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MONETARY-FISCAL INTERACTIONS DURING LARGE-SCALE ASSET PURCHASE PROGRAMS

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Monetary-fiscal interactions during large-scale asset purchase programs

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Abstract: This paper examines the effects of asset purchase programs (APPs) that were implemented in a number of countries during the COVID-19 pandemic in concert with large fiscal stimulus packages. We identify APP shocks for 14 advanced and emerging market economies using high-frequency identification techniques. We next estimate panel local projections, finding that APPs tend to stimulate output, but decrease prices. By using a Kitagawa-Blinder-Oaxaca decomposition, we demonstrate that these responses significantly depend on the magnitude of the simultaneously applied fiscal stimulus. Remarkably, higher government purchases during that period crowded in private consumption and had a large effect on inflation. We show that these empirical findings, some of which are inconsistent with a standard New Keynesian framework, can be rationalized in a simple general equilibrium model with segmented asset markets and fiscal dominance.

Keywords: asset purchases, monetary-fiscal interactions, fiscal dominance, high-frequency identification, local projections, general equilibrium models

JEL codes: E44, E52, F41

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1 Introduction

Following the outbreak of the COVID-19 pandemic, many central banks around the world embarked on large-scale asset purchase programs (APPs). Remarkably, for the first time this policy was implemented not only in advanced economies, which already used APPs earlier to stabilize financial markets and provide stimulus at the effective lower bound, but also by many emerging market economies, where monetary policy was still largely unconstrained. Perhaps even more importantly, the macroeconomic context was exceptional as purchases of bonds coincided with their massive issuance by the governments, which were trying to mitigate the effects of lockdowns on businesses and household income. The unprecedented scale, coordination, and fast deployment of these measures raise questions on how the swelling public debt will eventually be repaid and on the role of monetary policy in the process.

It is then not surprising that a growing number of studies acknowledge the possibility that much of the COVID-19 period debt will eventually be inflated away rather than repaid by an adjustment in taxes or public spending, also drawing analogies to exceptional episodes in the past like the world wars (see, e.g., Hall and Sargent, 2022; Cochrane, 2022; Leeper, 2021). In other words, the regime of fiscal dominance, extensively analyzed by the fiscal theory of the price level literature,¹ might have become a reality. These circumstances could be particularly relevant for emerging markets and developing economies, in some of which (including those that implemented APPs) the government framework can be considered relatively weak (Adrian et al., 2021). We also know from the recent theoretical literature that fiscal dominance can significantly change, or even reverse, the transmission of standard shocks and policies (Smets and Wouters, 2024). It is therefore reasonable to expect that asset purchases implemented during a period of a particularly large and emergency fiscal stimulus may have had different macroeconomic effects than similar programs applied earlier by advanced economies.

Against this backdrop, in this study we first provide new empirical evidence on the effects of APPs applied during the COVID-19 pandemic and explore how these effects interact with fiscal policy. We use a sample of 14 small open economies, encompassing both advanced and emerging markets, for which we estimate monetary policy shocks using high-frequency identification methods that build on Swanson (2021). More specifically, for each country we extract three types of shocks, reflecting conventional interest rate setting, forward guidance, and asset purchases. These shocks are next cleaned of central bank information effects following

¹Classical references include Sargent and Wallace (1981), Leeper (1991), Sims (1994), Woodford (1994), and Cochrane (2001). See also the literature review section below.

Jarociński and Karadi (2020). The sample runs from 2011 to 2023, and hence encompasses the period of monetary stimuli implemented in response to the COVID-19 pandemic.

In order to assess how APPs affect financial and macroeconomic variables, we estimate a number of panel local projections á la Jordà (2005). We find that APPs tend to boost output, household spending, and stock prices. However, there is limited evidence of currency appreciation, and consumer prices decline. This surprising response of inflation turns out to be driven by emerging market economies, while advanced countries exhibit a more conventional reaction of this variable. If we compare our results with those obtained without removing information effects, we find that APPs were indeed partially interpreted as revealing bad news about economic fundamentals. This finding underscores the importance of shock orthogonalization during the identification procedure.

Since the launch of APPs during COVID-19 recession was accompanied by substantial fiscal expansion, we next conduct a Kitagawa-Blinder-Oaxaca decomposition of the local projection estimates as recently proposed by Cloyne et al. (2020), utilizing data on government spending. This allows us to separate the average monetary policy impact across the sample from its country-specific component, capturing the degree of domestic fiscal accommodation. Notably, our analysis reveals significant cross-country variation in government spending, which drives heterogeneous responses in GDP, consumption, and prices to APP shocks. Importantly, in countries where APPs coincided with a larger fiscal stimulus, the response of private consumption was significantly stronger, thus suggesting a crowding-in effect that amplifies the expansion in output. This part of our analysis also indicates that the response of inflation could be less negative, or even positive, in countries where the fiscal stimulus was particularly big.

We note that some of the documented macroeconomic responses, including a fall in prices following a monetary easing, crowding-in of private consumption by government purchases, and a high sensitivity of inflation to fiscal policy, are inconsistent with monetary policy transmission implied by the standard New Keynesian setup. We hence proceed by proposing a simple theoretical framework that could rationalize these findings. The key ingredients of the model are segmented bond markets and fiscal dominance. The latter feature may be particularly relevant in countries having a relatively weaker policy framework. More specifically, we consider a simplified version of the setup proposed by Andres et al. (2004) and further developed by Chen et al. (2012). These papers incorporate limits to arbitrage between short and long-term bonds into a general equilibrium setup with nominal rigidities. In consequence, changes in the relative supply of these assets, like those that arise from

large-scale purchases by a central bank, can have real effects on economic activity and prices. Within this framework, we allow for the possibility that fiscal policy is active in the spirit of Leeper (1991).

In this model, APPs expand the economic activity and inflation if fiscal policy is assumed to be passive, i.e., if taxes (or other fiscal instruments) eventually adjust to ensure long-run stabilization of public debt. However, when the economy operates under fiscal dominance, the response of inflation is negative, consistent with our empirical results, particularly for emerging market economies. This is because APPs lower debt servicing cost and hence improve the fiscal position. In the absence of any adjustment in fiscal instruments, bringing public debt back to its long-run equilibrium level requires low inflation that is unaccommodated by monetary policy (which hence assumes a passive stance) – a mechanism consistent with the fiscal theory of the price level.

The model operating under fiscal dominance is also consistent with our results that rely on the Kitagawa-Blinder-Oaxaca decomposition of APP effects with respect to government consumption. As this regime implies that taxes do not respond to an increase in public debt, it is brought back to its long-run level through higher inflation, which decreases the real value and cost of servicing it. As a result, private consumption is crowded in while the response of inflation, given its key role in stabilizing debt, is much stronger than under the standard monetary active / fiscal passive regime.

Related literature The empirical part of our project builds on the vast literature that uses monetary policy shocks based on high-frequency identification to analyze their impact on financial markets (e.g., Kuttner, 2001; Cochrane and Piazzesi, 2002; Gürkaynak et al., 2005; Gilchrist et al., 2015; Altavilla et al., 2019; Andrade and Ferroni, 2021; Swanson, 2021; Lewis, 2023) and macroeconomic variables (e.g., Gertler and Karadi, 2015; Bauer and Swanson, 2023). To address the concern that central bank announcements may convey news about economic conditions, Jarociński and Karadi (2020) and Miranda-Agrippino and Ricco (2021) additionally isolate potential information effects. Some of these studies distinguishes between conventional and unconventional monetary policy shocks, the latter also including APPs. Fabo et al. (2021) provides a meta-analysis of this literature. The common feature of these papers is that they all focus on large advanced economies, such as the US or the euro area, and it is not clear to what extent the obtained results carry over to other countries, and especially to developing economies with much shallower bond markets and less established monetary and fiscal policy credibility.

We also contribute to the growing literature on identifying monetary policy shocks for multiple countries using a consistent econometric framework. Brandao-Marques et al. (2021) construct monetary policy shocks for 39 emerging markets and developing economies using Taylor rule residuals and investigate how the transmission of monetary policy rates to output and prices varies across country characteristics such as financial development, monetary policy frameworks, and financial dollarization. Deb et al. (2023) adopt a similar approach to construct monetary policy shocks for 33 countries and find significant heterogeneity in their transmission across countries, contingent upon cyclical conditions and structural characteristics. Checo et al. (2024) identify monetary policy shocks for 18 emerging market economies using Bloomberg analysts' forecasts of policy rate decisions and analyze their impact on a range of financial and macroeconomic outcomes, as well as firm-level variables. Choi et al. (2024) construct a panel dataset collecting estimates of monetary policy shocks for a sample of 176 countries and analyze how their effects vary with industry characteristics. Relative to these studies, we contribute to the analysis of monetary transmission by distinguishing between three different types of monetary policy shocks and by focusing on the effects of APPs rather than conventional policy.

From a methodological perspective, we relate to papers that apply the Kitagawa-Blinder-Oaxaca (KBO) decomposition (Kitagawa, 1955; Blinder, 1973; Oaxaca, 1973) — a tool commonly used in applied microeconomics — in the macroeconomic context. In particular, Cloyne et al. (2020) use the KBO decomposition to show that the fiscal multiplier identified in the data depends on the behavior of monetary policy. Using a similar framework, Kolasa and Wesolowski (2024) study the domestic-foreign monetary policy interactions. In contrast to these studies, we apply the KBO decomposition to examine how the effects of APPs may be conditioned on fiscal reactions, which can be particularly relevant during exceptional circumstances such as those associated with the COVID-19 pandemic.

The theoretical part of our project builds on the bond market segmentation framework developed by Andres et al. (2004), Chen et al. (2012), and Kiley (2014). We extend this framework to incorporate an active fiscal / passive monetary policy mix as considered by Leeper (1991) and to investigate the interactions between APP shocks and the fiscal policy stance.

Our paper is also related to the growing body of literature that investigates the impact of the interactions between monetary and fiscal policies on inflation dynamics, especially in the context of programs implemented during the COVID-19 pandemic, and which have been attracting particular interest due to the following surge in inflation. Bianchi et al. (2020) study the implications of a coordinated fiscal and monetary strategy aiming at creating

a controlled rise of inflation and an increase in fiscal space in response to the COVID-19 shock. Barro and Bianchi (2023) apply the idea of fiscal dominance to a panel of 37 OECD countries for the period 2020-2023 and find that the recent fiscal expansion has been a key driver of inflation. Caramp and Silva (2023) use a decomposition of the equilibrium in a simple model with sticky prices to show how the economy's responses to monetary policy crucially depend on the fiscal backing. Witheridge (2024) develops a small open economy New Keynesian model with monetary-fiscal interactions to show that a fiscal-led policy mix can explain the increase in inflation documented in emerging markets after monetary policy tightening. Despite these recent empirical and theoretical advances, there is still a major gap in the literature concerning the degree to which the fiscal stance determines the effectiveness of unconventional monetary policy measures such as APPs, and how these interdependencies differ from the case of standard interest rate-based monetary policy.

