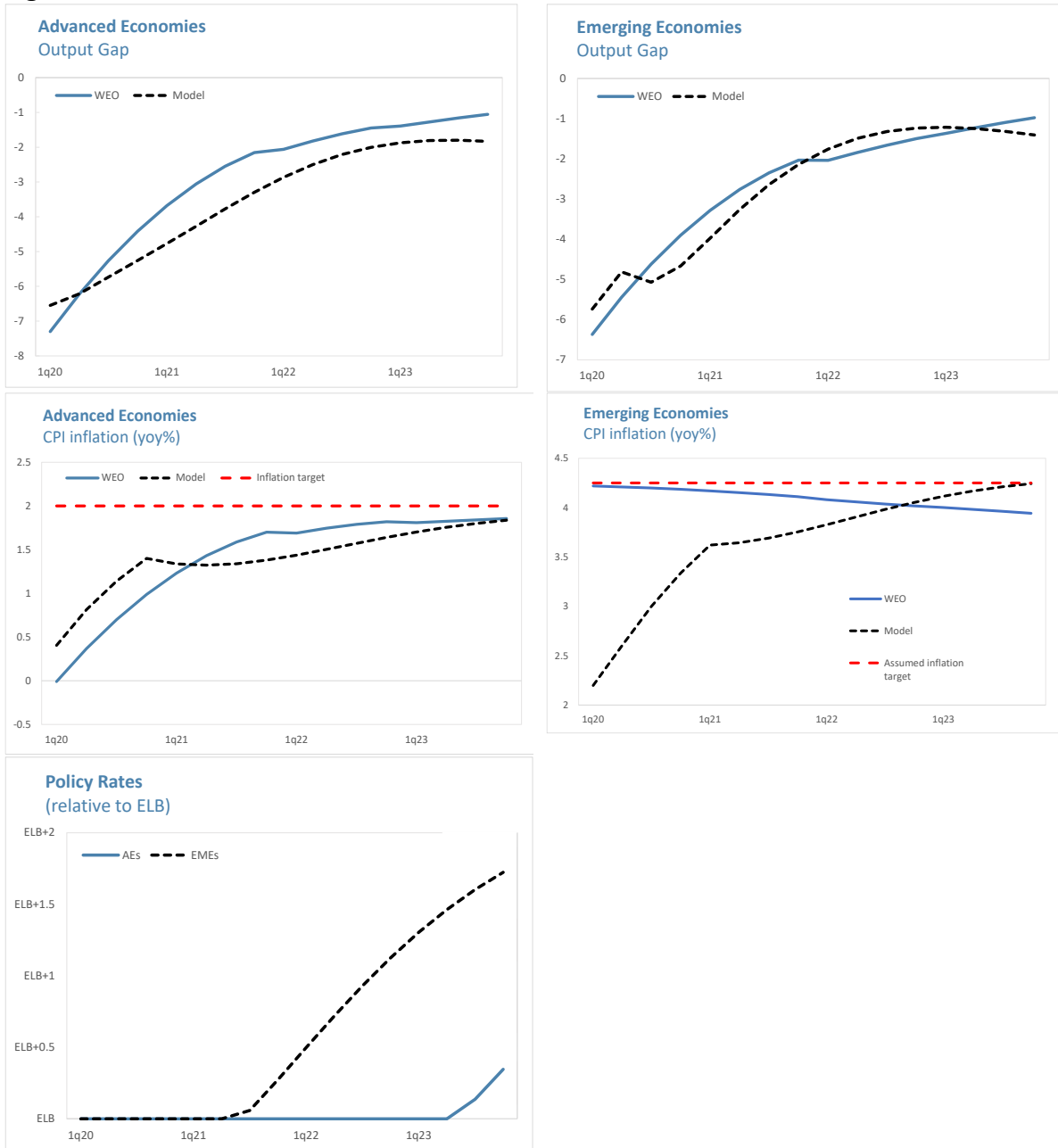
As noted previously, we use the model to generate a severe recession, similar to that experienced recently, by matching the model predictions with the April 2020 WEO's projection.⁴ Given the ELB constraint on policy rates, the effects of shocks depend on the perceived depth and duration of the underlying liquidity trap, and it is therefore important to generate initial macroeconomic conditions that roughly capture some salient features of severe recessions. Large negative supply shocks, reflecting production line disorders, as well as negative consumption demand shocks are thus assumed to generate the baseline. In addition, exchange rate risk premium shocks are added to the EM to generate sizeable depreciation of its exchange rate (around 10 percent on average).

The solid blue lines in Figure 2 depict the WEO outlook for a selected set of variables, and the black dotted lines the baseline simulation, under the benchmark calibration of the model with the ELB imposed on the policy rule, for both the home small open economy (the EM) and the foreign large and relatively closed economy (the AE). The underlying shocks are negative consumption demand shocks and negative productivity shocks, modeled as AR(1) processes with persistence of 0.9, and identical for both countries. However, the effects on output gaps and inflation, as shown in Figure 2, differ because of the capital flow shock for the EM, and a higher policy rate ELB in the EM, relative to the AE. Even so, our baseline features the view that policy rate liftoff from the ELB is likely to occur earlier in EMs compared to advanced economies, as the AEs are assumed to engage more heavily in a "lower-for-longer" policy. In all other dimensions, for instance the policy rules and the Phillips curves, the parametrization of the model is symmetric in the two economies, so one can think about the EM as a small open AE or an EM economy with a robust and credible policy framework.

⁴ For AEs we took the aggregate of "G20: Advanced economies plus Advanced European Union countries" and for EMs we took the group "Emerging Market and Developing Economies: excluding Low Income Developing Countries". Annual numbers from the WEO were interpolated to quarterly using quadratic splining.

As can be observed from Figure 2, the baseline closely matches the output gap outlook from the April 2020 World Economic Outlook for both regions. Moreover, the figure shows that the model closely matches the WEO inflation forecast for AEs. For EMs, the model is not as successful, since inflation for EMs was projected to just gradually decline and stay close to the “implicit” target in the April 2020 WEO (mostly due to fact that the pass-through from exchange rate depreciation offset the recessionary forces). For later reference, the baseline features a protracted period of inflation below target. This is important when the central bank follows an average inflation targeting strategy.

Figure 2. A Severe Recession Scenario



III.2 What can central banks do alone to fight the recession?

Starting from this baseline, we present in this section a model-based assessment of what central banks can do to fight the recession and increase inflation through UMP tools alone.⁵ We present results for the small open economy in Figure 2, which we think about as an EM economy with relative stable and credible monetary and fiscal policy frameworks. But the results also apply to small open AEs.

To begin with, we note that very large asset purchases have been required typically to reduce yields significantly. Empirical studies suggest that asset purchases in the range of 15-20 percent of GDP are required to lower 10-year yields by 100 basis points in the U.S. and in the euro area. Studies that try to gauge the broader economic impact find that the cumulative effect from asset purchases of this magnitude has been a boost to GDP of roughly 1-2 percent for those economies, see Fabo et al. (2020). As implied by Fabo et al. (2020), there is considerable uncertainty around these effects and the estimated impacts vary across different studies.

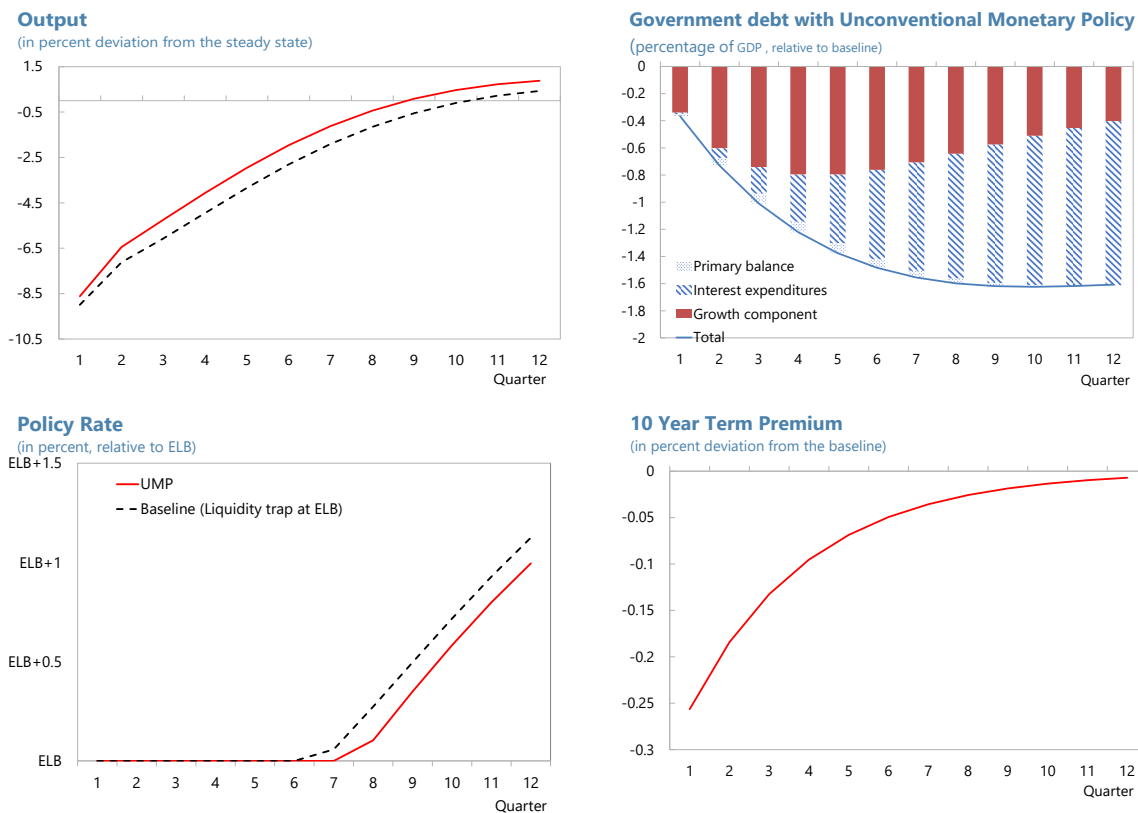
Importantly long-term interest rates had already fallen to very low levels prior to the pandemic, and this trend continued in 2020. This limits the scope of UMP tools to provide significant economic stimulus. This constraint is illustrated in the upper left panel of Figure 3, which shows the baseline path (dashed black line) for output along with a scenario (solid red line) assuming that quantitative easing (QE) reduces 10-year term premia by 25 basis points as shown in the bottom right panel.⁶ Such sizeable asset purchases, would only boost output by less than 0.5 percent after 2 years. Complementing QE by forward guidance of a later lift-off from the ELB improves outcomes but would only boost output by about 1 percent relative to the baseline (difference between the solid red and black dashed line for output in the upper right panel in Figure 3). Given our calibration of fairly flat Phillips curves relevant for small open credible EMs (or AEs), even such an aggressive monetary policy would only boost inflation by 0.1 - 0.2 percent (not shown).

An important insight from Figure 3 is that UMP creates fiscal space that can be used to provide further stimulus. The chart presenting government debt shows that the debt-to-GDP ratio is reduced, in this scenario thanks to higher nominal GDP (the “growth component”), lower interest payments over time (“interest expenditure” component), and (to a lesser extent) higher tax revenues (“primary deficit component”). Given the challenges and constraints, Figure 3 thus highlights that central banks cannot do all the heavy lifting, and that—where fiscal space exists—fiscal policy should play a larger role in countering recessions.

⁵ Notice that we do not discuss unconventional monetary policies aimed at stabilizing financial markets in distress. We take as given that market stress has been addressed and that the monetary transmission mechanism is functioning.

⁶ Our model assumes that lower government bond yields propagate to lower corporate and household bond yields. In practice, sovereign guarantees of credit support policies also played an important role. This policy gave a lot of traction to another set of unconventional policies from the central bank when trying to provide liquidity for commercial banks to continue providing credit to firms in distress due to collapsed demand. These sovereign guarantees allowed central bank liquidity to end up in the hands of firms that were badly hit from COVID, see Acosta-Henao et al. (2022).

Figure 3. What can monetary policy do alone to fight the recession



III.3 Fiscal Stimulus with Alternative Monetary Policy Strategies

Having demonstrated the limits of monetary policy to provide sufficient stimulus in a severe recession, we now turn to examining the efficacy of a transitory discretionary fiscal expansion worth 1 percent of GDP for 2 years, followed by a gradual decline (calibrated with an AR(1) root of 0.65). The fiscal package thus amounts to 2.5 percent of baseline GDP over 3-4 years. The duration of the stimulus is set to coincide roughly with the expected time during which monetary policy is constrained by the ELB (see Figure 2). A key assumption is that the fiscal impetus can be credibly communicated by EM (or small open AE) treasury to be transient.⁷ This assumption implies that the fiscal stimulus is particularly effective (see Christiano, Eichenbaum and Rebelo, 2011, and Woodford, 2011). Since the size of the country undertaking the fiscal stimulus is small relative to the rest of the world, fiscal spillovers are negligible. Furthermore, we assume that the central bank does not lift off earlier from the ELB because of the fiscal stimulus, although the improvements in output and inflation gaps might be sufficiently large that the policy rule would prescribe an earlier liftoff.

⁷ If the fiscal stimulus cannot credibly be communicated to be of temporary in nature, the benefits would be paired back notably, as permanent expenditure commitments to not have as beneficial effects on the equilibrium real interest rate and needs to be financed by higher taxes.