Outline The rest of this paper is structured as follows. Section 2 presents the monetary shock identification procedure and its outcomes. Section 3 provides empirical evidence on the impact of APPs on macroeconomic and financial variables and how it depends on the simultaneously provided fiscal stimulus. Section 4 develops a simple general equilibrium model with sticky prices and segmented bond markets, that allows us to consider alternative monetary-fiscal regimes. Section 5 presents the model simulations. Section 6 concludes.

2 Shock identification

In this section, we describe the procedure used to identify conventional and unconventional monetary surprises for a number of small open economies that implemented large-scale asset purchase programs during the COVID-19 pandemic. In total, we consider 14 countries, encompassing both advanced and emerging market economies.² As our goal is to focus on exceptional circumstances that led to a large and concerted monetary-fiscal stimulus during the COVID-19 recession, our dataset excludes countries that were actively using asset purchases prior to the pandemic, such as the US, euro area, Japan, Sweden, and the UK. The data sample for most economies covers the period from 2011m1 to 2023m12.³

²The countries are: Brazil, Canada, Chile, Colombia, Hungary, Indonesia, Israel, Korea, Mexico, Norway, Poland, Romania, South Africa, and Thailand.

³The exceptions here are Brazil, Colombia, Mexico, and Romania, for which, due to limited data availability, the samples cover the periods of, respectively, 2014m2-2023m12, 2012m8-2023m12, 2011m1-2023m1, and 2011m8-2023m12.

To construct the monetary policy shocks, we rely on a high-frequency identification scheme proposed by Swanson (2021) and applied to the US, which builds upon earlier work by Gürkaynak et al. (2005). A similar method was employed by Altavilla et al. (2019) to identify conventional monetary policy surprises, as well as forward guidance and QE shocks in the euro area.

In the first step of our procedure, we construct a monetary event database for each country in the sample. This database includes not only the meeting dates of monetary policy decision-making bodies (downloaded from Bloomberg) but also the announcement dates of asset purchase programs collected by Fratto et al. (2021) and Rebucci et al. (2020), which are listed in Table 3. Next, we gather high-frequency data on interest rates with varying maturities to calculate the changes in these rates around the monetary policy events. Due to limited data availability, we consider slightly different sets of interest rates for each country. We utilize both spot and forward interest rates. The detailed list of interest rates used, along with their Bloomberg tickers, is presented in Table 2. Since the financial markets in many of the economies included in our sample are not as liquid as in the US, we do not rely on the intraday changes in the interest rates but utilize two-day windows around monetary events (from the end of the day before to the end of the day after). A natural concern is that changes in interest rates of small open economies in such wider time windows may not solely reflect the effects of domestic monetary events, but can also result from trends in global financial markets. To control for this effect, we run a simple linear regression for each interest rate, where we explain the changes in that rate using changes in the interest rates of the corresponding maturities in two leading global economies, namely the U.S. and the euro area.⁴ The residuals from these regressions are then utilized in the subsequent analysis.

As a next step, for each country, we construct a $T \times n$ matrix X , where the rows correspond to monetary policy events and the columns represent the residuals from the regressions described above. Following Swanson (2021), we first scale each column of X to have a mean of zero and a variance of one. We then employ factor analysis to describe the variability among the collected standardized changes in interest rates using a smaller number of unobserved factors. Thus, we express X as:

$$X = F\Lambda + \varepsilon \tag{1}$$

where F is a $T \times k$ matrix of unobserved factors (with $k \leq n$), Λ is a $k \times n$ matrix of loadings of interest rate responses on the k factors, and ε is a $T \times n$ matrix of white noise residuals that are uncorrelated over time and across interest rates.

⁴To increase the number of observations, we do not restrict ourselves to monetary policy event dates when running these regressions. Instead, we use the entire time series of daily data.

We estimate the unobserved factors F and retain three principal components (i.e. $k = 3$) that have the greatest systematic impact on interest rates around the considered monetary events.⁵ We then rotate these components to provide a structural interpretation as conventional monetary policy, forward guidance, and asset purchase program factors. For this purpose, we construct an alternative factor model represented by the matrices $F^* \equiv FU$ and $\Lambda^* \equiv U'\Lambda$, where U is a 3×3 orthogonal rotation matrix that satisfies the following three restrictions: (i) changes in APP have no effect on the short-term (one-month) interest rate, (ii) changes in forward guidance have no effect on the short-term (one-month) interest rate, and (iii) the APP factor has the smallest variance during the period before the implementation of APP in 2020 and after the end of 2021. More technical details regarding the identification strategy and the construction of the rotation matrix can be found in Swanson (2021) and Altavilla et al. (2019), which we follow closely.

The three restrictions, along with the orthogonality assumption, uniquely identify U and F^* up to a sign normalization for each column. In the final step, we normalize the sign of the first rotated factor to have a positive effect on the one-month rate, the sign of the second one such that it has a positive impact on the two-year rate,⁶ and the third one to have a positive impact on the ten-year interest rate.

Once we have estimated the conventional, forward guidance and APP factors, we obtain their surprise components by eliminating the information effects from the identified shocks. As argued by Jarociński and Karadi (2020) or Miranda-Agrippino and Ricco (2021), central bank decisions convey information about both monetary policy and the central bank's view on the economic outlook. These two components can have very different implications for the reaction of standard macroeconomic aggregates. In order to disentangle one from another, we follow the strategy proposed by Jarociński and Karadi (2020) and analyze the co-movement of shocks identified in the previous step and stock prices around policy announcements. If the shock co-moves negatively with the stock market, we treat it as a 'pure' monetary intervention. The positive co-movement is an indication for the presence of an accompanying information shock. In the further analysis, we use the shocks that have been cleaned of the informational content of monetary decisions.

Having estimated the surprise components of monetary policy decisions, we verify our identification scheme by estimating their effects on four assets at a weekly frequency: the one-month interest rate, the 10-year interest rate, stock prices, and the exchange rate of the domestic

⁵Depending on the country, the three factors explain between 77% and 97% of the variation in X .

⁶For Hungary, (long enough) daily data on two-year interest rates are not available, and so we normalize the forward guidance shock to have a positive impact on the three-year interest rate.

currency against the US dollar (an increase indicates an appreciation of the local currency). For each of these variables, we run the sequence of the following panel regressions:

$$y_{j,t+h} - y_{j,t-1} = \alpha_{j,h} + \beta_h \varepsilon_{j,t} + \mathbf{x}_{j,t} \gamma_h + \nu_{j,t+h} \quad (2)$$

where $y_{j,t}$ is one out of four endogenous variables in country j in period t and $\varepsilon_{j,t}$ is a vector of the three monetary policy shocks that hit the economy j at time t . The first two shocks represent surprise components of conventional monetary policy and forward guidance, as obtained in the identification procedure described above. The third shock is defined as the surprise APP factor multiplied by the dummy variable $d_{j,t}$ that equals one in the periods following the first APP announcement in a given country and zero otherwise. The set of control variables $\mathbf{x}_{j,t}$ includes: four lags of the dependent variable and monetary policy factors, as well as the APP factor multiplied by $1 - d_{j,t}$ (contemporaneous and four lags).

Figure 1 presents the responses of the above-mentioned financial variables to each of the three types of accommodative monetary shocks. In line with our identification restrictions, forward guidance and APP shocks are found to have no impact on the short-term interest rate. This applies not only to the immediate response of the variable, but also to its reaction in the following weeks. Long-term interest rates decline in response to all three types of monetary disturbances. However, the reaction to conventional monetary policy shocks occurs somewhat more gradually. The accommodative conventional monetary shock also leads to depreciation of the domestic currency in line with the standard theory, and insignificant response of stock prices. At the same time, equity valuations turn out to be more responsive to expansionary forward guidance and APP shocks, pointing to their importance for financial markets. Furthermore, these two shocks result in appreciation of the domestic currency – the latter result found also by Arena et al. (2021) in the context of APP programs.

3 Empirical evidence

This section presents the main empirical results of the paper. First, we estimate the impact of monetary policy shocks on the economies included in our sample. To this end, we run a set of panel local projections (Jordà, 2005) and present the impulse response functions (IRFs) based on them. Second, we focus on the monetary-fiscal interactions and use the so-called Kitagawa-Blinder-Oaxaca (KBO) decomposition (Kitagawa, 1955; Blinder, 1973; Oaxaca, 1973) to condition the transmission of APP shocks on the level of government

spending. More specifically, we do it by adopting a panel local projection implementation of this decomposition developed by Cloyne et al. (2020).

3.1 Panel local projections

While analyzing the effects of APP shocks, we consider six monthly time series, i.e. industrial production,⁷ retail sales, CPI, real effective exchange rate, long-term interest rate, and stock prices. More specifically, for each of these six variables we estimate the following panel local projections:

$$y_{j,t+h} - y_{j,t-1} = \alpha_{j,h} + \beta_h \epsilon_{j,t} + \mathbf{x}_{j,t} \gamma_h + \nu_{j,t+h} \quad (3)$$

for horizons $h = 0, \dots, 11$ months, where $\epsilon_{j,t}$ represents the APP shock defined as in regressions 2. The set of control variables $\mathbf{x}_{j,t}$ in our baseline specification includes: 6 lags of the dependent variable, the APP factor multiplied by the $1 - d_{j,t}$, 6 lags of the APP factor, contemporaneous and 6 lags of the US industrial production growth, contemporaneous and 6 lags of the Google mobility index for transit stations (which aims to capture the impact of COVID-19 restrictions)⁸, and contemporaneous and 6 lags of growth of the VIX index. In the regressions for variables other than industrial production, we also include 6 lags of this variable. In the equation above, $\alpha_{j,h}$, β_h and γ_h are the estimated parameters, where $\alpha_{j,h}$ denote the country fixed effects, and $\nu_{j,t+h}$ are the regression residuals. The choice of the control variables was based on economic intuition and common practice, but we also test a number of alternative specifications differing in the number of lags and set of controls. The data sources are listed in Table 4.

Figure 2 presents the responses of the endogenous variables to a one-standard deviation APP shock. As one could expect, the accommodative APP shock lowers the long-term interest rate by 2 bp on impact and 4 bp at the trough. It also stimulates the economic activity, leading to a persistent increase in industrial production and a temporary rise in retail sales (by 0.4% each). These results are robust across many specifications such as including less (see Figure 3) and more controls and changing the number of their lags.⁹

⁷Since industrial production data for Mexico and South Africa are unavailable, we use instead the series for production in total industry, including construction, and production in total manufacturing, respectively.

⁸Google LLC, "Google COVID-19 Community Mobility Reports", <https://www.google.com/covid19/mobility/>

⁹We tested adding variables such as the exchange rate, interest rate, oil prices as well as conventional and forward guidance monetary policy shocks. These results are not reported in the paper but available upon request.

Furthermore, we find that after an APP accommodation, the exchange rate slightly depreciates (by 0.1%), stock prices increase (by 0.5% at the peak), while consumer prices fall. Importantly in the context of fiscal-monetary interactions that we study later using a theoretical model, the negative response of inflation is more pronounced if we run our local projections on a subsample of emerging markets, which usually are characterized by a larger degree of fiscal dominance (Figure 4). In fact, if we use instead only a subsample of advanced economies (Figure 5), inflation increases in response to asset purchases and the expansion of economic activity is also much stronger.

Moreover, the estimated responses to APP depend on whether we clean shocks of the information effects, stressing the importance of this step while identifying the unexpected component of the policy. Figure 6 shows the results for shocks unadjusted for information effects.¹⁰ In particular, unadjusted APP shocks do not significantly increase stock prices on impact and lead to exchange rate appreciation, which is consistent with some of the findings reported in the literature as discussed in section 2. Interestingly, if we do not clean the shocks of information effects, prices no longer fall in response to an APP expansion, but even show some increase. Together with a somewhat smaller expansion of industrial production and retail sales in this specification compared to our baseline variant, the change in the sign of the inflation response suggests that APP announcements were partially interpreted as unfavorable information about economic supply-side fundamentals, revising agents' expectations towards lower economic activity and higher inflation pressure. We also note that eradicating the information effects is particularly important for a representative emerging market economy and less so for advanced economies. This can be seen in Figures 7 and 8. In particular, if contaminated APP shocks are used, the response of inflation to APP in the first group of countries is no longer negative, and the estimated expansion in economic activity is also limited, with retail sales even contracting on impact.

3.2 Kitagawa-Blinder-Oaxaca decompositions

The second part of our empirical investigation focuses on monetary-fiscal interactions, aiming to assess the extent to which fiscal policy may affect the transmission of APPs. To this end, we use the KBO decomposition, which boils down to running a two-step regression. In the first step, we estimate a panel model, in which we regress the changes in government spending from period $t - 1$ to $t + h$ on the APP shock $\epsilon_{j,t}$, allowing the coefficient to vary by country.

¹⁰Note that we also orthogonalize the shocks with respect to changes in foreign interest rates. However, this step does not affect our results in an important way.

More specifically, we estimate the sequence of the following local projections:

$$G_{j,t+h} - G_{j,t-1} = \alpha_{j,h} + \sum_{i=1}^j \varepsilon_{j,t} I(j=i) \Theta_j^h + (\mathbf{x}_{j,t} - \bar{\mathbf{x}}_j) \gamma_h + \nu_{j,t+h} \quad (4)$$

where Θ_j^h is our key object of interest, capturing cross-country heterogeneity in the sensitivity of fiscal policy to APP shocks, and all control variables are expressed in differences from their means.

In the second step, we use the estimates of Θ_j^h to decompose the response of selected variables into two components: the direct (average) effect of an APP shock and the indirect effect that explores how the transmission of APP is modulated by the fiscal reaction in a particular country. More precisely, we estimate:

$$y_{j,t+h} - y_{j,t-1} = \alpha_{j,h} + \beta_h \varepsilon_{j,t} + \varepsilon_{j,t} (\Theta_j^h - \bar{\Theta}^h) \theta_\varepsilon^h + \varepsilon_{j,t} (\mathbf{x}_{j,t} - \bar{\mathbf{x}}_j) \theta_x^h + (\mathbf{x}_{j,t} - \bar{\mathbf{x}}_j) \gamma_h + \nu_{j,t+h} \quad (5)$$

where $\beta_h \varepsilon_{j,t}$ measures the direct impact of an APP shock and $\varepsilon_{j,t} (\Theta_j^h - \bar{\Theta}^h) \theta_\varepsilon^h$ captures the indirect effect. Here, $\bar{\Theta}^h$ represents the average of Θ_j^h across all countries, while θ_ε^h denotes the estimated parameter. Following Cloyne et al. (2020), our regression includes the control variables expressed as deviations from their means, as well as the interaction between the demeaned controls and the APP shock.

Due to the limited availability of fiscal variables at a monthly frequency, we conduct the KBO decomposition using quarterly data and consider three endogenous variables: GDP, private consumption, and consumer prices. Furthermore, since regression (5) includes interaction terms, we need to limit the number of controls compared to the local projections (3) in order to preserve degrees of freedom. As a result, our set of controls includes: the APP shock as well as its interaction with $1 - d_{j,t}$, their first lags, one lag of domestic GDP, as well as contemporaneous and first lags of US GDP and Google mobility index. As can be seen by comparing our baseline results (Figure 2) with those that use this reduced set of controls (Figure 3), they are very similar.

Figure 9 presents the responses of the three key variables to an APP shock depending on the degree of fiscal accommodation obtained from the KBO decomposition. More precisely, in the upper left panel showing the response of government spending, each line represents

$\bar{\Theta}^h + \kappa\sigma_{\Theta_j^h}$, where $\sigma_{\Theta_j^h}$ denotes the cross-country standard deviation of Θ_j^h , and κ takes one of the following values: -1, -0.5, 0, 0.5, and 1. On the panels presenting the remaining variables, each line corresponds to $\beta_h + \theta_\varepsilon^h \kappa \sigma_{\Theta_j^h}$, with κ taking the same values as in the case of government spending.

As shown in Figure 9, the response of government spending to an APP shock is highly heterogeneous across the analyzed countries: its average reaction in our sample is slightly negative, but in some countries the decrease is much more prominent, while in others it is positive. Interestingly, we find the crowding-in effects of fiscal expenditures on private spending since more expansionary fiscal policy is associated with higher household consumption and, as a result, also higher GDP. What is also remarkable, output and consumption vary significantly depending on the government spending level (Figure 10). They may even decline after an expansionary APP shock if the government decides to significantly cut its spending in response to this shock.

Similarly to our baseline results from local projections, the average response of consumer prices to an accommodative APP shock is negative and the drop in prices becomes more pronounced when fiscal policy is more restrictive. Even though the response of inflation is not as heterogeneous conditional on fiscal policy as in the case of real variables, we find that it may also change sign. In particular, prices increase slightly if accommodative APP is accompanied by a sufficiently large increase in government spending.

4 Theoretical model

In this section, we develop a simple model that combines segmented bond markets with fiscal dominance, otherwise collapsing to the textbook New Keynesian framework. We will then show that this model is consistent with the empirical results presented above.

4.1 Households

Our model economy is populated by two types of households, differing in their financial market participation. The first type, whom we call passive investors, indicated with superscript P , and whose mass is $0 \leq \omega \leq 1$, can trade only long-term bonds. The other type of households, dubbed as active, indicated with superscript A and of mass $1 - \omega$, have access to both short and long-term bonds, but holding the latter is subject to transaction costs.

Following Woodford (2001), we model long-term bonds as perpetuities that pay an exponentially decaying coupon $1, \delta, \delta^2, \dots$ starting in the period following issuance, where $\delta \in (0, 1]$ is a parameter that controls the average bond duration. Both types of agents earn labor income and receive profits from monopolistically competitive firms. They purchase a homogeneous consumption good and pay lump-sum taxes. Their nominal budget constraints can hence be written as

$$P_t c_t^P + T_t^P + P_{L,t} L_t^P \leq W_t n_t^P + D_t^P + (1 + \delta P_{L,t}) L_{t-1}^P \quad (6)$$

$$P_t c_t^A + T_t^A + P_{L,t} L_t^A (1 + \zeta_t^A) + B_t^A \leq W_t n_t^A + D_t^A + \Gamma_t^A + (1 + \delta P_{L,t}) L_{t-1}^A + R_{t-1} B_{t-1}^A \quad (7)$$

where, for $j = \{P, A\}$, B_t^j and L_t^j denote, respectively, agent j 's holdings of short and long-term bonds, c_t^j is real consumption, n_t^j is labor effort, T_t^j stands for taxes paid to the government, and D_t^j are nominal dividends. The nominal wage rate is denoted by W_t , the price of newly issued long-term bonds is $P_{L,t}$,¹¹ the short-term interest rate is R_t , and the price level is P_t . We assume that transaction costs are an increasing function of aggregate holdings of long-term bonds by active agents, i.e., $\zeta_t^A = \zeta(L_t^A/P_t)$, $\zeta' > 0$. These costs are rebated back in a lump-sum fashion and denoted as Γ_t^A .

Households maximize a standard utility functional

$$U_0^j = \mathbb{E}_0 \sum_{t=0}^{\infty} (\beta_j)^t \left[\log(c_t^j) - \frac{(n_t^j)^{1+\varphi}}{1+\varphi} \right] \quad (8)$$

where $0 \leq \beta_j < 1$ is the discount factor, and $\varphi > 0$ denotes the (inverse) Frisch elasticity of labor supply.

4.2 Production

The production sector in our model is very standard in the New Keynesian literature. At the final stage of production homogeneous goods are produced by perfectly competitive aggregators that use a continuum of intermediate inputs indexed by i

¹¹See Chen et al. (2012) on how to derive the equations above without needing to keep track of all past long-term bond purchases.

$$y_t = \left(\int_0^1 y_t(i)^{\frac{1}{\mu}} di \right)^\mu \quad (9)$$

where $\mu > 1$ controls the degree of substitution between individual input varieties.

Intermediate inputs are produced by monopolistically competitive firms that operate a linear production function in labor

$$y_t(i) = n_t(i) - \phi \quad (10)$$

where $\phi \geq 0$ is a fixed cost of production that ensures zero profits in the steady state.