Figure 4 shows that when the policy rate is at the ELB, output increases by slightly more – about 1.25 percent on average the first two years – than the fiscal expansion itself.⁸ This implies that higher government consumption crowds in consumption and investment when monetary policy is at the ELB.⁹ As a result, the fiscal multiplier, defined as the cumulated sum of output expansion during the first two years divided by the cumulated increase in spending during the same period, is around 1.25. Hence, even a modestly sized fiscal stimulus package may boost the output gap and nudge inflation closer to target on par with the very ambitious UMP program simulated in Figure 3. This result assumes that the fiscal stimulus is understood to be temporary. The simulation also assumes that the country is fiscally solvent, so that spreads on public debt do not rise. An additional assumption is that the central bank can credibly commit to maintain its policy rate at the ELB despite the fiscal stimulus, and independently of inflation. If the fiscal stimulus package is sized so that it does not raise inflation above the central banks' target, such a pledge is credible. However, an oversized fiscal stimulus package that causes the output gap to become positive and inflation to persistently run above target would make it difficult for the central bank to credibly accommodate it.

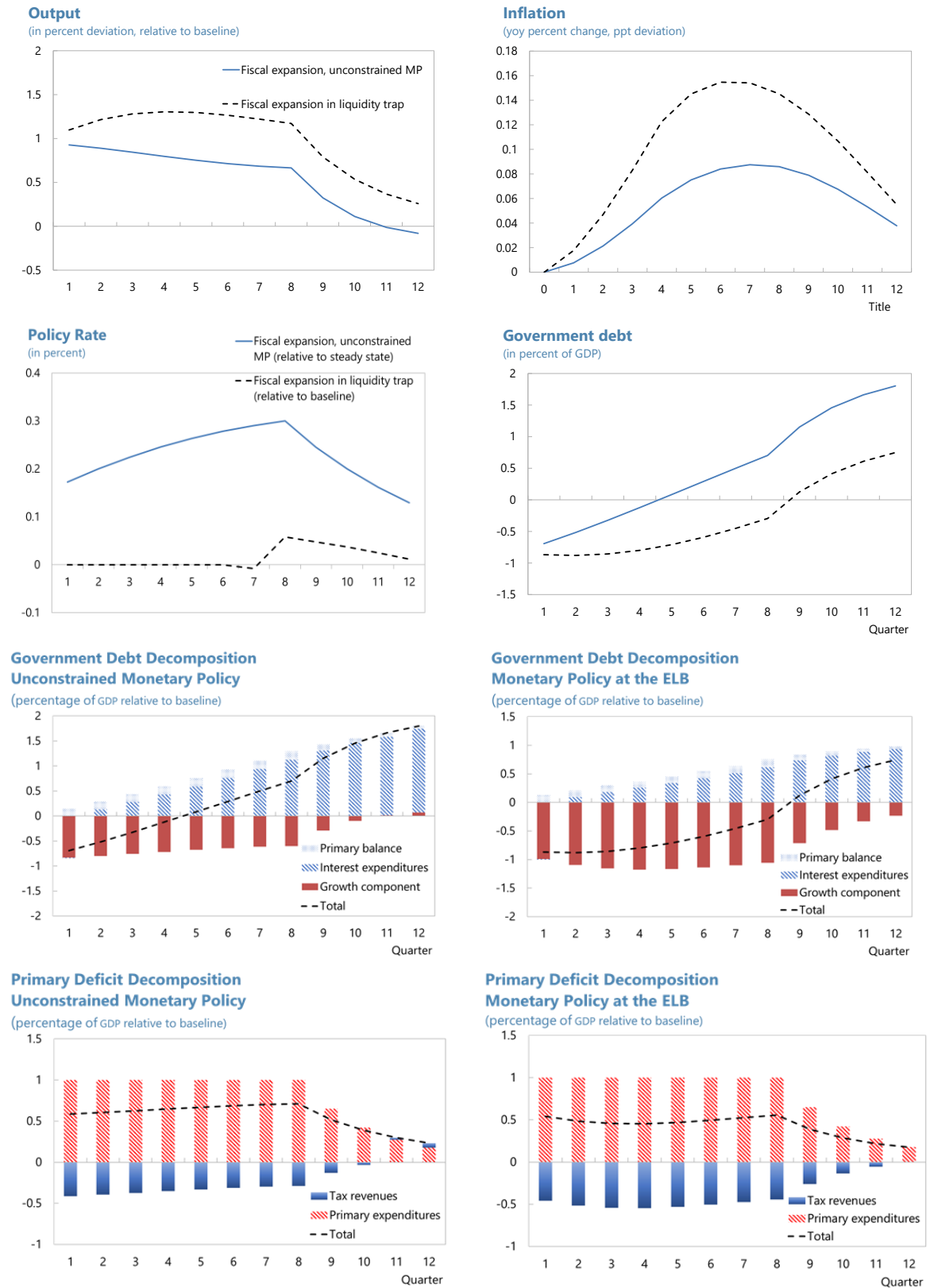
In this vein, the blue solid lines in Figure 4 show the hypothetical case where the output gap is closed and inflation at target before public spending increases. In this case, the central bank would tighten monetary policy as inflation exceeds the target and the economy is running above potential, thereby reducing the positive effect of fiscal policy on output and inflation.

Whether the central bank welcomes or leans against the fiscal stimulus has important implications for the cost of the fiscal stimulus. When the central bank maintains an accommodative monetary policy, debt as a share of GDP falls persistently because output has increased and the interest rate on debt remains low. When the central bank leans against the fiscal stimulus, the decline in the debt-to-GDP ratio is short-lived, driven by higher debt service costs and a smaller increase in GDP. In both cases, the contribution of the primary balance to debt dynamics is modest, reflecting that larger tax revenues, due to automatic stabilizers, partly offset the increase in public spending.

⁸ Note that the simulation results for the liquidity trap case are reported as deviations from baseline in Figure 4, i.e., we report the difference between the scenario with higher government consumption and the baseline in Figure 2 without higher government spending. For the reference case with unconstrained monetary policy, we simply compute the effects of the same sized hike in government consumption at the steady state. This renders the results comparable since all equations in the model are linearized apart from the nonlinear ELB policy rule.

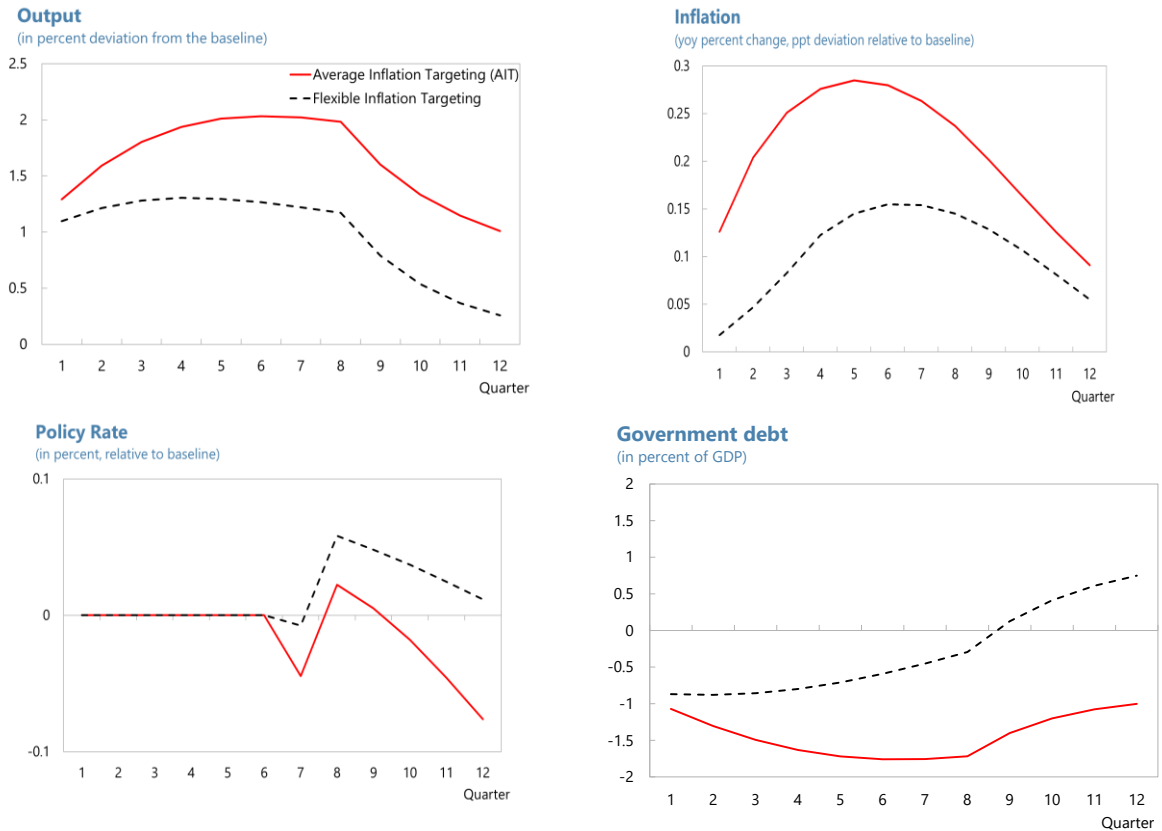
⁹ Net export as share of GDP is crowded out since the real exchange rate appreciates.

Figure 4. Transient government spending hike of 1 percent of baseline GDP for two years



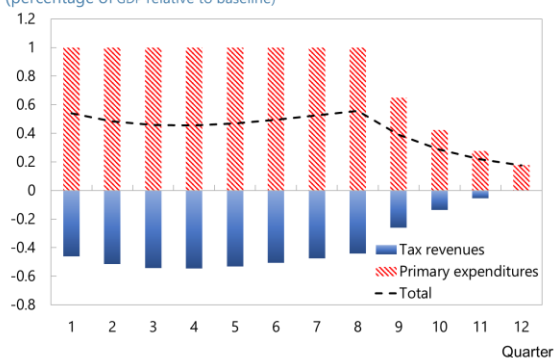
We now turn to discuss the effects of the same fiscal expansion in Figure 4 under an alternative monetary policy strategy (average inflation targeting, AIT) which credibly aims to make up for shortfalls of inflation below target.¹⁰ Under AIT, we assume that the central bank targets the 5-year average annual inflation rate and that the economy initially is at a situation where this average inflation gap is minus 0.5 percent. The results of this exercise are plotted in Figure 5, which compares the dynamics of the economy under AIT (red lines) with the dynamics under standard flexible inflation targeting (black dotted lines, repeated from Figure 4 for ease of comparison).

Figure 5. Transient government spending hike in liquidity trap under alternative monetary strategies

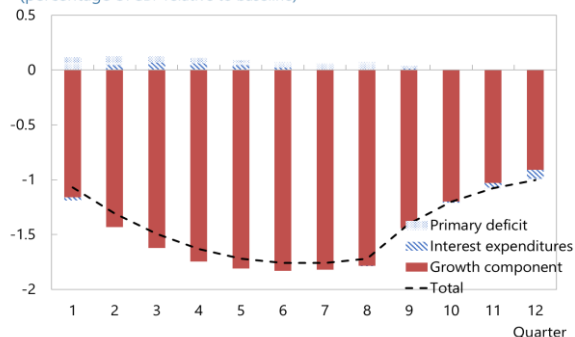


¹⁰ Since AIT might require more credibility that an EM economy can muster, the results in Figure 5 may pertain more to small open AEs.

Primary deficit under fiscal expansion and liquidity trap
(percentage of GDP relative to baseline)



Government debt with fiscal expansion and AIT
(percentage of GDP relative to baseline)



The results show that, under this alternative monetary policy strategy, the central bank keeps the nominal interest rate at the ELB for longer and this generates higher actual inflation, also raising inflation expectations and thus reducing the real interest rate. Lower real rates, in turn, produce an even larger impact on output and inflation relative to flexible inflation targeting, which further reduces the budget cost of the fiscal stimulus.

In fact, Figure 5 reports that the increase in nominal GDP is sufficiently large that the debt-to-GDP ratio falls and returns to baseline from below. This echoes Keynes (1936) argument of the possibility of a fiscal free lunch in a liquidity trap, an argument recently developed in Erceg and Linde (2014, JEEA). While the debt decomposition shows that the elevated multiplier is the primary driver of the “fiscal free lunch” compared to the flexible inflation targeting regime, the figure reveals that an AIT monetary policy strategy is associated with a very modest rise in debt service costs, and the contribution from the primary balance is also very modest.

It is important to point out that the favorable effects under an AIT strategy are sensitive to the initial inflation gap (compared to the AIT target), as well as to the inflation outlook with and without the fiscal stimulus. As we show in the Appendix B, for example, if there were no initial negative AIT gap to make up for and/or inflation quickly reverted to back target, the AIT strategy would have a much more limited impact on debt dynamics.