All intermediate goods firms set their prices subject to the Calvo-style price rigidity. More specifically, every period producers face a constant probability $1 - \theta$ of price reoptimization. The problem of firms at the time of price reset is to maximize

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \theta^t \frac{\lambda_t}{P_t} [P_0(i) y_t(i) - W_t n_t(i)] \quad (11)$$

where $\lambda_t = (\beta_P/c_t^P)^\omega (\beta_A/c_t^A)^{1-\omega}$ is the stochastic discount factor reflecting that firms are owned by households proportionally to their shares in population. This maximization problem is subject to the demand schedules solving aggregators' optimization problem described above.

4.3 Monetary authority

Monetary authority follows a Taylor-like rule

$$\frac{R_t}{R} = \left(\frac{\pi_t}{\pi} \right)^{\gamma_\pi} \left(\frac{y_t}{y} \right)^{\gamma_y} \quad (12)$$

where variables without time subscripts indicate their steady state values while γ_π and γ_y control the policy rate feedback to the cyclical deviations of inflation and output from their steady state values π and y .

The central bank can also take an exogenous position in long-term bonds L_t^C , fully financing it by issuing reserves $-B_t^C$ that pay the same interest rate as short-term bonds. Its one-period holding profit is then

$$\Phi_t = (1 + \delta P_{L,t})L_{t-1}^C + R_{t-1}B_{t-1}^C \quad (13)$$

4.4 Fiscal authority

The fiscal authority purchases an exogenously determined amount of goods g_t and adjusts taxes according to the following rule

$$\frac{T_t}{P_t} = \phi \left(\frac{F_t^G}{P_t} - f^G \right) \quad (14)$$

where $\phi \geq 0$. To prevent taxes from adjusting to changes in public debt that are purely driven by revaluation effects, the rule responds to debt evaluated at steady-state bond prices $F_t^G \equiv f_t^G P_t = B_t^G + P_L L_t^G$, which is close to the face value concept used in official government statistics.

We assume that both types of households pay the same taxes in per capita terms, i.e., $T_t = T_t^P = T_t^A$. We also assume that the fiscal authority keeps the maturity structure of its debt constant, i.e., $P_{L,t} L_t^G / B_t^G = \alpha$ for all t .

Given these policies, public debt evolves according to

$$P_{L,t} L_t^G + B_t^G = (1 + \delta P_{L,t})L_{t-1}^G + R_{t-1}B_{t-1}^G + P_t g_t - T_t - \Phi_t \quad (15)$$

4.5 Market clearing

The model is closed with a standard set of market clearing conditions. Goods market clearing implies

$$y_t = \omega c_t^P + (1 - \omega)c_t^A + g_t \quad (16)$$

The aggregate resource constraint is

$$y_t \Delta_t = \omega n_t^P + (1 - \omega) n_t^A - \phi \quad (17)$$

where $\Delta_t = \int_0^1 \left(\frac{P_t(i)}{P_t} \right)^{\frac{\mu}{1-\mu}} di$ is the measure of price dispersion resulting from staggered pricing by intermediate goods producers.

Finally, the bond market clearing implies

$$B_t^G - B_t^C = (1 - \omega) B_t^A \quad (18)$$

$$L_t^G - L_t^C = \omega L_t^P + (1 - \omega) L_t^A \quad (19)$$

4.6 Calibration

As the simulations that we present in the next section are meant to be illustrative, we do not calibrate our model to any particular country but choose the parameters to values typically used in the literature or to match long-run proportions observed on average in the group of countries that we use in the empirical part of the paper.

We assume that long-term bonds correspond to the 10-year maturity, implying $\delta = 0.981$, and set their steady-state share in total public debt to 75% so that the obtained average debt duration is slightly below 8 years. The steady-state ratio of debt to annual GDP is set to 40% and the share of government spending is 20%. The assumed value $\beta_A = 0.995$ targets the annual real interest rate of 2%, which together with $\beta_P = 0.99375$ implies the annual term premium of 0.5%. To keep our analysis simple, we abstract away from trend inflation and hence set $\pi = 1$.

The parameters controlling the degree of market segmentation are set to $\omega = 0.2$ and $\zeta' = 0.02$, and are chosen to yield conservative responses of long-term yields and output to asset purchases. The Frisch elasticity of labor supply and steady-state production markups are calibrated at standard values: $\varphi = 1$, $\mu = 1.1$. The Calvo probability $\theta = 0.9$ is consistent with a realistically flat Phillips curve during the analyzed period.

Finally, the parameters describing the dynamic reactions of monetary and fiscal authorities (γ_π , γ_y and ϕ) depend on the considered variant of the monetary-fiscal policy mix and are explained in the next section.

5 Model implications

5.1 Transmission of asset purchases

We first use the model described above to simulate the effects of APPs by the central bank. The results are presented in Figure 11, in which we contrast two versions of the monetary-fiscal policy mix. The first one, depicted with solid lines, is when fiscal policy does not endogenously adjust its instruments in response to changes in public debt ($\phi = 0$) and the monetary authority follows an interest rate peg ($\gamma_\pi = \gamma_y = 0$). This regime hence corresponds to the active fiscal / passive monetary policy mix in the sense of Leeper (1991), and we will refer to it as fiscal dominance. The second regime, represented by dashed lines in the figure, is the standard passive fiscal / active monetary policy mix typically assumed in New Keynesian models. In this case, the fiscal authority adjusts taxes in response to deviations of public debt from its steady-state level. This is achieved by assuming $\phi = 0.01$, which implies that the adjustment is realistically delayed far into the future. As regards the monetary policy, it follows a standard Taylor rule with feedback coefficients $\gamma_\pi = 1.5$ and $\gamma_y = 0.125$.

Broadly in line with how APPs were implemented in practice, we assume that, once the purchases are announced, they are phased in over a period of one year to peak at about 10 percent of pre-stimulus annual GDP. Then the program is slowly withdrawn so that the central bank balance sheet is back to its pre-APP level after five years since the stimulus. This path is presented in the upper-left panel of Figure 11 as the market value of long-term bonds held by the central bank relative to total outstanding bonds issued by the fiscal authority. By lowering transaction costs associated with holding long-term bonds, asset purchases drive their yields down. It is worth noting that the path of long-term rates is very similar under the two considered variants of the monetary-fiscal policy mix. However, the responses of economic activity, and even more so of inflation differ.

In both monetary-fiscal regimes, lower yields stimulate spending by passive investors, which translates into higher aggregate output. However, lower long-term rates also imply a lower cost of servicing the public debt, so that it starts declining, and the way it is restored to its steady-state value is very different under the two considered variants of the policy mix. When fiscal policy is passive, as in a textbook New Keynesian setup, public debt is brought back to its initial level by a reduction in taxes, which gives an additional boost to consumption. In contrast, an active fiscal regime implies no reaction of any fiscal instrument, so the response of consumption is weaker. Instead, public debt is brought back to its long-run equilibrium

by persistently lower inflation, which, absent an offsetting response from monetary policy, implies higher real interest payments to agents holding short-term bonds and a higher real value of coupons paid to long-term bond holders.

Overall, the proposed simple theoretical framework can rationalize why inflation may fall in response to APPs, as suggested by our empirical results presented earlier in the paper. According to our model, this is a possible outcome during the periods of fiscal dominance. This regime is likely to prevail in exceptional circumstances like the COVID-19 pandemic, which is exactly when so many central banks introduced large-scale asset purchase programs. Fiscal dominance is also more likely in emerging market economies, which typically have a weaker policy framework than advanced countries.

5.2 Effects of government spending

Another somewhat surprising result presented in Section 3 is a strong crowding-in of private consumption by an increase in public spending and high inflation sensitivity to this policy instrument. Note that a standard New Keynesian setup implies that private spending is crowded out unless the policy rate is stuck at the effective lower bound for sufficiently long, which was not necessarily the case for many countries in our sample, and especially not for most emerging market economies. Moreover, the textbook New Keynesian model implies low responsiveness of inflation to an increase in public consumption as this policy increases both actual and potential output, and hence does not generate large movements in the relevant measure of economic slack (the output gap).

Our next experiment with the model is then aimed at checking if it can account for these puzzling results. To this end, Figure 12 plots the dynamic responses to a persistent increase in public consumption, again comparing the two alternative monetary-fiscal regimes. More specifically, we assume that the public consumption shock is driven by an AR(1) process with autocorrelation 0.75, and its initial reaction is normalized to 1 percent.

Starting with the fiscal passive / monetary active regime, we can see standard responses, including an expansion in output but crowding out of private consumption as higher public spending means that taxes must be eventually increased. The implied fiscal multiplier is hence positive, but lower than unity. For reasons discussed above, inflation moves very little.¹²

¹²As can be seen in Figure 12, inflation even falls. This is because we assume that the monetary policy rule responds to deviations of output from the steady state, and so it tightens sufficiently to generate a negative

These outcomes can be contrasted with those arising under fiscal dominance. As taxes do not respond to an increase in public debt, the latter is brought back to its long-run level through higher inflation, which decreases its real level and the real cost of servicing it (given no response of the policy rate). As a result, private consumption is crowded in while inflation, because of its role in achieving debt sustainability, responds vigorously.

Overall, the model is consistent with the reactions of private consumption and inflation that we documented in the empirical part of the paper if the analyzed period could be characterized by fiscal dominance.

6 Conclusions

Large-scale asset purchases have become a commonly used tool in central banks' arsenals in recent years, no longer being limited to several advanced economies struggling with the effective lower bound on the policy rates. This has become recently apparent as APPs were used by the monetary authorities worldwide to mitigate the economic repercussions of the COVID-19 pandemic. These policies have raised concerns about fiscal dominance as they were accompanied by massive fiscal packages. In this study, we presented a new set of estimates of the effects of APPs using a sample of 14 advanced and emerging economies, zooming in on the COVID-19 recession and its aftermath. To this end, we identify APPs shocks using high-frequency methods and use panel local projections as well as Kitagawa-Blinder-Oaxaca decompositions to assess how they affected financial and macroeconomic variables in the analyzed economies.

Our findings indicate that APPs had several effects that are difficult to reconcile with a standard monetary transmission mechanism but can be rationalized in a simple theoretical framework that allows for fiscal policy to be active. These include a fall in inflation in response to an expansion in central bank assets as well as crowding-in of private consumption by government spending, as well as its high influence on inflation. Overall, our combined empirical and theoretical analysis can be treated as indirect evidence that the monetary-fiscal policy mix observed during the COVID-19 recession could be characterized as fiscal dominance, at least in the group of emerging market economies.

output gap. If we assumed that the policy rule features the deviation of output from its flexible price level, the model would generate a positive but still very small response of inflation.