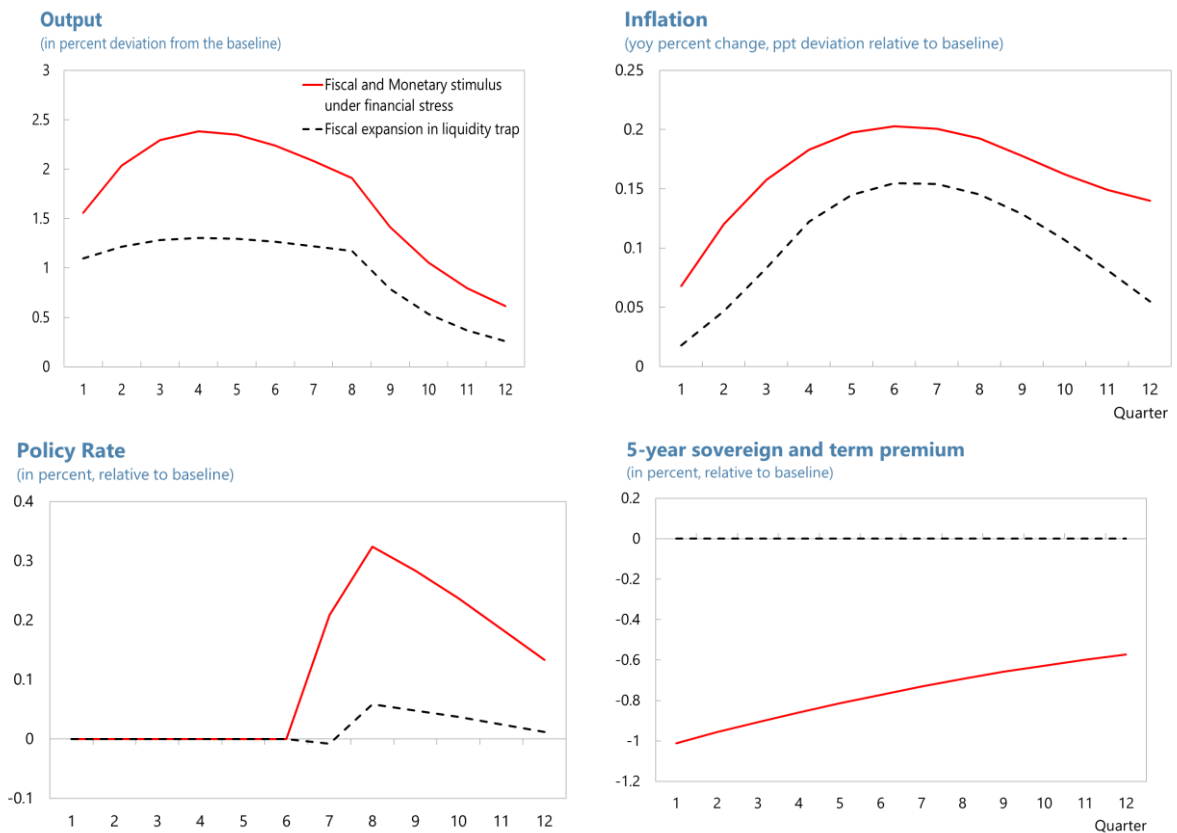
III.4 Credible Monetary and Fiscal Stimulus with Financial Stress

As a final experiment, we study the effects of monetary and fiscal stimulus when financial stress driven by non-fundamental factors causes domestic long-term interest rates to rise well above the long-term foreign rates. The financial market turbulence driven elevated spreads cause an even deeper contraction in output compared to the baseline simulation in Figure 2 and drag inflation even deeper below the central banks’ inflation target for a protracted period. Against this background, the central bank undertakes large scale asset purchases to ease domestic financial conditions and thereby leans also help nudge inflation closer to target. The asset purchases reduce the 5-year term-premium on domestic bonds as shown in Figure 4 (spreads fall are 100 basis points lower). This stimulates investment and consumption and causes inflation to rise relative to baseline. In addition, a credible commitment to maintain an expansionary short-term monetary policy stance (although we here do not assume AIT policy) contains expectations of an early policy rate lift-off from the ELB.

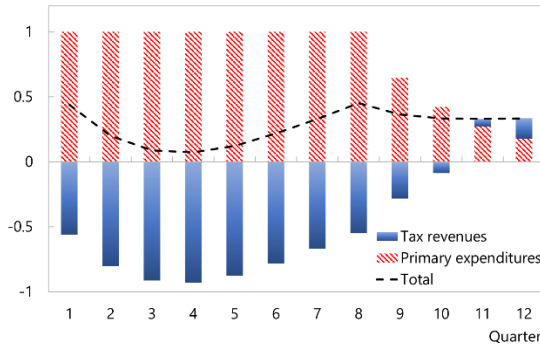
By easing financial conditions and stimulating nominal output, expansionary monetary policy helps to put debt onto a more sustainable path and enhances the effectiveness of a credible short-lived fiscal stimulus plan shown in the simulation in Figure 6. Specifically, the simulation assumes the same fiscal spending as in Figure 4 (reported as the dashed black line in Figures 4 and 6), but thanks to QE, the output expansion in Figure 6 is almost twice as large as in Figure 4. This is due to the favorable feedback effects of credible expansionary monetary and fiscal policies. It is important to note that, while the primary deficit rises somewhat due to higher government spending, government debt as a share of GDP falls since nominal GDP rises.

Hence, while the outlook may appear dire in a recessionary scenario with global financial stress, decisive and credible actions by the central bank to fulfill its flexible inflation targeting mandate can ease financial tensions and put the economy back on a sustainable path and thereby avoid self-fulfilling expectations of material sovereign default risk, provided that the government is fully committed to put its fiscal accounts in order.

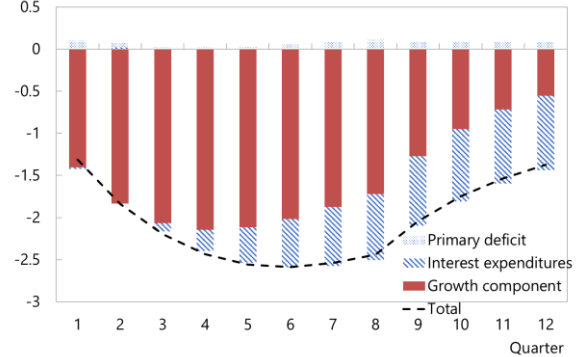
Figure 6. Credible monetary and fiscal stimulus at the ELB under financial market stress



Primary deficit under fiscal and monetary stimulus under financial stress (percentage of GDP relative to baseline)



Fiscal and monetary stimulus under financial stress (percentage of GDP relative to baseline)



IV. COUNTRY-SPECIFIC CONSIDERATIONS – CASE STUDIES

IV.1 Context

The modeling exercise (Section III) illustrates the benefits of greater interaction, which are particularly large when constraints on policies are frequently binding. For example, in a severe recession scenario, higher government consumption can crowd in investment when monetary policy is at the ELB. Likewise, when sovereign bond yields increase due to concerns about the fiscal outlook, the central bank can help ease financial conditions and thereby support output and bring back inflation to target. Yet, it is important to recognize that such interaction also bears risks. Greater fiscal-monetary interaction could have adverse consequences if implemented inappropriately, including by putting at risk the independence of the central bank. Such risks are likely to vary across countries depending on the credibility of the institutional frameworks and other country-specific factors.

This section takes a detailed look into the policy response to the COVID-19 pandemic of five countries, with a focus on fiscal and monetary policy as well as the interaction between the two policy levers. The set of countries covers several regions and comprises two AEs—Belgium and Iceland—and three EMs—Botswana, South Africa, and Thailand.¹¹ We briefly present the countries’ monetary policy framework and pre-pandemic macroeconomic environment, and then delve into the impact of the pandemic and the main elements of the policy mix. For each case study country, we analyze fiscal-monetary interaction in the country-specific context and contrast the findings with the prescription based on general considerations reflecting model implications, output, inflation, and policy constraints. It is important to note that the case studies are illustrative of our proposed approach to take country-specific circumstances into account and are not meant to represent specific views on these countries. In addition, these case studies were undertaken as of mid-2021 and the assessment might not apply to a different economic environment.

The case studies show that on several occasions, the pursuit of fiscal-monetary interaction during the COVID-19 crisis was warranted, supported by both general considerations and country-specific characteristics, although in one case, the case for greater interaction was limited a few months into the

¹¹ We thank the Belgium, Botswana, Iceland, South Africa, and Thailand teams for valuable feedback and comments.

pandemic. Sometimes, greater use of interaction would have been warranted, however, the case studies highlight that certain risks limited the use of such policies. Table 1 presents an overview of these findings.

IV.2 Monetary Policy Frameworks

Our selected case study countries have monetary policy frameworks focused on achieving price stability as a primary objective. Belgium has been a member of the euro area monetary union since 1999. The European Central Bank (ECB) focuses on economic conditions in the monetary union, with the objective of maintaining euro area “inflation rates below, but close to, 2 percent over the medium term”¹² Although the weight given to Belgium’s macroeconomic situation in the ECB’s monetary policymaking may be relatively small, its economic cycle is highly correlated with that of the group of 19 countries in the euro area. As a result, the ECB’s conduct of monetary policy has been roughly consistent with Belgium’s cyclical and inflation developments. The Central Bank of Iceland (CBI) adopted an inflation target of 2.5 percent in 2001. With the move to inflation targeting, it also abolished its former focus on the exchange rate.

The South African Reserve Bank (SARB) and the Bank of Thailand (BoT) were among the first EMs to adopt inflation targeting regimes in 2000 with current target ranges of 3-6 percent and 1-3 percent, respectively. The SARB has publicly expressed its preference for inflation and inflation expectations to durably move toward 4.5 percent over time. In June 2021, the governor suggested that there may be a case for reducing the inflation target.¹³ The BoT emphasized that its inflation targeting regime was flexible and suitable to achieve multiple objectives. The Bank of Botswana’s (BoB) primary objective is price stability, defined as inflation between 3-6 percent. It has also maintained a stable real exchange rate against a basket of the South African rand and the SDR.

IV.3 Pre-Crisis Economic Environment and Impact of the COVID-19 Pandemic

The case study countries experienced different macroeconomic environments in the years leading to the pandemic. Belgium and Iceland saw stable growth and improving or sound policy buffers. Although Belgium faced a long-standing trade-off between the need to protect fiscal space and the desire to support the economy, debt had been on a declining path reaching 98 percent of GDP in 2019.¹⁴ Inflation fell to 1.5 percent on average since the global financial crisis and growth—although modest—remained robust averaging 1.4 percent over 2010-2019. As the monetary policy rate approached its ELB, the ECB resorted to unconventional strategies, including various asset purchasing programs.¹⁵ In Iceland, inflation remained close to target prior to the COVID-19 pandemic and inflation expectations were anchored, supported by the inflation targeting framework. Growth was robust, averaging just over 4 percent during 2013-2019. Heading

¹² See [European Central Bank](#).

¹³ See [South African Business Times](#).

¹⁴ IMF (2020b), which models this tradeoff explicitly, found a strong leaning toward too loose fiscal stances for 25 years. Pre-pandemic, IMF (2020b) estimates that the country’s primary (structural) balance should be increased by 1.5 percent (0.75 percent) of GDP by 2025, to bring debt to around 90 percent of GDP. At the same time, the response of fiscal policy to real shocks appears weak, with no association between changes in output gaps and changes in the structural primary balance between 1995 and 2018.

¹⁵ Quantitative easing started after the global financial crisis as the ECB sought to unfreeze credit markets. With the unfolding of the European sovereign debt crisis, the ECB’s unconventional policy measures aimed to improve monetary transmission through a flexible approach to asset purchases that reduced disparities in financing conditions among different euro area countries. Post the debt crisis, quantitative easing continued to fight the risk of deflation in the euro area. The public sector component of the asset purchasing program, which started in 2015, was gradually unwound before the pandemic but resumed in 2020.

into 2020, Iceland maintained favorable domestic and external positions and had gained abundant policy space. Public debt amounted to about 66 percent in 2019 whereas the policy rate stood at 3 percent at end-2019.

Botswana had relatively strong policy buffers despite its challenging external environment and slowing growth potential prior to the COVID-19 pandemic. While the fiscal deficit widened over 2017-2019, gross public debt remained broadly stable due to buffers and financing from exceptional revenue from the BoB. Headline and core inflation remained at the lower end of the target range amid foreign exchange interventions to stabilize the real exchange rate. Inflation expectations were anchored around the midpoint of the target range. As of end-2019, the policy rate stood at 4.75 percent. Similarly, Thailand built sizeable fiscal and external buffers prior to the pandemic despite slowing growth driven by low productivity growth and capital accumulation, high household indebtedness and weak social safety nets. Demand was weak, putting downward pressure on inflation and inflation expectations, which declined below the lower end of the target band. The policy rate stood at 1.25 percent at end-2019, well below other EMs. The government's long-standing commitment to prudent fiscal policy contributed to a low level of government debt—around 40 percent of GDP—thereby providing some fiscal space as the pandemic hit.

South Africa's economic conditions were fragile prior to the COVID-19 pandemic. Real GDP almost stagnated and per-capita GDP growth remained negative for a fifth consecutive year in 2019, dampened by structural rigidities in product and labor markets. Low growth and elevated fiscal deficits eroded fiscal space and public debt was on a rising trajectory. Large current account deficits were mainly financed by nonresident portfolio investment, particularly through local currency government bonds that offered attractive real yields above many EM counterparts. Central bank official reserves were relatively low. On a positive note, inflation was stable within the official target range and inflation expectations remained well anchored. The policy rate stood at 6.5 percent at end-2019.

The pandemic introduced new challenges on the macroeconomic front, affecting growth severely. Output gaps turned negative, and the magnitude of the economic contraction was similar across countries. Inflation developments, in contrast, were somewhat heterogeneous (Figure 7). In Belgium, GDP fell by 6.3 percent in 2020, in line with the euro area average. Inflation dropped to 0.4 percent on the back of weak demand and lower energy prices while the current account turned to a small deficit of 0.2 percent of GDP. Growth also took a significant hit in Iceland with output falling by 6.5 percent in 2020, primarily due to the collapse in global tourism. The current account surplus declined to 0.9 percent, as services exports plunged. Relative to end-2019, the currency depreciated by well over 10 percent against the euro following the onset of COVID, which contributed to a rise in average inflation above the 2.5 percent target to 2.9 percent in 2020.

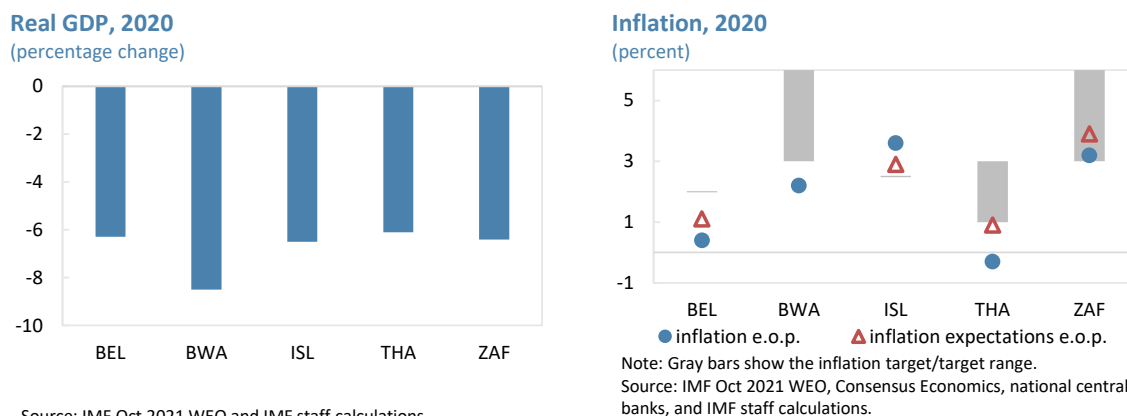
The EMs analyzed also experienced large economic contractions. Botswana's economy saw an unprecedented contraction of 8.5 percent in 2020 due to necessary containment measures and weak external demand. The current account deficit deteriorated to over 10 percent of GDP, with a drop in diamond exports and tourism receipts. Foreign exchange reserves declined amid portfolio outflows in 2020Q2-Q3 but remained above adequate levels.

In South Africa, real GDP contracted by 6.4 percent in 2020, the steepest decline since 1946. Annual average inflation declined to 3.3 percent—around the lower end of the target range. The current account balance recorded a surplus, driven mostly by a large import contraction, but also strong agricultural and commodity exports. Global market jitters prompted sharp capital outflows and currency depreciation. The economy experienced its largest nonresident portfolio outflows since the mid-1990s. Relative to end-2019,

the currency depreciated by nearly 40 percent against the U.S. dollar—to an unprecedented low—in early April 2020. Asset price selloffs were likely exacerbated by sovereign credit downgrades to sub-investment grade by Moody’s in March.¹⁶ Reflecting the long-standing policy of letting the rand float freely, official reserves fell only moderately.

In Thailand, real GDP contracted by 6.1 percent in 2020, the country’s largest contraction since the Asian crisis. The tourism sector—accounting for more than 15 percent of GDP and a key driver of employment—suffered a particularly large decline. Headline inflation entered negative territory, decelerating to -0.9 percent in 2020, well below the BoT’s target range, amid a combination of sluggish demand, both domestic and external, and low commodity prices. However, inflation expectations were still within the BoT’s target range. The current account surplus narrowed, reflecting the dramatic impact of the pandemic on tourism. Despite the large economic contraction, external pressures were limited. While portfolio flows declined during the initial phase of the pandemic, they fully recovered by end-2020.

Figure 7. Impact of the pandemic on output and inflation



IV.4 Fiscal-Monetary Policy Mix

The fiscal-monetary policy mix varied substantially across the case study countries. While all of them had elevated gross financing needs resulting in larger deficits and an increase in public debt, countries faced different fiscal and monetary policy constraints and macroeconomic challenges, in turn necessitating varying degrees of interaction. In some countries, neither fiscal policy nor monetary policy were constrained (Botswana, Iceland), while in others only one policy lever faced constraints (Thailand), or constraints were common across both policies (Belgium, South Africa).

Belgium

Despite constraints, Belgium’s fiscal response was strong, with fiscal support measures amounting to about 5 percent of GDP in 2020.¹⁷ Debt jumped by 16 percentage points to 114 percent of GDP in 2020 (Figure 8). The ECB’s monetary policy—even though appropriately focused on euro area wide considerations—was instrumental in providing much needed fiscal space in response to the pandemic.

¹⁶ Nonresident outflows after South Africa had been removed from a global local currency sovereign bond index were not as large as expected due in part to a delay in index rebalancing following the exclusion.

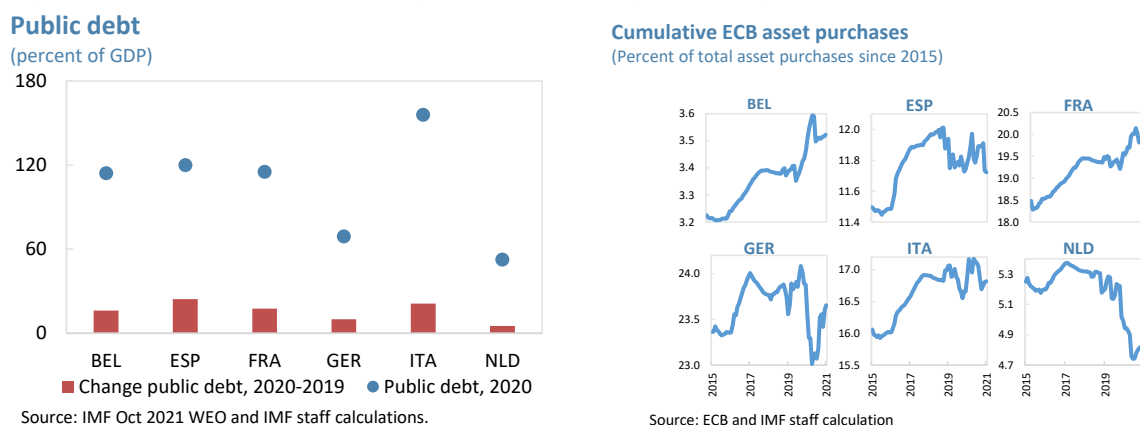
¹⁷ This figure excludes equity injections and guarantees.

Despite the large increase in debt, the government's interest bill declined slightly in 2020. In 2021, interest expenses fell further as average yields had fallen.

Prior to the pandemic, the ECB policy rate had already approached the ELB, with a rate of zero from 2016 onwards. To respond to the crisis, the ECB increased the scale of quantitative easing under the Pandemic Emergency Purchase Program (PEPP). Liquidity in bond markets was preserved and inflation stayed above zero in 2020, at 0.3 percent in the euro area and 0.4 percent in Belgium. Data on ECB purchases of sovereign bonds show that the ECB's purchases of Belgian government bonds over 2015-20 were significant and that the share of Belgian assets in the ECB's purchases remained relative stable (Figure 8). Crucially, the scale of the asset purchase program in the secondary market was significant in terms of Belgium's refinancing needs. In 2020, ECB net purchases of Belgian government debt (only authorized in the secondary market) were equivalent to around 80 percent of net debt issued by the Belgian government in the primary market.

Considering the macroeconomic environment and policy space constraints, both general considerations based on model implications and the case study suggest that asset purchases were warranted in Belgium. ECB monetary played a crucial role in providing fiscal space and allowed Belgium to deploy a countercyclical response to the COVID shock. Nevertheless, the favorable impact of ECB monetary policy on fiscal space could reverse in the future if interest rates increase.

Figure 8. Public debt and asset purchases in Belgium and peer countries.



Botswana

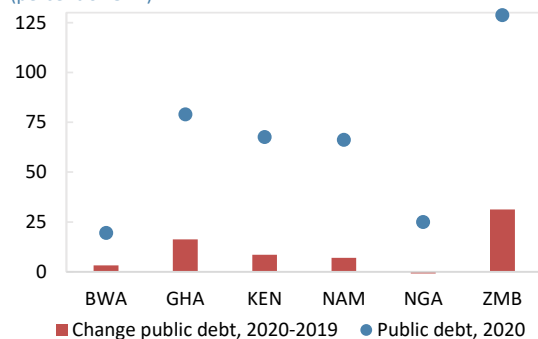
In Botswana, the government initially implemented a 2.6 percent of GDP stimulus package.¹⁸ In addition, it provided a supplementary budget and a loan facility together amounting to 1.3 percent of GDP. The deficit was financed partially by drawing down on the Government Investment Account. In addition, domestic debt issuance increased by about 3 percent of GDP whereby 10Y government bond yields remained below 6 percent in 2020. In the first half of 2021, yields headed slightly higher amid rising U.S. Treasury yields. Public debt increased by 3.2 percent of GDP to 19.5 percent in FY2020 but remained well below the country's debt ceiling of 40 percent (Figure 9).

Figure 9. Public debt and monetary policy rate in Botswana and peer countries.

¹⁸ The stimulus package includes forgone revenue, accelerated spending, and loan guarantees.

Public debt

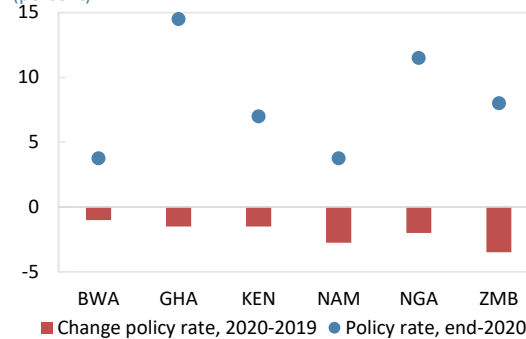
(percent of GDP)



Source: IMF Oct 2021 WEO and IMF staff calculations.

Monetary policy rate

(percent)



Source: Haver, national central banks, and IMF staff calculations.

The BoB cut the policy rate in two steps by 100 bps to a record low of 3.75 percent between April and October 2020 (Figure 9). The policy rate adjustment was consistent with the fixed exchange rate regime in light of SARB's monetary loosening during the same period. Moreover, the BoB moved the crawl rate to further contribute to the easing of real monetary conditions. Reducing the reserve requirement ratio, extending the maturity of repo operations, and broadening the collateral framework also contributed to a looser monetary policy stance. Despite the accommodative monetary policy stance, as well as domestic price increases reflecting higher public sector wages driven by the fiscal expansion, inflation dropped to 1.9 percent in 2020 amid lower oil prices and reduced aggregate demand.

Applying general considerations reflecting model implications on fiscal-monetary interaction to the Botswana case suggests the implemented policy mix was suitable to support the economy during the pandemic and the recovery. The case study attests this finding. Market conditions remained favorable, reflecting Botswana's low debt and investment grade rating for both foreign and domestic currency bonds. While there was room for fiscal and monetary policy to independently provide further stimulus even in a downside scenario, closer interaction could be considered under exceptional circumstances. The secondary market is still underdeveloped, providing limited options for BoB asset purchases. However, in a downside scenario with severe market dysfunction, the BoB could consider temporary government asset purchases, including on the primary market¹⁹—to be repaid within six months—as stipulated in the BoB Act. This option has not been exercised in the past, and therefore if made use of, should be accompanied by clear communication on the purpose and tenure of the policy, to maintain policy credibility.

Iceland

Policy buffers provided space for a large fiscal response to the COVID shock. Fiscal support measures amounted to 6.6 percent of GDP in 2020²⁰ and public debt increased to around 77 percent of GDP in 2020, from 66 percent in 2019 (Figure 10). The relatively shallow domestic bond market initially experienced some uncertainty as the COVID shock hit. Subsequently, government bond yields rose gradually.

In March 2020, the CBI announced an asset purchase program to support financial market confidence in anticipation of a rapid increase in government debt issuance. The program was authorized for up to 5 percent of GDP (ISK150 billion), broadly in line with announced purchases in Canada, Israel, and Sweden. The CBI announced that it would give "particular consideration [...] to the market effects that the

¹⁹ Temporary credit facilities to lend to the government are limited to 5 percent of the government's average annual ordinary revenues over three years according to the BoB Act.

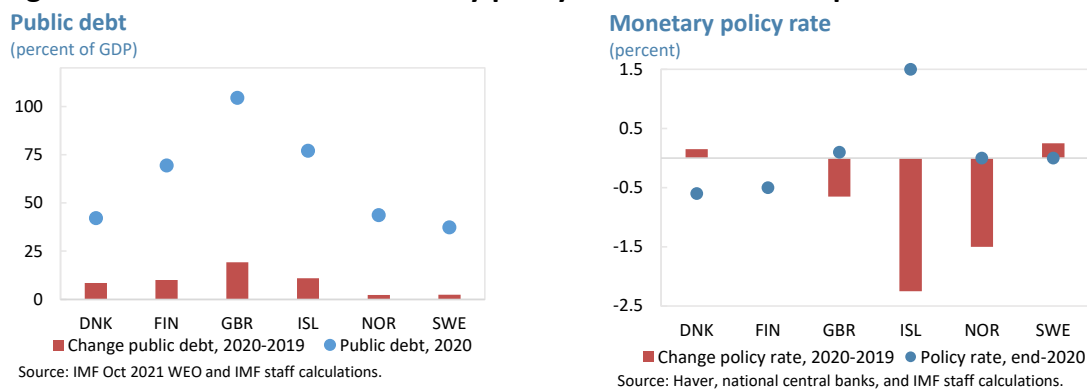
²⁰ This excludes tax deferrals, state guarantees, and pension withdrawals.

foreseeable increase in Treasury bond supply will have on monetary policy transmission”.²¹ The CBI thus clearly described the objectives of the program in the context of achieving its monetary policy objectives and ensuring that government bond issuance did not affect them unduly.