References

- Adrian, Tobias, Christopher J Erceg, Simon T Gray, and Ms Ratna Sahay (2021) *Asset purchases and direct financing: guiding principles for emerging markets and developing economies during COVID-19 and beyond* (International Monetary Fund)
- Altavilla, Carlo, Luca Brugnolini, Refet S. Gürkaynak, Roberto Motto, and Giuseppe Rugga (2019) ‘Measuring euro area monetary policy.’ *Journal of Monetary Economics* 108(C), 162–179
- Andrade, Philippe, and Filippo Ferroni (2021) ‘Delphic and odyssean monetary policy shocks: Evidence from the euro area.’ *Journal of Monetary Economics* 117, 816–832
- Andres, Javier, J. David Lopez-Salido, and Edward Nelson (2004) ‘Tobin’s imperfect asset substitution in optimizing general equilibrium.’ *Journal of Money, Credit and Banking* 36(4), 665–90
- Arena, Marco, Rudolfs Bems, Nadeem Ilahi, Jaewoo Lee, William Lindquist, and Tonny Lybek (2021) ‘Asset Purchase Programs in European Emerging Markets.’ Departmental Paper Series DP/2021/021, International Monetary Fund
- Barro, Robert J, and Francesco Bianchi (2023) ‘Fiscal influences on inflation in oecd countries, 2020-2023.’ Working Paper 31838, National Bureau of Economic Research, November
- Bauer, Michael D., and Eric T. Swanson (2023) ‘A Reassessment of Monetary Policy Surprises and High-Frequency Identification.’ *NBER Macroeconomics Annual* 37(1), 87–155
- Bianchi, Francesco, Renato Faccini, and Leonardo Melosi (2020) ‘Monetary and fiscal policies in times of large debt: Unity is strength.’ Working Paper 27112, National Bureau of Economic Research, May
- Blinder, Alan S. (1973) ‘Wage Discrimination: Reduced Form and Structural Estimates.’ *Journal of Human Resources* 8(4), 436–455
- Brandao-Marques, Luis, Thomas Harjes, Ratna Sahay, Yi Xue, and Gaston Gelos (2021) ‘Monetary Policy Transmission in Emerging Markets and Developing Economies.’ CEPR Discussion Papers 15931, C.E.P.R. Discussion Papers, March
- Caramp, Nicolas, and Dejanir Silva (2023) ‘Fiscal Policy and the Monetary Transmission Mechanism.’ *Review of Economic Dynamics* 51, 716–746

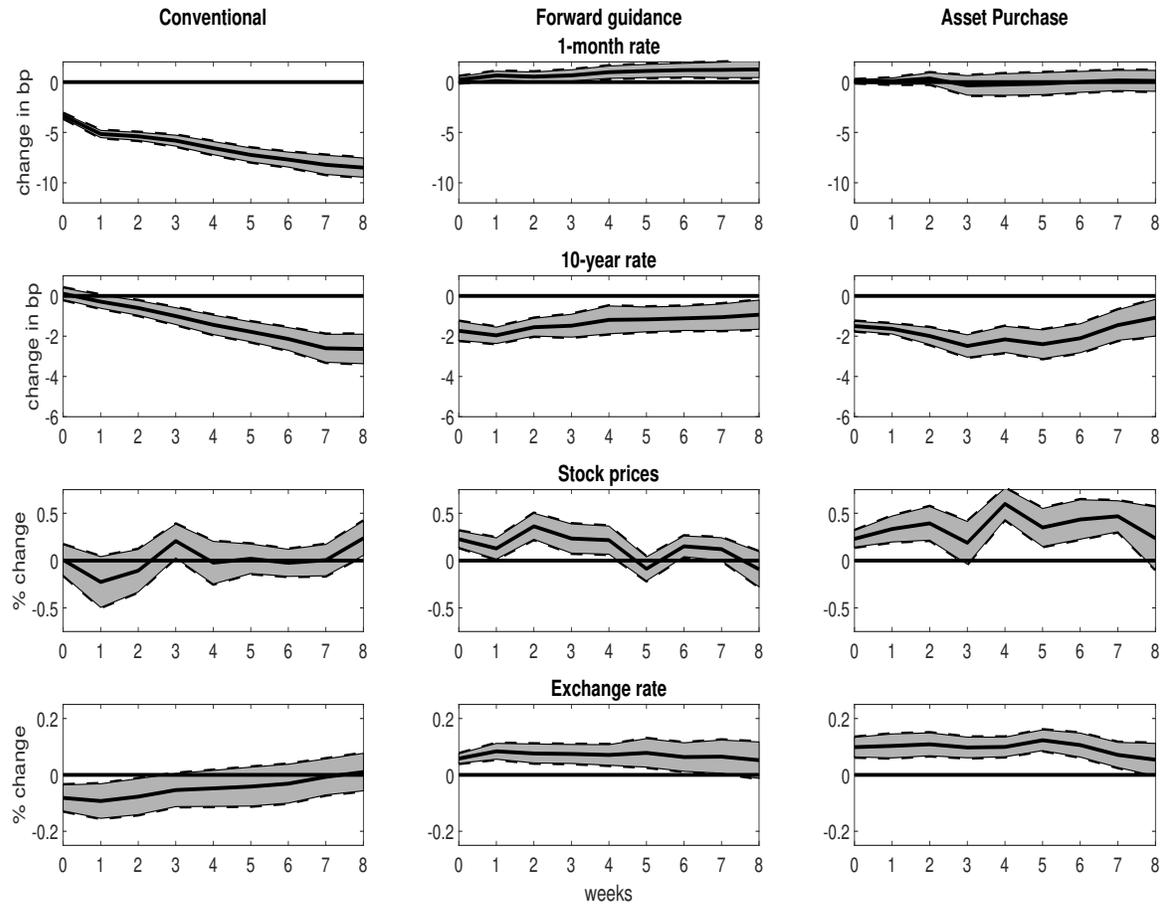
- Checo, Ariadne, Francesco Grigoli, and Damiano Sandri (2024) ‘Monetary Policy Transmission in Emerging Markets: Proverbial Concerns, Novel Evidence.’ BIS Working Papers 1170, Bank for International Settlements, March
- Chen, Han, Vasco Curdia, and Andrea Ferrero (2012) ‘The Macroeconomic Effects of Large-scale Asset Purchase Programmes.’ *Economic Journal* 122(564), F289–F315
- Choi, Sangyup, Tim Willems, and Seung Yong Yoo (2024) ‘Revisiting the monetary transmission mechanism through an industry-level differential approach.’ *Journal of Monetary Economics* 145, 103556
- Cloyne, James S., Òscar Jordà, and Alan M. Taylor (2020) ‘Decomposing the Fiscal Multiplier.’ NBER Working Papers 26939, National Bureau of Economic Research, Inc, April
- Cochrane, John H. (2001) ‘Long-term debt and optimal policy in the fiscal theory of the price level.’ *Econometrica* 69(1), 69–116
- (2022) ‘Fiscal Histories.’ *Journal of Economic Perspectives* 36(4), 125–146
- Cochrane, John H., and Monika Piazzesi (2002) ‘The fed and interest rates: A high-frequency identification.’ *The American Economic Review* 92(2), 90–95
- Deb, Pragyan, Julia Estefania-Flores, Melih Firat, Davide Furceri, and Siddharth Kothari (2023) ‘Monetary Policy Transmission Heterogeneity: Cross-Country Evidence.’ IMF Working Papers 2023/204, International Monetary Fund, October
- Fabo, Brian, Martina Jancokova, Elisabeth Kempf, and Lubos Pastor (2021) ‘Fifty shades of QE: Comparing findings of central bankers and academics.’ *Journal of Monetary Economics* 120(C), 1–20
- Fratto, Chiara, Brendan Harnoy Vannier, Borislava Mircheva, David de Padua, and Helene Poirson (2021) ‘Unconventional Monetary Policies in Emerging Markets and Frontier Countries.’ IMF Working Papers 2021/014, International Monetary Fund, January
- Gertler, Mark, and Peter Karadi (2015) ‘Monetary Policy Surprises, Credit Costs, and Economic Activity.’ *American Economic Journal: Macroeconomics* 7(1), 44–76
- Gilchrist, Simon, David López-Salido, and Egon Zakrajšek (2015) ‘Monetary policy and real borrowing costs at the zero lower bound.’ *American Economic Journal: Macroeconomics* 7(1), 77–109

- Gürkaynak, Refet S, Brian Sack, and Eric Swanson (2005) ‘Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements.’ *International Journal of Central Banking* 1(1), 55–93
- Hall, George J., and Thomas J. Sargent (2022) ‘Three world wars: Fiscal–monetary consequences.’ *Proceedings of the National Academy of Sciences* 119(18), 1–12
- Jarociński, Marek, and Peter Karadi (2020) ‘Deconstructing Monetary Policy Surprises—The Role of Information Shocks.’ *American Economic Journal: Macroeconomics* 12(2), 1–43
- Jordà, Òscar (2005) ‘Estimation and Inference of Impulse Responses by Local Projections.’ *American Economic Review* 95(1), 161–182
- Kiley, Michael T. (2014) ‘The Aggregate Demand Effects of Short- and Long-Term Interest Rates.’ *International Journal of Central Banking* 10(4), 69–104
- Kitagawa, Evelyn M. (1955) ‘Components of a Difference Between Two Rates.’ *Journal of the American Statistical Association* 50(272), 1168–1194
- Kolasa, Marcin, and Grzegorz Wesolowski (2024) ‘Does it matter if the Fed goes conventional or unconventional?’ Working Papers 2024-01, Faculty of Economic Sciences, University of Warsaw
- Kuttner, Kenneth N. (2001) ‘Monetary policy surprises and interest rates: Evidence from the Fed funds futures market.’ *Journal of Monetary Economics* 47(3), 523–544
- Leeper, Eric M. (1991) ‘Equilibria under ‘active’ and ‘passive’ monetary and fiscal policies.’ *Journal of Monetary Economics* 27(1), 129–147
- Leeper, Eric M (2021) ‘Shifting policy norms and policy interactions.’ In ‘Federal Reserve Bank of Kansas City Jackson Hole Symposium,’ Macroeconomic Policy in an Uneven Economy’
- Lewis, Daniel J. (2023) ‘Announcement-specific decompositions of unconventional monetary policy shocks and their effects.’ *The Review of Economics and Statistics* pp. 1–46
- Miranda-Agrippino, Silvia, and Giovanni Ricco (2021) ‘The Transmission of Monetary Policy Shocks.’ *American Economic Journal: Macroeconomics* 13(3), 74–107
- Oaxaca, Ronald (1973) ‘Male-Female Wage Differentials in Urban Labor Markets.’ *International Economic Review* 14(3), 693–709