The CBI’s government bond purchases were limited, however. Only one percent of the total envelope had been used five months after the program was announced. While government bond yields declined in the period immediately following the announcement, in the second half of 2020, there was a gradual increase in the spread between long-term interest rates and the policy rate, as issuance increased domestically and abroad. The 10-year government bond yield slightly increased up from a low of 2.6 percent in June 2020 to 3 percent in July 2021. Separately, the government issued a seven-year 750mn Eurobond in January 2021 at a yield of 0.1 percent, reflecting the authorities’ strategy to diversify financing. From the standpoint of monetary policy, this reduced somewhat the upward pressure on domestic long-term interest rates and alleviated to some extent the need to pursue a more aggressive asset purchase program policy.

Sufficient policy space and inflation above target limited the case for FMI in Iceland and greater use of the asset purchase program would not have appeared warranted both based on general considerations reflecting model implications and the case study. The implemented policy mix with fiscal stimulus and an accommodative monetary policy stance were appropriate, and further data-driven adjustments of the policy mix may be needed going forward.²² Nonetheless, the authorities consider the asset purchase program to be a useful tool that should remain permanently in their policy toolkit.²³ A steepening yield curve following large issuance of government debt may tighten financial conditions markedly, or further large downside shocks could exhaust the potential monetary policy space. These situations could present an opportunity for greater interaction and necessitate the use of the asset purchase program.

Figure 10. Public debt and monetary policy rate in Iceland and peer countries.



South Africa

In South Africa, both fiscal and monetary policy space were constrained. The government implemented a fiscal package of about 5 percent of GDP, some of which was financed by a redistribution of expenditure in favor of outlays to tackle the pandemic impact.²⁴ The larger deficit lifted public debt to 69 percent in 2020, up from 56 percent a year earlier (Figure 11). The recession and capital outflows created significant

²¹ See [CBI](#).

²² The CBI hiked the interest rate by 25bps to 1 percent in May 2021.

²³ See Iceland [2021 Article IV consultation](#).

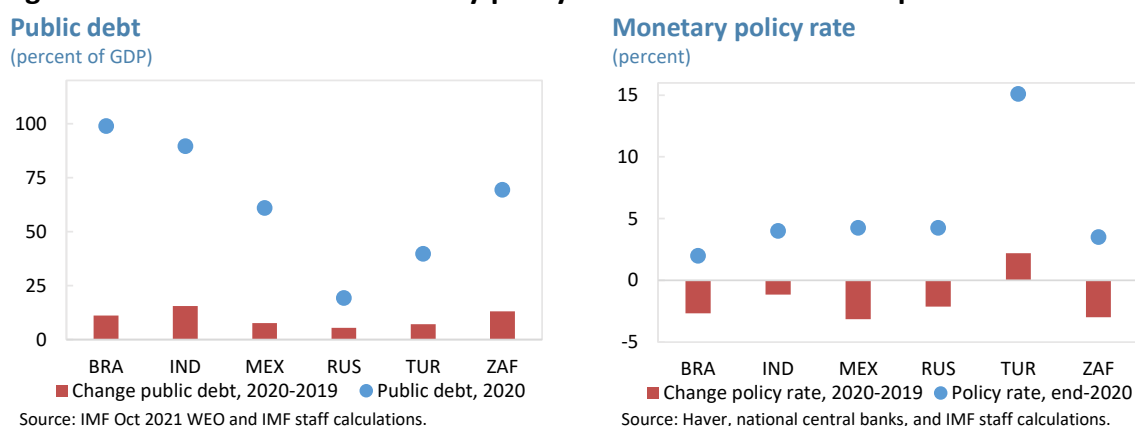
²⁴ This figure includes disbursements under the National Treasury guaranteed SARB loan guarantee scheme.

financing needs, which were primarily met by domestic investors and, to a smaller extent, lending from IFIs. The SARB progressively cut the policy rate by 275 basis points between March and July 2020, more than many other EMs, to a historic low of 3.5 percent (Figure 11).²⁵ It also eased liquidity conditions in the financial system by increasing the number of repo auctions, raising the size of refinancing operations, and adjusting the standing facility lending and borrowing rates.

As part of the COVID emergency measures, the SARB launched a government bond purchase program to ensure proper functioning of domestic financial markets. As nonresident investors held a large share of local currency government bonds, their departure pushed up local bond yields sharply, considerably tightening liquidity conditions in the domestic interbank market. When domestic bond markets experienced challenges in late March 2020, the central bank announced the purchase of government securities in the secondary market. The SARB noted that the program’s objective was to provide market liquidity and promote a smooth functioning of the domestic financial market, and that it was not designed for economic stimulus purposes. The SARB did not announce the scope and time horizon of the purchases. As of end-December 2020, total government securities purchases since the beginning of the program stood at about 1.5 percent of GDP. While the program was smaller than those implemented in many other EMs, it sent a strong signal that the SARB stood ready to smooth undue volatility in the government bond market.²⁶ The 10-year government yield eased back to around 9 percent in April 2021 from its peak of above 12 percent at the height of the pandemic.

Some voices called for more government bond purchases but these proposals were not heeded by the SARB. The governor warned that “...the domestic currency will no longer be issued by a credible, inflation-targeting central bank, but by one that is fully financing the public sector instead”. He also argued that a larger scale asset purchase program “would imply that the SARB would be buying, more or less, all new debt for the foreseeable future” and that “such interventions would crowd pension funds and other institutional investors out of the bond market”.²⁷

Figure 11. Public debt and monetary policy rate in South Africa and peer countries.



In the face of a sluggish recovery and inflation below target, general considerations based on model implications suggest that interaction between fiscal and monetary policy could have benefitted the economy. The case study, however, takes into consideration that monetary policy was constrained by

²⁵ Real rates relative to inflation expectations had fallen to similar levels in the early-2000s.

²⁶ Program size as reflected by holdings in 2020 less 2019.

²⁷ See BIS central bankers’ speeches.

fiscal risk. Upside inflationary risks stemming mainly from a potentially large currency depreciation should fiscal risks materialize constrained further monetary policy easing. Greater interaction—in the form of further conventional or unconventional monetary easing—would therefore not have been warranted. The accommodative monetary policy stance, with the negative real policy rate significantly below the estimated neutral real rate of around 2 percent, was appropriate. A favorable sovereign debt composition, including long average maturities, provides a source of resilience in the near term. In the medium term, debt sustainability concerns need to be addressed through fiscal consolidation supported by the implementation of structural reforms to boost growth.

In a situation of acute stress in the government bond market, additional asset purchase programs in the secondary market by the SARB could be considered to normalize market liquidity conditions while paying attention to any potential negative effects. Such interventions should also consider potential adverse effects on price stability and central bank credibility, especially given elevated fiscal risk. In particular, the SARB should continue to avoid direct financing of government deficits to preserve its hard-won monetary policy credibility.

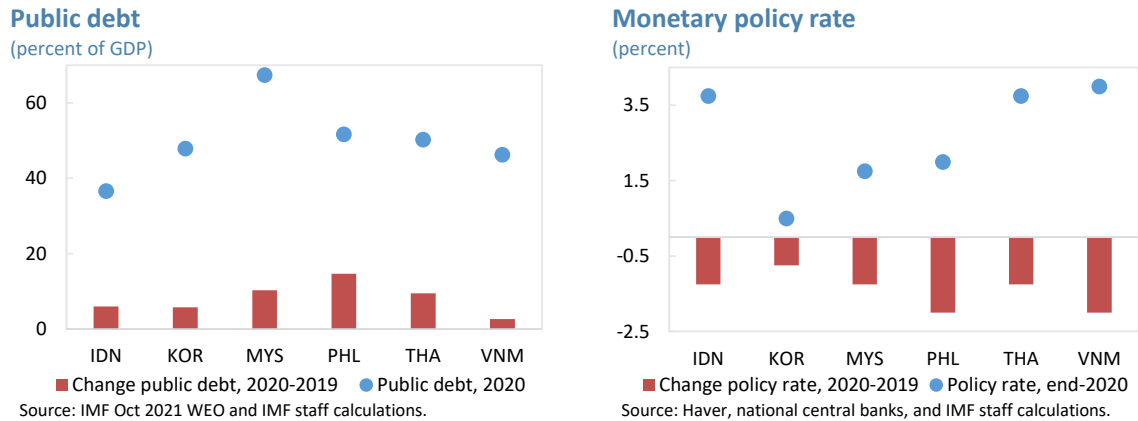
Thailand

In Thailand, sizable fiscal space allowed for a strong response. The authorities launched a large fiscal package of 8 percent of GDP, financed mostly by domestic debt issuance and some expenditure reprioritization.²⁸ Public debt increased from 41 percent in 2019 to almost 50 percent of GDP in 2020 but remained below the 60 percent of GDP debt ceiling (Figure 12). The 10-year government bond yield remained low at about 1.3 percent in 2020, reflecting a low level of government debt and a large domestic investor base. Nonetheless, the spread over the policy rate increased and widened further in April 2021, pushing yields to 1.7 percent amid increasing U.S. 10-year treasury yields and generalized global fears of accelerating inflation.

The BoT cut the policy rate by a cumulative 75bps between February and May 2020 to a historic low of 0.5 percent, but monetary policy transmission was constrained (Figure 12). Despite a loosening of the monetary policy stance, bank lending to SMEs declined, reflecting concerns about credit risk—which had increased due to the impact of lockdown measures on the sector—and tighter lending standards implemented by banks. To address limitations in monetary policy transmission, the authorities launched credit guarantees and provided on-lending through both state-owned and private banks at favorable rates. In March 2020, the BoT also purchased government assets equivalent to 0.6 percent of GDP to support bond market functioning.

²⁸ This figure excludes equity injections, loans, asset purchases, debt assumptions, guarantees, and quasi-fiscal measures.

Figure 12. Public debt and monetary policy rate in Thailand and peer countries.



Some fiscal space in combination with constrained monetary policy presented an opportunity for more accommodation and closer interaction both under general considerations reflecting model implications and according to the case study. Provision of government guarantees for loans was key to enhancing monetary policy transmission and channeling liquidity to the private sector during a period of elevated uncertainty. In addition, fiscal policy could also play an important role in boosting demand without creating financial stability risks—which feature prominently in the BoT’s objective function—and overburdening monetary policy. In a downside scenario with financial market stress, an asset purchase program could counter market pressures, support fiscal policy by avoiding surges in government borrowing cost amid elevated gross financing needs, ease financial conditions for households and firms.²⁹ If credible, further asset purchases could be coupled with forward guidance on the evolution of policy support.

Table 1. Overview of findings from general considerations reflecting model implications and case studies under a mid-2021 baseline.

Country	General considerations	Output gap negative	Inflation below target	Fiscal policy constrained	Monetary policy space constrained	Elevated gross financing needs
Belgium		Y	Y	Y	Y	Y
	Assessment: asset purchases warranted					
	Country-specific considerations					
Botswana		Y	N	N	N	Y
	Assessment: asset purchases not warranted					
	Country-specific considerations					
Iceland		Y	N	N	N	Y
	Assessment: asset purchases not warranted					
	Country-specific considerations					

²⁹ A discussion on the modalities of asset purchases is beyond the scope of this work. See the [2021 Thailand AIV Consultation](#) for an analysis of modalities for asset purchases in Thailand in a downside scenario.

South Africa	<ul style="list-style-type: none"> Moderate public debt (compared to peers) Policy rate not at the ELB but inflation above target 				
	Assessment: further asset purchases not warranted (but useful policy tool)				
	General considerations				
	Output gap negative Y	Inflation below target N	Fiscal policy constrained Y	Monetary policy space constrained Y	Elevated gross financing needs Y
Assessment: asset purchases warranted					
Thailand	Country-specific considerations				
	<ul style="list-style-type: none"> High public debt and credit rating downgrade reduce fiscal space Concerns over fiscal risks constrain monetary policy space 				
	Assessment: further asset purchases not warranted due to risks				
	General considerations				
	Output gap negative Y	Inflation below target (Y)	Fiscal policy constrained N	Monetary policy space constrained Y	Elevated gross financing needs Y
	Assessment: further fiscal support/credit guarantees warranted				
Country-specific considerations					
<ul style="list-style-type: none"> Long-standing fiscal discipline, low borrowing costs, and large domestic investor base generate fiscal space Fiscal policy can support aggregate demand without creating financial stability risks and can support monetary policy transmission 					
Assessment: further fiscal support/credit guarantees warranted					

V. CONCLUSIONS

The scope and the scale of the COVID crisis intensified a preexisting debate on the appropriateness of the strict separation of macroeconomic policies. The unprecedented economic impact from COVID has required a large scale of fiscal and monetary support to protect the welfare of households and businesses. In turn, the reduction in conventional policy space has led to a rethink of the interactions and role of monetary and fiscal policy. We argue that in some cases, close fiscal policy and monetary policy interactions can help countries improve the tradeoffs each policy faces

Our relatively conventional macro model, coupled with several scenarios for policy rules and framework, shows that macroeconomic policy objectives can be achieved more quickly by leaning on forceful interactions of policy. For instance, quantitative easing can help moderate financial-turbulence driven increases in sovereign spreads and may thus create space for fiscal policy action, as long as fiscal policy ensures that debt is sustainable. Furthermore, a more active role for fiscal policy, despite somewhat conservative assumptions on the effects of government spending on private sector productivity, is particularly powerful in output stabilization when monetary policy is constrained. As an aside, average inflation targeting in economies with credible monetary-fiscal frameworks can reinforce the effect of fiscal policy, providing another lever to counter negative demand shocks and achieve superior results to the traditional setup. An additionally important lesson from the model-based analysis is that it is key to size the fiscal stimulus properly; the central bank can only accommodate expansionary fiscal policy as long as it does not overheat the economy and drives inflation above the central banks target.

In practice, we have seen that countries' ability to leverage closer interactions differs significantly. A selection of diverse case studies therefore highlighted this variety of practical factors that may alter the baseline results from the model. We argued that the case for closer interactions of policies has depended crucially on each country's institutional setup, history of inflation and (in)stability, the pre-pandemic economic environment and the macroeconomic effect of the pandemic. While the fiscal-monetary mix

varied substantially across the cases considered, all faced elevated gross financing needs and were confronted with trade-offs in terms of the interactions of policies.

The analysis of the policy interactions considered in both the model and the case studies is generally more advanced in high-income countries. Many central banks in AEs had already reduced their policy rate to the ELB in the aftermath of the GFC. Many of those central banks embarked on unconventional measures such as asset purchases before the COVID crisis. However, constraints on both monetary and fiscal policy have become binding for an increasing number of countries, further necessitating studies of the interaction of decisions made by fiscal and monetary authorities.

It is not the case, however, that all countries should aim to exploit greater interactions across policies. There are clear risks associated with greater interactions between monetary and fiscal authorities. These include the potential for asset purchase programs being perceived to be inconsistent with central bank price stability mandate, which would in turn introduce the risk of adverse and sudden market reactions, particularly in EMs. As discussed in the case studies, institutional credibility is important to avoid bold policies feeding directly through to prices and to achieve material benefits for the real economy. This in turn underscores the importance of safeguards to mitigate gaps in the existing institutional framework if authorities decide to pursue greater interaction.

This paper provides some initial thinking on this very complex topic. There are many important considerations that are beyond the scope of this paper. These include the specific modalities of an effective fiscal-monetary mix, interactions between monetary and fiscal policies during normal times outside of recessions, interaction of fiscal and monetary policy with other policy levers such as macroprudential policies, and the dynamic effect of interactions on institutional credibility. Furthermore, the appropriate response depends on the type of shock encountered. In our case, the downward pressure on both prices and activity point to the same need for support but, conversely, a scenario with growth and inflation going in opposite directions would present a more challenging trade-off for policies.

Of particular interest in future work would be to analyze the effective fiscal-monetary policy mix when adverse supply disruptions cause inflation to surge well-above the central banks' target and output to fall below potential. In this case, if the treasury can deploy policies which have supply side effects this can ease the trade-off faced by the central bank. Even so, given that many countries have elevated levels of government debt following the COVID pandemic, it may be beneficial – at least a from public finance perspective – to fight such a surge in inflation with a mix of tight fiscal policy and loose monetary policy rather to let fiscal policy remain expansionary and rely on the central bank to tighten financial conditions to bring back inflation to target. A full assessment of the pros and cons of alternative policy mixes under these circumstances is the topic of another paper. Nonetheless, we believe our paper provides a step in introducing a simple and unified framing for considering the case for closer interactions between monetary and fiscal policies in recessions.

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Appendix A. The Open Economy DSGE Model

The open economy model closely follows the Erceg and Lindé (2013) variant of the Erceg, Guerrieri and Gust (2006) SIGMA model. The main difference w.r.t. to Erceg and Linde, is that we allow for discounting in the pricing bloc to address the forward-guidance puzzle (see Del Negro, Giannoni and Patterson, 2015) by making inflation and inflation expectations less sensitive to macroeconomic news, including fiscal policy changes, in prolonged liquidity traps).

The model consists of two countries (or regions) that can differ in size, and allows for endogenous investment, hand-to-mouth (HM) or Keynesian households, sticky wages as well as sticky prices, trade adjustment costs, and incomplete financial markets across the two countries. Given the isomorphic structure of the two economies in the model, our exposition below largely focuses on the structure of one of the two countries (or regions).

The model also features a financial accelerator channel which closely parallels earlier work by Bernanke, Gertler, and Gilchrist (1999) and Christiano, Motto, and Rostagno (2008). Given that the mechanics underlying this particular financial accelerator mechanism are well-understood, we simplify our exposition by focusing on a special case of our model which abstracts from the financial accelerator. However, we conclude our model description with a brief description of how the model is modified to include the financial accelerator (Section A.6).

A.1. Firms and Price Setting

A.1.1. Production of Domestic Intermediate Goods

There is a continuum of differentiated intermediate goods (indexed by $i \in [0,1]$) in each economy, each of which is produced by a single monopolistically competitive firm. In the domestic market, firm i faces a demand function that varies inversely with its output price $P_{Dt}(i)$ and directly with aggregate demand at home Y_{Dt} :

$$Y_{Dt}(i) = \left[\frac{P_{Dt}(i)}{P_{Dt}} \right]^{-\frac{(1+\theta_p)}{\theta_p}} Y_{Dt} \quad (\text{A.1})$$

where $\theta_p > 0$, and P_{Dt} is an aggregate price index defined below. Similarly, firm i faces the following export demand function:

$$X_t(i) = \left[\frac{P_{Mt}^*(i)}{P_{Mt}^*} \right]^{-\frac{(1+\theta_p)}{\theta_p}} M_t^* \quad (\text{A.2})$$

where $X_t(i)$ denotes the quantity demanded of domestic good i in the foreign economy, $P_{Mt}^*(i)$ denotes the price that firm i sets in the foreign market, P_{Mt}^* is the import price index abroad, and M_t^* is an aggregate of the economy's imports (we use an asterisk to denote the foreign country's variables).

Each producer utilizes capital services $K_t(i)$ and a labor index $L_t(i)$ (defined below) to produce its respective output good. The production function is assumed to have a constant-elasticity of substitution (CES) form:

$$Y_t(i) = \left[\omega_K^{\frac{\rho}{1+\rho}} K_t(i)^{\frac{1}{1+\rho}} + \omega_L^{\frac{\rho}{1+\rho}} (Z_t L_t(i))^{\frac{1}{1+\rho}} \right]^{1+\rho} \quad (\text{A.3})$$

The production function exhibits constant-returns-to-scale in both inputs, and Z_t is a country specific shock to the level of technology. Firms face perfectly competitive factor markets for hiring capital and labor. Thus, each firm chooses $K_t(i)$ and $L_t(i)$, taking as given both the rental price of capital R_{K_t} and the aggregate wage index W_t (defined below). Firms can costlessly adjust either factor of production, which implies that each firm has an identical marginal cost per unit of output, MC_t . The (log-linearized) technology shock is assumed to follow an AR(1) process:

$$z_t = \rho_z z_{t-1} + \epsilon_{z,t} \quad (\text{A.4})$$

The prices of the intermediate goods are determined by Calvo-style staggered contracts (see Calvo, 1983). In each period, a firm selling its goods in the domestic market faces a constant probability, $1 - \xi_{t^p}$, of being able to re-optimize its price ($P_{Dt}(i)$). This probability of receiving a signal to reoptimize is independent across firms and time. If a firm is not allowed to optimize its prices, we follow Christiano, Eichenbaum and Evans (2005) and Smets and Wouters (2003), and assume that the firm must reset its domestic price as a weighted combination of the lagged and steady state rate of inflation $P_{Dt}(i) = \pi_{t-1}^{\iota_p} \pi^{\iota_p} P_{Dt-1}(i)$ for the non-optimizing firms. This formulation allows for structural persistence in price-setting if ι_p exceeds zero.

When a firm i is allowed to reoptimize its price in period t , the firm maximizes:

$$\max_{P_{Dt}(i)} E_t \sum_{j=0}^{\infty} \psi_{t,t+j} \xi_p^j \left[\prod_{h=1}^j \pi_{t+h-1} (P_{Dt}(i) - MC_{t+j}) Y_{Dt+j}(i) \right] \quad (\text{A.5})$$

The operator E_t represents the conditional expectation based on the information available to agents at period t . The firm discounts profits received at date $t + j$ by the state-contingent discount factor $\psi_{t,t+j}$; for notational simplicity, we have suppressed all of the state indices.³⁰

The first-order condition for setting the contract price of good i is:

$$E_t \sum_{j=0}^{\infty} \psi_{t,t+j} \xi_p^j \left[\frac{\prod_{h=1}^j \pi_{t+h-1}(i) P_{Dt}(i)}{(1+\theta_p)} - MC_{t+j} \right] Y_{Dt+j}(i) = 0 \quad (\text{A.6})$$

For the goods sold abroad, we assume local currency pricing (LCP). Although the price-setting problem for the exporting firms is isomorphic to the problem for the firms selling goods on the domestic market; the LCP assumption implies that the price of foreign import goods $P_{M,t}^*$ will deviate from the producer currency price as follows (in log-linear form)

$$\delta_t^* = -p_{M,t}^* - s_t + p_{X,t} \quad (\text{A.7})$$

where $p_{X,t} = p_{D,t}$. The deviations from the law of one price are due to price stickiness for the exported goods.

A.1.2. Production of the Domestic Output Index

³⁰ We denote $\xi_{t,t+j}$ to be the price in period t of a claim that pays one dollar if the specified state occurs in period $t + j$ (see the household problem below); then the corresponding element of $\psi_{t,t+j}$ equals $\xi_{t,t+j}$ divided by the probability that the specified state will occur.

Because households have identical Dixit-Stiglitz preferences, it is convenient to assume that a representative aggregator combines the differentiated intermediate products into a composite home-produced good Y_{Dt} :

$$Y_{Dt} = \left[\int_0^1 Y_{Dt}(i)^{\frac{1}{1+\theta_p}} di \right]^{1+\theta_p} \quad (\text{A.8})$$

The aggregator chooses the bundle of goods that minimizes the cost of producing Y_{Dt} , taking the price $P_{Dt}(i)$ of each intermediate good $Y_{Dt}(i)$ as given. The aggregator sells units of each sectoral output index at its unit cost P_{Dt} :

$$P_{Dt} = \left[\int_0^1 P_{Dt}(i)^{\frac{-1}{\theta_p}} di \right]^{-\theta_p} \quad (\text{A.9})$$

We also assume a representative aggregator in the foreign block who combines the differentiated domestic products $X_t(i)$ into a single index for foreign imports:

$$M_t^* = \left[\int_0^1 X_t(i)^{\frac{1}{1+\theta_p}} di \right]^{1+\theta_p} \quad (\text{A.10})$$

and sells M_t^* at price $P_{M,t}^*$:

$$P_{M,t}^* = \left[\int_0^1 P_{M,t}^*(i)^{\frac{-1}{\theta_p}} di \right]^{-\theta_p} \quad (\text{A.11})$$

A.1.3. Production of Consumption and Investment Goods

Final consumption goods are produced by a representative consumption goods distributor. This firm combines purchases of domestically-produced goods with imported goods to produce a final consumption good (C_{At}) according to a constant-returns-to-scale CES production function:

$$C_{At} = \left(\omega_c \frac{\rho_c}{1+\rho_c} C_{Dt}^{\frac{1}{1+\rho_c}} + (1 - \omega_c) \frac{\rho_c}{1+\rho_c} (\varphi_{ct} M_{ct})^{\frac{1}{1+\rho_c}} \right)^{1+\rho_c} \quad (\text{A.12})$$

where C_{Dt} denotes the consumption good distributor's demand for the index of domestically produced goods, M_{ct} denotes the distributor's demand for the index of foreign-produced goods, and φ_{ct} reflects costs of adjusting consumption imports. The final consumption good is used by both households and by the government.³¹ The form of the production function mirrors the preferences of households and the government sector over consumption of domestically-produced goods and imports. Accordingly, the quasi-share parameter ω_c may be interpreted as determining the preferences of both the private and public sector for domestic relative to foreign consumption goods, or equivalently, the degree of home bias in consumption expenditure. Finally, the adjustment cost term φ_{ct} is assumed to take the quadratic form:

$$\varphi_{ct} = \left[1 - \frac{\varphi_{M_c}}{2} \left(\frac{\frac{M_{ct}}{C_{Dt}}}{\frac{M_{ct-1}}{C_{Dt-1}}} - 1 \right)^2 \right] \quad (\text{A.13})$$

³¹ Thus, the larger-scale model constrains the import share of government consumption to equal that of private consumption.

This specification implies that it is costly to change the proportion of domestic and foreign goods in the aggregate consumption bundle, even though the level of imports may jump costlessly in response to changes in overall consumption demand. We assume that the adjustment costs for each distributor depend on distributors' current import ratio $\frac{M_{Ct}}{C_{Dt}}$ relative to the economy-wide ratio in the previous period $\frac{M_{Ct-1}^{agg}}{C_{Dt-1}^{agg}}$ so that adjustment costs are external to individual distributors.

Given the presence of adjustment costs, the representative consumption goods distributor chooses (a contingency plan for) C_{Dt} and M_{Ct} to minimize its discounted expected costs of producing the aggregate consumption good:

$$Y_{Dt}(i) = \left[\frac{P_{Dt}(i)}{P_{Dt}} \right]^{-\frac{(1+\theta_p)}{\theta_p}} Y_{Dt} b \min_{C_{Dt+k}, M_{Ct+k}} \mathbb{E}_t \sum_{k=0}^{\infty} \psi_{t,t+k} (P_{Dt+k} C_{Dt+k} + P_{Mt+k} M_{Ct+k}) + P_{Ct+k} \left[C_{A,t+k} - \left(\omega_c \frac{\rho_c}{1+\rho_c} C_{Dt+k}^{\frac{1}{1+\rho_c}} + (1 - \omega_c) \frac{\rho_c}{1+\rho_c} (\varphi_{Ct+k} M_{Ct+k})^{\frac{1}{1+\rho_c}} \right)^{1+\rho_c} \right] \quad (\text{A.14})$$

The distributor sells the final consumption good to households and the government at a price P_{Ct} , which may be interpreted as the consumption price index (or equivalently, as the shadow cost of producing an additional unit of the consumption good).