- Rebucci, Alessandro, Jonathan S. Hartley, and Daniel Jiménez (2020) ‘An Event Study of COVID-19 Central Bank Quantitative Easing in Advanced and Emerging Economies.’ NBER Working Papers 27339, National Bureau of Economic Research, Inc, June
- Sargent, Thomas J., and Neil Wallace (1981) ‘Some unpleasant monetarist arithmetic.’ *Quarterly Review*
- Sims, Christopher A (1994) ‘A Simple Model for Study of the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy.’ *Economic Theory* 4(3), 381–399
- Smets, Frank, and Raf Wouters (2024) ‘Fiscal backing, inflation and us business cycles.’ Technical Report
- Swanson, Eric T. (2021) ‘Measuring the effects of federal reserve forward guidance and asset purchases on financial markets.’ *Journal of Monetary Economics* 118, 32–53
- Witheridge, William (2024) ‘Monetary Policy and Fiscal-led Inflation in Emerging Markets.’ Technical Report
- Woodford, Michael (1994) ‘Monetary Policy and Price Level Determinacy in a Cash-in-Advance Economy.’ *Economic Theory* 4(3), 345–380
- (2001) ‘Fiscal Requirements for Price Stability.’ *Journal of Money, Credit and Banking* 33(3), 669–728

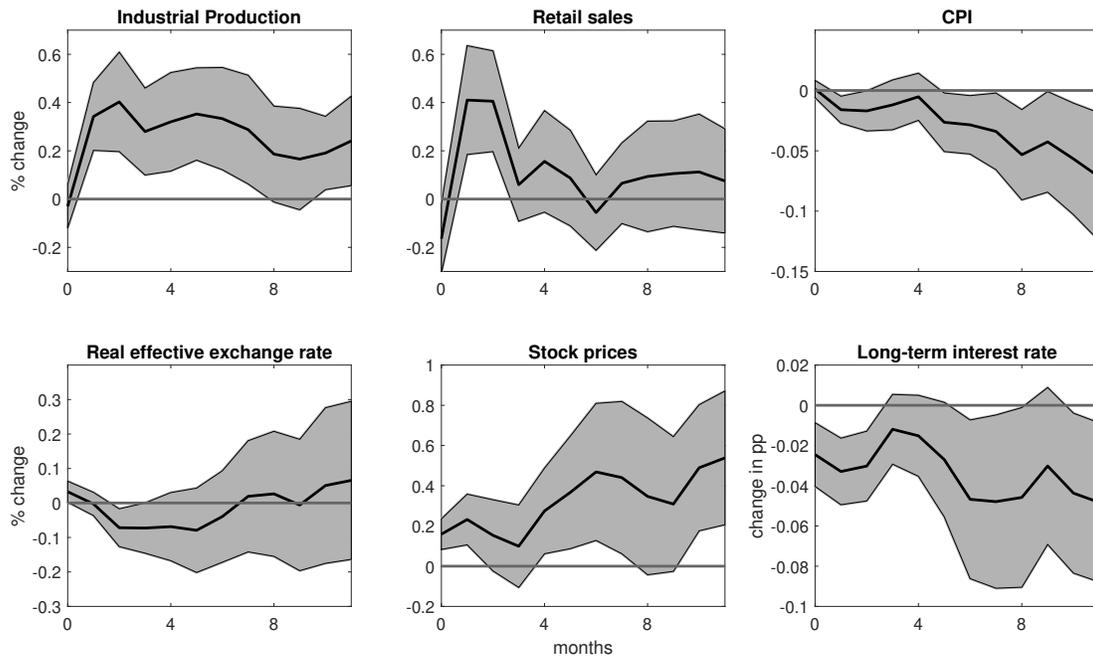
Figures

Figure 1: Shock identification: impact on financial variables



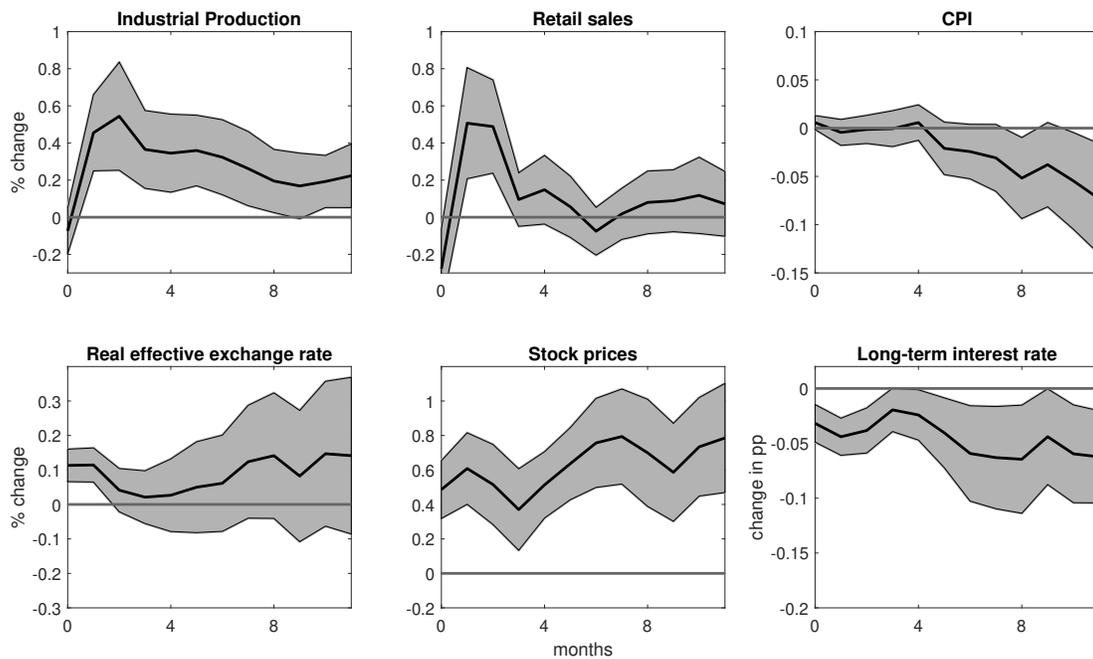
Note: The figure presents the mean responses to three types of identified monetary shocks and the 68% confidence bands.

Figure 2: Impulse response to an APP shock



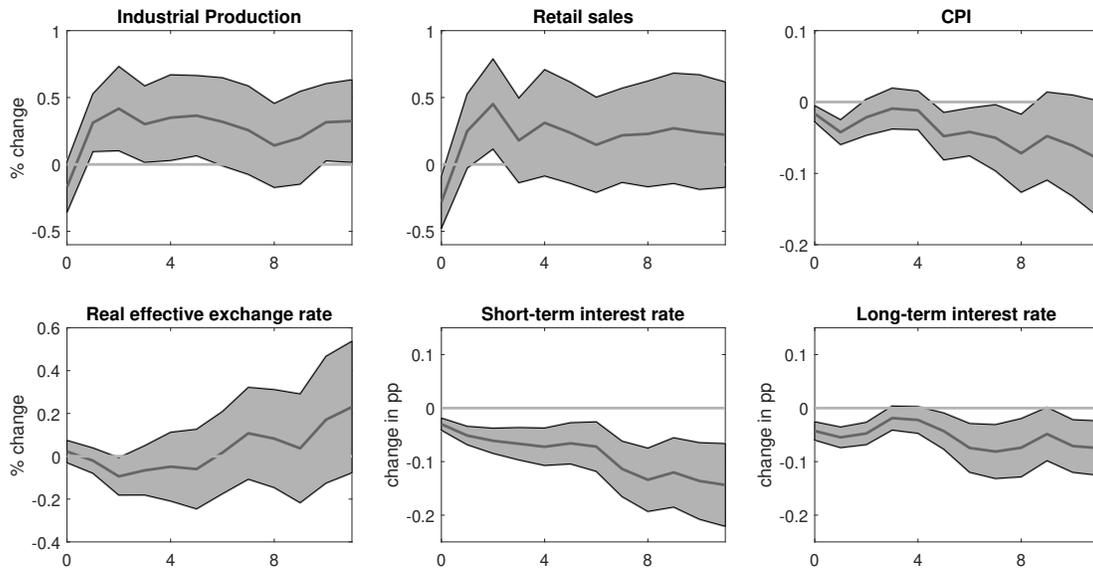
Note: The figure presents the mean responses to APP shocks and the 68% confidence bands.

Figure 3: Impulse response to an APP shock: KBO set of controls



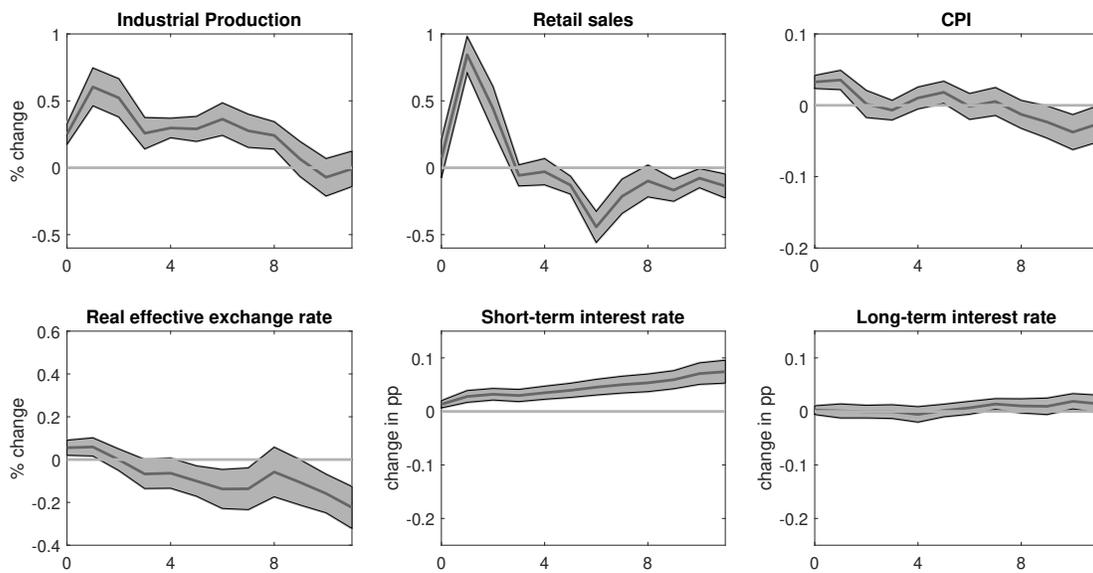
Note: The figure presents the mean responses to APP shocks and the 68% confidence bands.