We model the production of final investment goods in an analogous manner, although we allow the weight ω_I in the investment index to differ from that of the weight ω_c in the consumption goods index.³²

A.2. Households and Wage Setting

We assume a continuum of monopolistically competitive households (indexed on the unit interval), each of which supplies a differentiated labor service to the intermediate goods producing sector (the only producers demanding labor services in our framework) following Erceg, Henderson and Levin (2000). A representative labor aggregator (or employment agency) combines households labor hours in the same proportions as firms would choose. Thus, the aggregator's demand for each household's labor is equal to the sum of firms' demands. The aggregate labor index L_t has the Dixit-Stiglitz form:

$$L_t = \left[\int_0^1 (\zeta N_t(h))^{\frac{1}{1+\theta_w}} dh \right]^{1+\theta_w} \quad (\text{A.15})$$

where $\theta_w > 0$ and $N_t(h)$ is hours worked by a typical member of household h . The parameter ζ is the size of a household of type h , and effectively determines the size of the population in the home country. The aggregator minimizes the cost of producing a given amount of the aggregate labor index, taking each household's wage rate $W_t(h)$ as given, and then sells units of the labor index to the production sector at their unit cost W_t :

$$W_t = \left[\int_0^1 W_t(h)^{\frac{-1}{\theta_w}} dh \right]^{\theta_w} \quad (\text{A.16})$$

³² Government spending is assumed to fall exclusively on consumption, so that all investment is private investment.

The aggregator's demand for the labor services of a typical member of household h is given by

$$N_t(h) = \left[\frac{W_t(h)}{W_t} \right]^{-\frac{1+\theta_w}{\theta_w}} L_t / \zeta \quad (\text{A.17})$$

We assume that there are two types of households: households that make intertemporal consumption, labor supply, and capital accumulation decisions in a forward-looking manner by maximizing utility subject to an intertemporal budget constraint (FL households, for "forward-looking"); and the remainder that simply consume their after-tax disposable income (HM households, for "hand-to-mouth" households). The latter type receives no capital rental income or profits, and choose to set their wage to be the average wage of optimizing households. We denote the share of FL households by $1 - \zeta$ and the share of HM households by ζ .

We consider first the problem faced by FL households. The utility functional for an optimizing representative member of household h is

$$\mathbb{E}_t \sum_{j=0}^{\infty} \beta^j \left\{ \frac{1}{1-\sigma} (C_{t+j}^O(h) - \alpha C_{t+j-1}^O - C^O v_{ct+j})^{1-\sigma} + \frac{\chi_0 z_{t+j}^{1-\rho}}{1-\chi} (1 - N_{t+j}(h))^{1-\chi} + \mu_0 F\left(\frac{MB_{t+j+1}(h)}{P_{Ct+j}}\right) \right\} \quad (\text{A.18})$$

where the discount factor β satisfies $0 < \beta < 1$. As in Smets and Wouters (2003, 2007), we allow for the possibility of external habit formation in preferences, so that each household member cares about its consumption relative to lagged aggregate consumption per capita of forward-looking agents C_{t-1}^O . The period utility function depends on each member's current leisure $1 - N_t(h)$, his end-of-period real money balances, $\frac{MB_{t+1}(h)}{P_{Ct}}$, and a preference shock, v_{ct} . The subutility function $F(\cdot)$ over real balances is assumed to have a satiation point to account for the possibility of a zero nominal interest rate; see Eggertsson and Woodford (2003) for further discussion.³³ The (log-linearized) consumption demand shock v_{ct} is assumed to follow an AR(1) process:

$$v_{ct} = \rho_v v_{ct-1} + \varepsilon_{v_{ct}} \quad (\text{A.19})$$

Forward-looking household h faces a flow budget constraint in period t which states that its combined expenditure on goods and on the net accumulation of financial assets must equal its disposable income:

$$P_{Ct}(1 + \tau_{Ct})C_t^O(h) + P_{It}I_t(h) + MB_{t+1}(h) - MB_t(h) + \int_s \xi_{t,t+1} B_{Dt+1}(h) - B_{Dt}(h) + P_{Bt}B_{Gt+1} - B_{Gt} + S_t \frac{P_{Bt}^* B_{Ft+1}(h)}{\phi_{bt}} - S_t B_{Ft}(h) = (1 - \tau_{Nt})W_t(h)N_t(h) + \Gamma_t(h) + TR_t(h) + (1 - \tau_{Kt})R_{Kt}K_t(h) + P_{It} \tau_{Kt} \delta K_t(h) - P_{Dt} \phi_{It}(h) \quad (\text{A.20})$$

Consumption purchases are subject to a sales tax of τ_{Ct} . Investment in physical capital augments the per capita capital stock $K_{t+1}(h)$ according to a linear transition law of the form:

$$K_{t+1}(h) = (1 - \delta)K_t(h) + I_t(h) \quad (\text{A.21})$$

³³ For simplicity, we assume that μ_0 is sufficiently small that changes in the monetary base have a negligible impact on equilibrium allocations, at least to the first-order approximation we consider.

where δ is the depreciation rate of capital.

Financial asset accumulation of a typical member of FL household h consists of increases in nominal money holdings ($MB_{t+1}(h) - MB_t(h)$) and the net acquisition of bonds. While the domestic financial market is complete through the existence of state-contingent bonds B_{Dt+1} , cross-border asset trade is restricted to a single non-state contingent bond issued by the government of the foreign economy.³⁴

The terms B_{Gt+1} and B_{Ft+1} represent each household member's net purchases of the government bonds issued by the domestic and foreign governments, respectively. Each type of bond pays one currency unit in the subsequent period, and is sold at price (discount) of P_{Bt} and P_{Bt}^* , respectively. S_t is the nominal exchange rate. To ensure the stationarity of foreign asset positions, we follow Turnovsky (1985) by assuming that domestic households must pay a transaction cost when trading in the foreign bond. The intermediation cost depends on the ratio of economy-wide holdings of net foreign assets to nominal GDP, $P_{Dt} Y_{Dt}$, and are given by:

$$\phi_{bt} = \exp\left(-\phi_b \left(\frac{B_{Ft+1}}{P_{Dt} Y_{Dt}}\right)\right) \quad (\text{A.22})$$

If the domestic economy is an overall net lender position internationally, then a household will earn a lower return on any holdings of foreign bonds; conversely, if the domestic economy is a net debtor position, the domestic households pay a higher return on their foreign liabilities. Given that the domestic government bond in the domestic economy and foreign bond have the same payoff, the price faced by home residents net of the transaction cost is identical, so that $P_{Bt} = \frac{P_{Bt}^*}{\phi_{bt}}$. The effective nominal interest rate on domestic bonds (and similarly for foreign bonds) hence equals $i_t = 1/P_{Bt} - 1$.

Each member of FL household h earns after-tax labor income, $(1 - \tau_{Nt})W_t(h)N_t(h)$, where τ_{Nt} is a stochastic tax on labor income. The household leases capital at the after-tax rental rate $(1 - \tau_{Kt})R_{Kt}$, where τ_{Kt} is a stochastic tax on capital income. The household receives a depreciation write-off $P_{It} \tau_{Kt} \delta$ per unit of capital. Each member also receives an aliquot share $\Gamma_t(h)$ of the profits of all firms and a lump-sum government transfer, $TR_t(h)$ (which is negative in the case of a tax). Following Christiano, Eichenbaum and Evans (2005), we assume that it is costly to change the level of gross investment from the previous period, so that the acceleration in the capital stock is penalized:

$$\phi_{It}(h) = \frac{1}{2} \phi_I \frac{(I_t(h) - I_{t-1})^2}{I_{t-1}} \quad (\text{A.23})$$

In every period t , each member of FL household h maximizes the utility functional (A.18) with respect to its consumption, investment, (end-of-period) capital stock, money balances, holdings of contingent claims, and holdings of domestic and foreign bonds, subject to its labor demand function (A.17), budget constraint (A.20), and transition equation for capital (A.21). In doing so, a household takes as given prices, taxes and transfers, and aggregate quantities such as lagged aggregate consumption and the aggregate net foreign asset position.

Forward-looking (FL) households set nominal wages in staggered contracts that are analogous to the price contracts described above. In particular, with probability $1 - \xi_w$, each member of a household is allowed to

³⁴ The domestic contingent claims B_{Dt+1} are in zero net supply from the standpoint of the domestic economy as a whole.

reoptimize its wage contract. If a household is not allowed to optimize its wage rate, we assume each household member resets its wage according to:

$$W_t(h) = \omega_{t-1}^{\omega} \omega^{1-\omega} W_{t-1}(h) \quad (\text{A.24})$$

where ω_{t-1} is the gross nominal wage in inflation rate in period $t - 1$, i.e., W_t/W_{t-1} , and $\omega = \pi$ is the steady state rate of change in the nominal wage (equal to gross price inflation since steady state gross productivity growth is assumed to be unity). Dynamic indexation of this form introduces some element of structural persistence into the wage-setting process. Each member of household h chooses the value of $W_t(h)$ to maximize its utility functional (A.18) subject to these constraints.

Finally, we consider the determination of consumption and labor supply of the hand-to-mouth (HM) households. A typical member of a HM household simply equates his nominal consumption spending, $P_{Ct}(1 + \tau_{Ct})C_t^{HM}(h)$, to his current after-tax disposable income, which consists of labor income plus lump-sum transfers from the government:

$$P_{Ct}(1 + \tau_{Ct})C_t^{HM}(h) = (1 - \tau_{Nt})W_t(h)N_t(h) + TR_t(h): \quad (\text{A.25})$$

The HM households are assumed to set their wage equal to the average wage of the forward-looking households. Since HM households face the same labor demand schedule as the forward-looking households, this assumption implies that each HM household works the same number of hours as the average for forward-looking households.

A.3. Monetary Policy

The central bank is assumed to adhere to a Taylor-type policy rule subject to an effective lower bound

$$i_t = \max[i_t^{SHADOW}, -i_{ELB}],$$

where i_t is the nominal policy rate measured as deviation from the effective lower bound (i_{ELB}), and i_t^{SHADOW} is the shadow (i.e., unconstrained) policy rate which follows:

$$i_t^{SHADOW} = (1 - \gamma_i)[\gamma_\pi(\pi_{Ct} - \pi_c) + \gamma_x x_t + \gamma_{\Delta x} \Delta x_t] + \gamma_i i_{t-1}^{SHADOW} + \varepsilon_{i,t}, \quad (\text{A.26})$$

where π_{Ct} is consumer price inflation, and x_t is the model consistent employment gap, i.e., the percent deviation of actual employment from the notional level of employment that would prevail if prices and wages were fully flexible, and $\varepsilon_{i,t}$ is a monetary policy shock.

A.4. Fiscal Policy

The government does not need to balance its budget each period, and the aggregate end of period t debt D_{Gt+1} law of motion evolves according to:

$$D_{Gt+1} = P_{Ct} G_t + TR_t^O + TR_t^{HM} - \tau_{N,t} W_t L_t - \tau_{Ct} P_{Ct} C_t - \tau_{Kt} (R_{Kt} - \delta P_{It}) K_t + (1 + i_{Gt-1}) D_{Gt} - (MB_{t+1} - MB_t) \quad (\text{A.27})$$

where C_t is total private consumption and i_{Gt} is the effective interest rate on outstanding government debt. Equation (A.27) aggregates the capital stock, money and bond holdings, and transfers and taxes over all households so that, for example, $TR_t^O = \int_0^1 TR_t^O(h) dh$. The taxes on capital τ_{Kt} , consumption τ_{Ct} and labor income $\tau_{N,t}$, as well as

the ratio of real transfers to (trend) GDP to hand to mouth households, $tr_t^{HM} = \frac{TR_t^{HM}}{P_t Y}$, are also assumed to be fixed.³⁵ Government purchases have no direct effect on the utility of households, nor do they affect the production function of the private sector.

The debt accumulation equation (A.27) allows for long-term government debt following Krause and Moyen (2016).³⁶ In log-linearized form, their model implies that i_{Gt} is determined as follows. First, the effective interest rate on newly issued debt is given by,

$$i_{Gt}^{new} = \vartheta_{new} i_t + (1 - \vartheta_{new}) E_t i_{Gt+1}^{new},$$

where $\vartheta_{new} = (i + \vartheta)/(1 + i)$ and ϑ is the probability of the stochastic bond maturing in the next quarter and i is the steady state short-term nominal interest rate. Now, the debt stock is only gradually maturing, so the effective interest rate on the debt stock is only gradually updated according to

$$i_{Gt} = \vartheta_{long} i_{Gt}^{new} + (1 - \vartheta_{long}) i_{Gt-1},$$

where $\vartheta_{long} = 1 - (1 - \lambda)/(1 + \pi)$ which approximatively equals λ when π is low (we have $\pi = 0.005$ in our calibration). Notice that this approach allows us to nest a framework with one-period debt by setting $\lambda = 0$, since then i_{Gt} equals i_t .

The process for the (log of) government spending is given by an AR(1) process:

$$(g_t - g) = \rho_g (g_{t-1} - g) + \varepsilon_{g,t}; \quad (\text{A.28})$$

where $\varepsilon_{g,t}$ is independently normally distributed with zero mean and standard deviation σ_g .