Figure 4: Impulse response to an APP shock in Emerging Market Economies



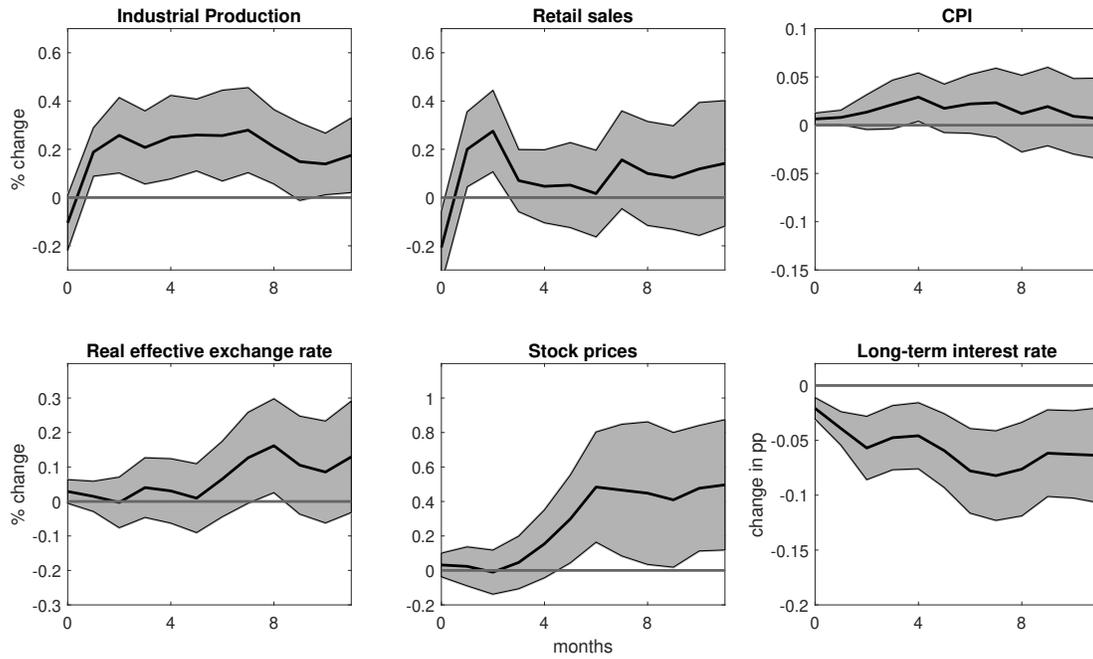
Note: The figure presents the mean responses to APP shocks and the 68% confidence bands.

Figure 5: Impulse response to an APP shock in Advanced Economies



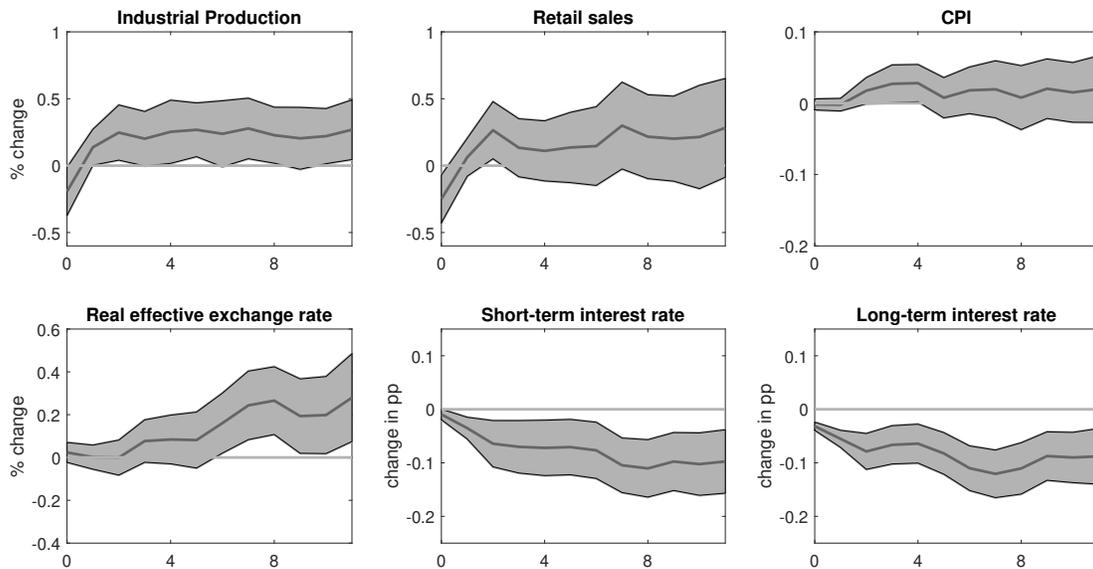
Note: The figure presents the mean responses to APP shocks and the 68% confidence bands.

Figure 6: Impulse response to an APP shock: shocks uncleaned from information effects



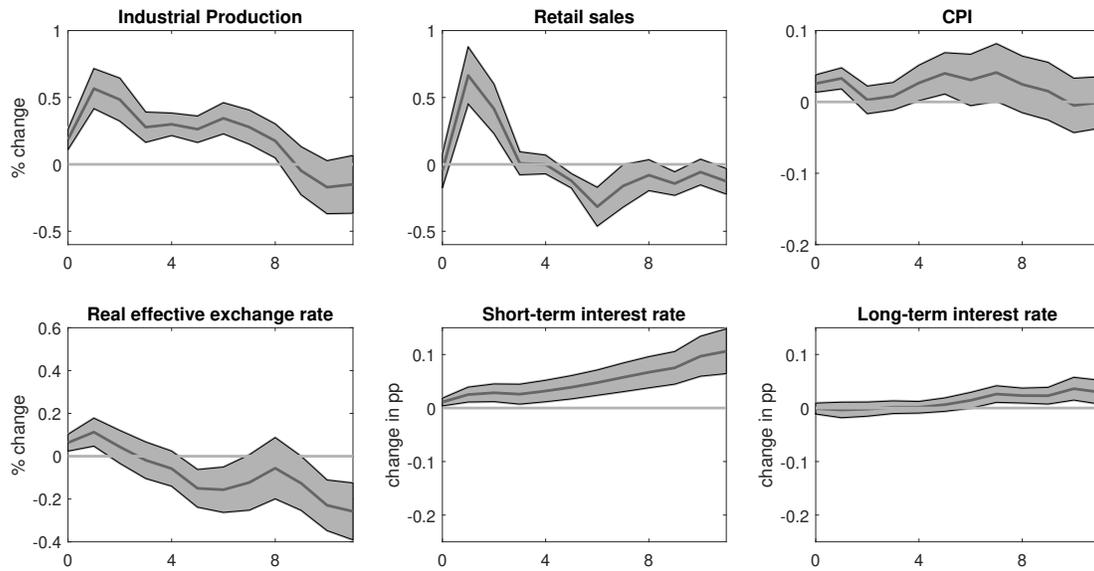
Note: The figure presents the mean responses to APP shocks and the 68% confidence bands.

Figure 7: Impulse response to an APP shock in Emerging Market Economies: shocks uncleaned from information effects



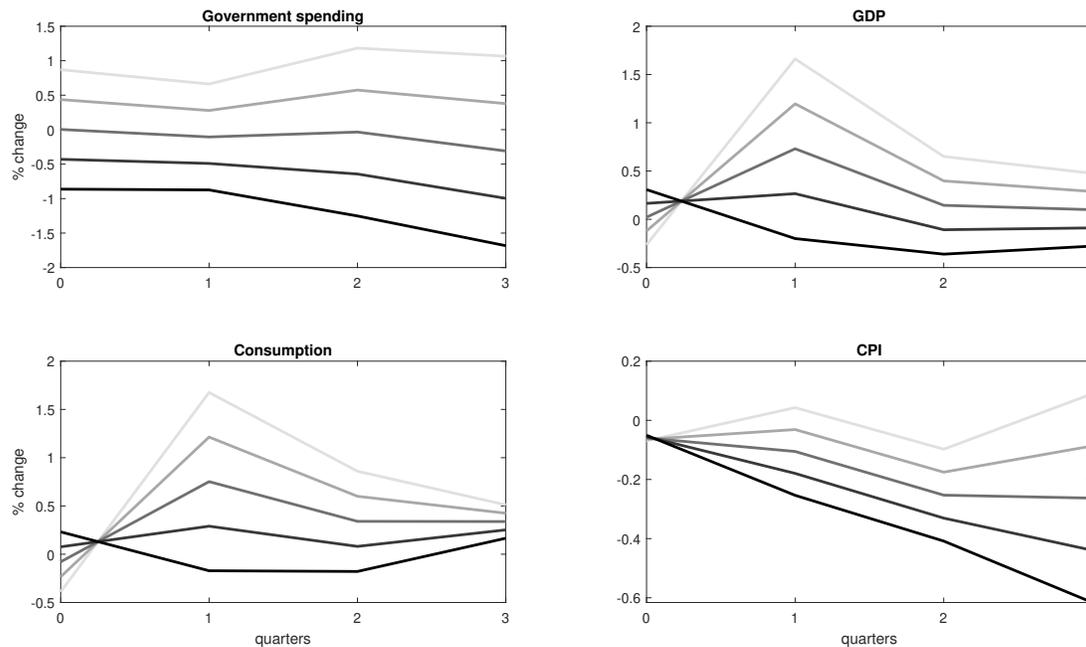
Note: The figure presents the mean responses to APP shocks and the 68% confidence bands.