We assume that policymakers adjust the labor income tax rate to stabilize the debt/GDP ratio and the deficit, according to:

$$\tau_{N,t} - \tau_N = v_1 (\tau_{N,t-1} - \tau_N) + (1 - v_1) [v_2 (d_{Gt} - d_G) + v_3 (\Delta d_{Gt+1} - \Delta d_{Gt})], \quad (\text{A.29})$$

where $d_{Gt} = D_{Gt}/(4\bar{P}_t Y)$, i.e. government debt as a share of annualized nominal trend output.

A.5. Resource Constraint and Net Foreign Assets

The domestic economy's aggregate resource constraint can be written as:

³⁵ Given that the central bank uses the nominal interest rate as its policy instrument, the level of seigniorage is determined by nominal money demand.

³⁶ The central element of their approach is an approximation of the maturity structure of public debt in terms of a stochastic, long-term, government bond. Each period, an individual bond of this type pays the interest determined when the bond was issued or matures with a given probability, in which case it pays back the face value plus interest. Technically, the bond is a callable perpetuity with stochastic call date, which is independent across bonds. Since the government issues a large number of these bonds, the fraction of bonds maturing each period is identical to the call probability. Private agents are assumed to hold the same, representative, portfolio of the bonds. The stochastic bond allows to calibrate the average maturity of outstanding debt to that observed in the data.

$$Y_{Dt} = C_{Dt} + I_{Dt} + \phi_{It} + \frac{\zeta^*}{\zeta} M_t^* \quad (\text{A.30})$$

where ϕ_{It} is the adjustment cost on investment aggregated across all households. The final consumption good is allocated between households and the government:

$$C_{At} = C_t + G_t; \quad (\text{A.31})$$

where C_t is (per capita) private consumption of FL (optimizing) and HM households:

$$C_t = (1 - \zeta)C_t^O + \zeta C_t^{HM}. \quad (\text{A.32})$$

Total exports may be allocated to either the consumption or the investment sector abroad:

$$M_t^* = M_{Ct}^* + M_{It}^*. \quad (\text{A.33})$$

The evolution of net foreign assets can be expressed as:

$$\frac{P_{B,t}^* B_{F,t+1}}{\phi_{bt}} = B_{F,t} + P_{Mt}^* \frac{\zeta^*}{\zeta} M_t^* - P_{Mt} M_t. \quad (\text{A.34})$$

This expression can be derived from the budget constraint of the FL households after imposing the government budget constraint, the consumption rule of the HM households, the definition of firm profits, and the condition that domestic state-contingent non-government bonds (B_{Dt+1}) are in zero net supply.

Finally, we assume that the structure of the foreign economy is isomorphic to that of the domestic economy.

A.6. Production of capital services

The model is amended to include a financial accelerator mechanism into both country blocks of our benchmark model following the basic approach of Bernanke, Gertler and Gilchrist (1999). Thus, the intermediate goods producers rent capital services from entrepreneurs (at the price R_{Kt}) rather than directly from households. Entrepreneurs purchase physical capital from competitive capital goods producers (and resell it back at the end of each period), with the latter employing the same technology to transform investment goods into finished capital goods as described by eqs. (A.21) and (A.23). To finance the acquisition of physical capital, each entrepreneur combines his net worth with a loan from a bank, for which the entrepreneur must pay an external finance premium (over the risk-free interest rate set by the central bank) due to an agency problem. Banks obtain funds to lend to the entrepreneurs by issuing deposits to households at the interest rate set by the central bank, with households bearing no credit risk (reflecting assumptions about free competition in banking and the ability of banks to diversify their portfolios). In equilibrium, shocks that affect entrepreneurial net worth i.e., the leverage of the corporate sector induce fluctuations in the corporate finance premium.³⁷

A.7. Solution Method and Calibration

The model is calibrated at a quarterly frequency. The domestic country size parameter ζ is set to a very small number so that the domestic economy is arbitrarily small relative to the foreign countries. The trade share of the small open economy is set to 24 percent of its GDP. This pins down the trade share parameters ω_c and ω_I for the domestic economy under the additional assumption that the import intensity of consumption is equal to 1/2 that of investment. We assume that $\rho_c = \rho_I = 2.5$, which together with our price markup $\theta_p = 0.2$, is consistent with a long-run price elasticity of demand for imported consumption

³⁷ We follow Christiano, Motto and Rostagno (2008) by assuming that the debt contract between entrepreneurs and banks is written in nominal terms (rather than real terms as in Bernanke, Gertler and Gilchrist, 1999). For further details about the setup, see Bernanke, Gertler and Gilchrist (1999), and Christiano, Motto and Rostagno (2008). An excellent exposition is also provided in Christiano, Trabandt and Walentin (2007).

and investment goods of 1.5. The import adjustment cost parameters are set so that $\varphi_{M_C} = \varphi_{M_I} = 1$, which slightly dampens the near-term relative price sensitivity. The financial intermediation parameter ϕ_b is set to a modest value (0.01), which ensures the model has a unique steady state and reasonable fluctuations in the external risk-premium.

The relative risk aversion parameter σ is set to a benchmark value in the literature (2), while the habit persistence parameter in consumption \aleph is set to 0.8 (following empirical evidence). The utility parameter χ_0 is set so that labor market activity comprises half of the household's time endowment, while the Frisch elasticity of labor supply is targeted to equal 1/2, which implies setting $\chi = 4$. $\mu_0\varsigma = 0.65$

The parameter determining investment adjustment costs $\phi_I = 3$ following the evidence in Christiano, Eichenbaum and Evans (2005) and Smets and Wouters (2007). The depreciation rate of capital is set at 0.03 (consistent with an annual depreciation rate of 12 percent). The parameter ρ in the CES production function of the intermediate goods producers is set to -1; implying a zero-elasticity of substitution between capital and labor $(1 + \rho)/\rho$, i.e. a Leontief production function technology. The quasi-capital share parameter ω_K - together with the price markup parameter of $\theta_p = 0.2$ - is chosen to imply a steady state investment to output ratio of [20] percent. In the augmented version of the model with a financial accelerator, our calibration of parameters follows Bernanke, Gertler and Gilchrist (1999). In particular, the monitoring cost, μ , expressed as a proportion of entrepreneurs total gross revenue, is set to [0.12]. The default rate of entrepreneurs is [3] percent per year, and the variance of the idiosyncratic productivity shocks to entrepreneurs is [0.28]:

The Calvo domestic price contract duration parameter is set to be $\xi_p = 0.92$, the import/export contract parameter $\xi_m = 0.90$, while the wage contract duration parameter is $\xi_w = 0.88$. We set the degree of price indexation ι_p to unity and wage and import price indexation parameters $\iota_w = \iota_m = 0.5$. In line with Smets and Wouters (2007) we set the wage markup is $\theta_w = 1/3$.³⁸ To address the forward guidance puzzle (see Del Negro, Giannoni and Patterson, 2015), we allow for the possibility that labor unions and firms form expectations in a non-rational fashion outside of the steady state. Our modeling of behavioral expectations in the pricing and wage equations follows the spirit of Gabaix (2020) $X_{t+1|t}^{BR} = \varphi X_{t+1|t}$ where $X_{t+1|t}$ is the rational t+1 expectation given the state in period t. The superscript BR abbreviates bounded rationality and the cognitive discount parameter φ is set equal to 0.9. This approach is implemented by replacing each forward-looking variable $X_{t+1|t}$ in the linearized wage and price Phillips curves with $\varphi X_{t+1|t}$. Relative to Gabaix (2020), who uses these assumptions about expectations formation to rederive the first order conditions, our approach clearly involves some simplifications. However, it captures the spirit of both Gabaix and related work -- including McKay, Nakamura, and Steinsson (2016) -- that a number of factors, including myopia and liquidity constraints, are likely to dampen the role of expectations in firms pricing and labor unions wage setting decisions.

The parameters of the monetary rule (A.26) are set to standard values; $\gamma_i = 0.9$, $\gamma_\pi = 1.5$, $\gamma_x = 0.125$, and $\gamma_{\Delta x} = 0.25$. This parametrization is in line with empirical estimates in DSGE models (see e.g., Smets and Wouters 2003 and 2007) and is aimed at capturing the basic behavior of a flexible inflation targeting central. With the discount factor set at $\beta = 0.99875$, and the inflation target at 2 percent, the steady state nominal interest rate is 2.5 percent.

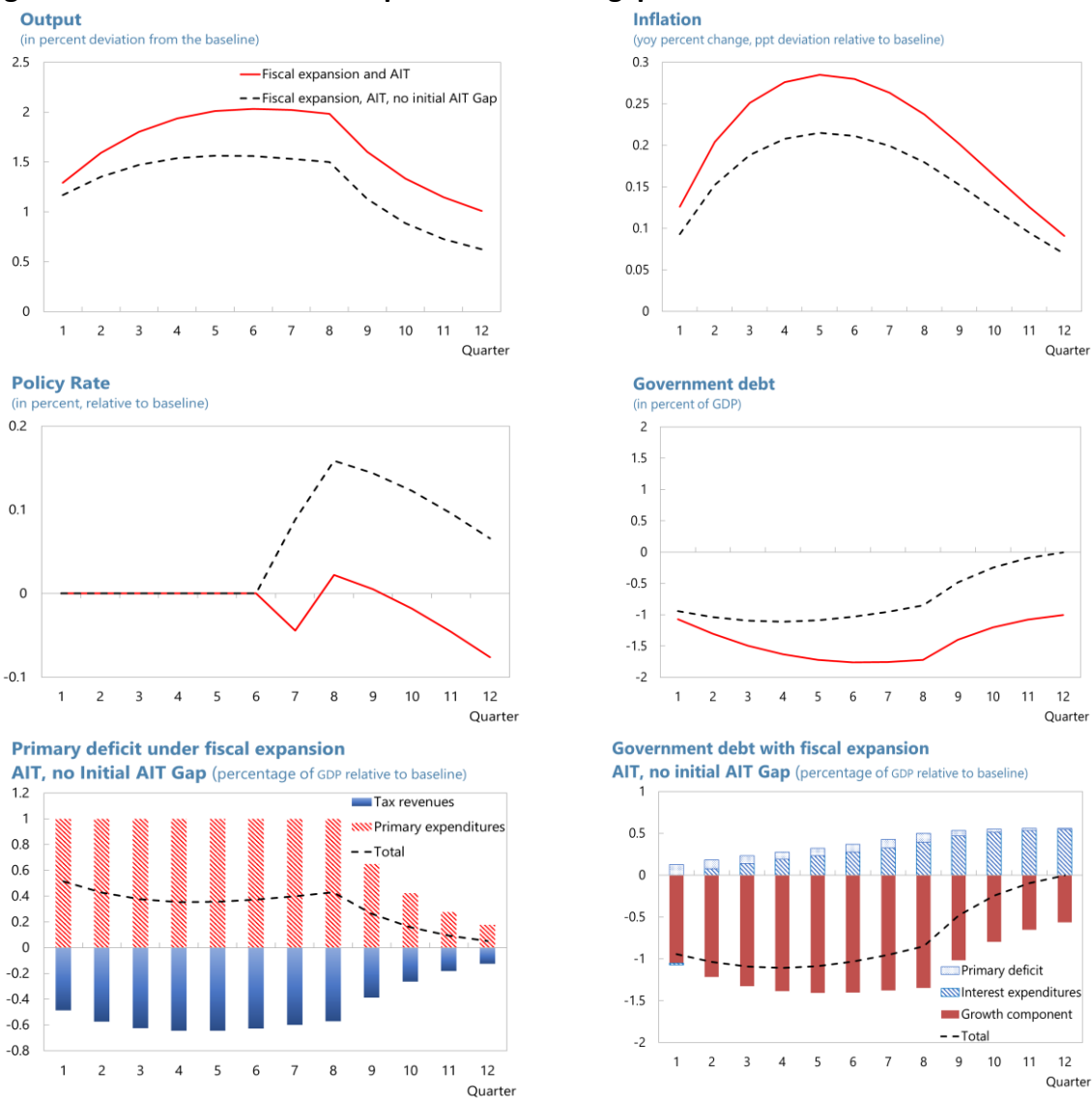
³⁸ Given strategic complementarities in wage-setting, the wage markup in influences the slope of the wage Phillips Curve.

The parameters pertaining to fiscal policy are intended to roughly capture the revenue and spending sides of the U.S. government budgets. The share of government spending on goods and services is set equal to 20 percent of steady state output. The government debt to annualized GDP ratio, b_G , is set to 0.90. The ratio of transfers to GDP is set to 7 percent. The steady state sales (i.e., VAT) tax rate τ_c is set to 10 percent, while the capital tax rate τ_K is set to 20 percent. Given the annualized steady state real interest rate (of 0.5 percent), the government's intertemporal budget constraint then implies that the labor income tax rate τ_N equals 0.35 in the steady state. We assume an unaggressive tax adjustment rule in (A.29) by setting $v_1 = 0.985$ and $v_2 = v_3 = 0.1$. Finally, we set $\vartheta=0.125$, consistent with a two-year steady state maturity structure of government debt. This value is intended to strike a balance between advanced small open economies with longer maturity structure and emerging markets ones which typically funds themselves at shorter maturities.

To analyze the behavior of the model, we log-linearize the models equations around the non-stochastic steady state. Nominal variables are rendered stationary by suitable transformations. To solve the unconstrained version of the model, we compute the reduced-form solution of the model for a given set of parameters using the numerical algorithm of Anderson and Moore (1985), which provides an efficient implementation of the solution method proposed by Blanchard and Kahn (1980).

Appendix B

Figure B.1. Robustness with respect to initial AIT gap





PUBLICATIONS

Effective Fiscal-Monetary Interactions in Severe Recessions

Working Paper No. **WP/2022/170**