Figure 8: Impulse response to an APP shock in Advanced Economies: shocks uncleaned from information effects



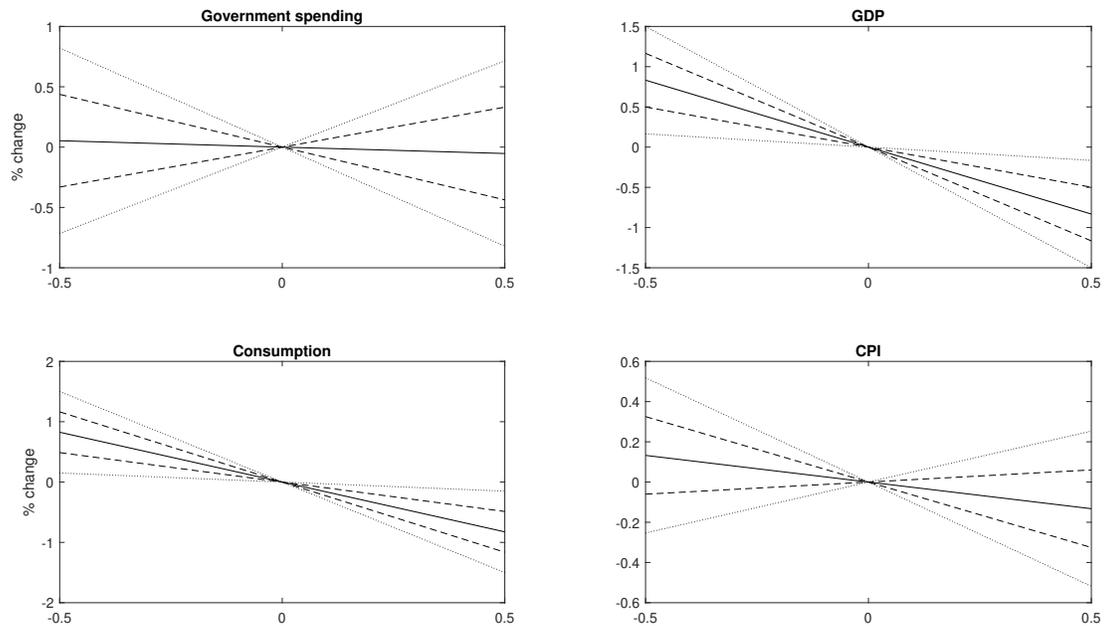
Note: The figure presents the mean responses to APP shocks and the 68% confidence bands.

Figure 9: Impulse responses to an APP shock depending on the degree of fiscal accommodation



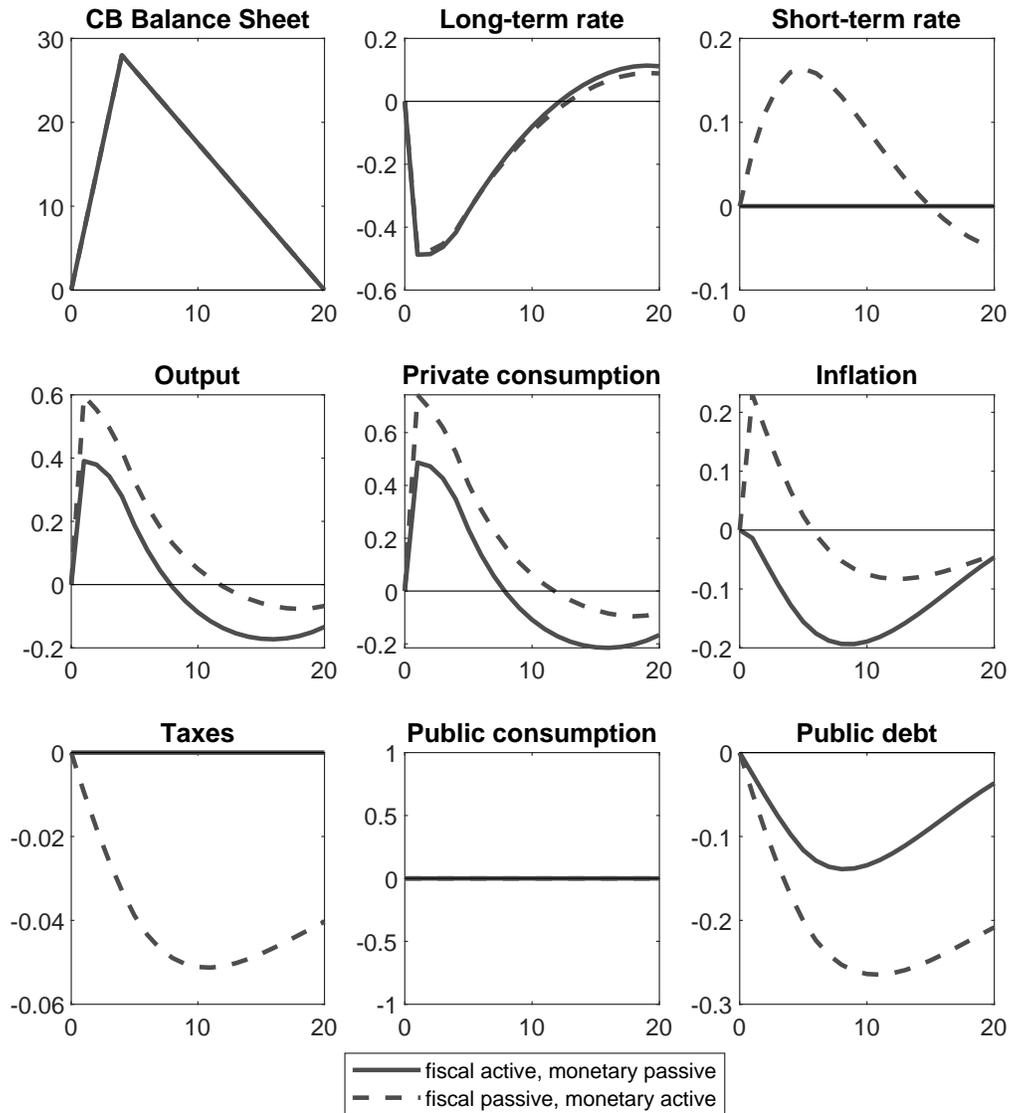
Note: The figure presents the responses to APP shocks for different values of government spending. Darker lines correspond to more restrictive fiscal policy (presented in the upper left panel).

Figure 10: Impact of government spending on responses to APP shocks at one-quarter horizon.



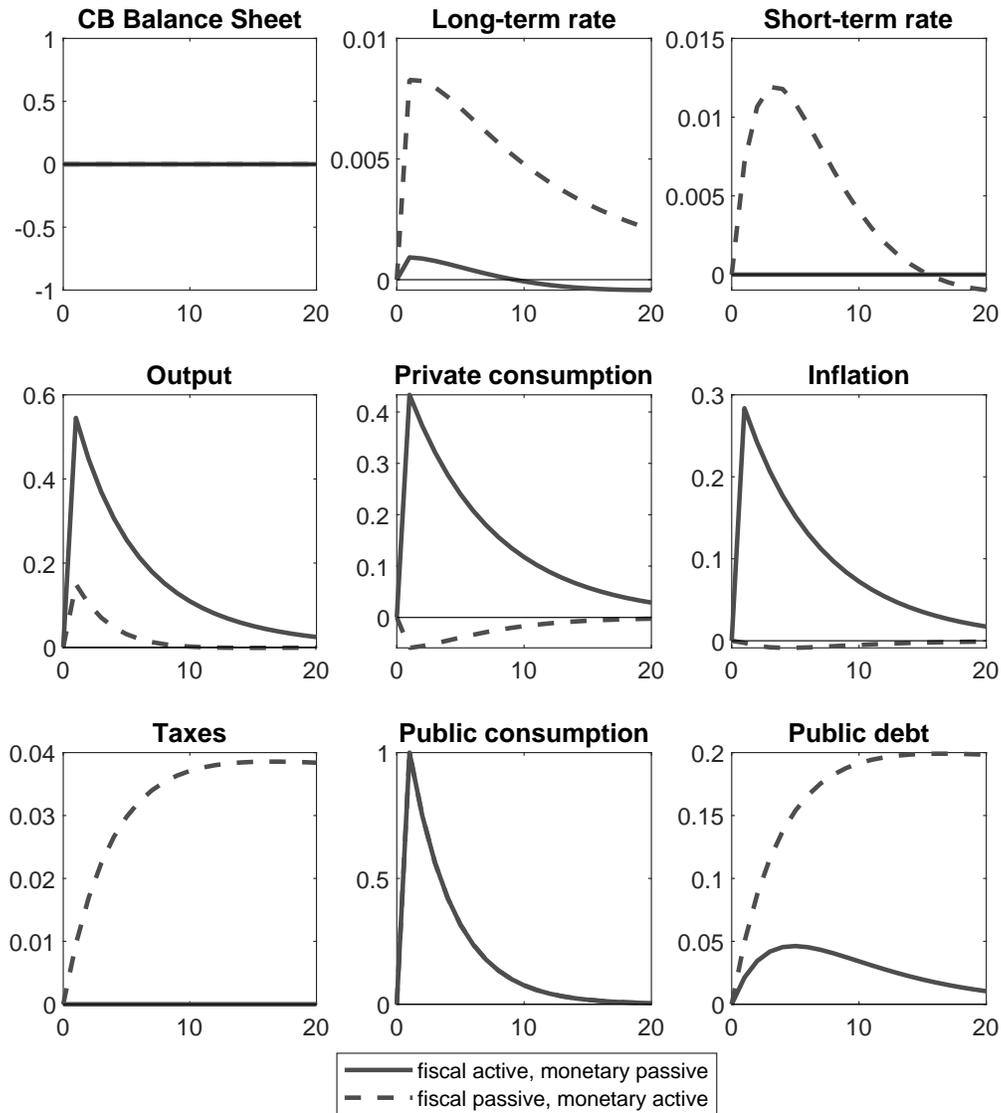
Note: The solid lines in the figure present the differences in the responses to an APP expansion from the mean response in the sample, depending on the degree of domestic fiscal accommodation depicted on the horizontal axis. More accommodative (restrictive) policies are described by positive (negative) values on the horizontal axis. All differences are calculated for the second quarter after the shock. The dashed lines depict \pm one standard deviation interval while the dotted lines correspond to \pm two standard deviation intervals.

Figure 11: Responses to asset purchases



Note: The figure presents dynamic responses to asset purchase programs, introduced as in the upper-left panel, which shows the market value of long-term bonds held by the central bank relative to total outstanding bonds issued by the fiscal authority. Output, private consumption, public consumption, and taxes are expressed in log percent. The long- and short-term rates as well as inflation are presented in annualized percentage points. The public debt is expressed in percent of steady-state annual output. All variables are plotted as deviations from their initial (steady state) levels.

Figure 12: Model-based responses to increase in public consumption



Note: Output, private consumption, public consumption, and taxes are expressed in log percent. The long- and short-term rates as well as inflation are presented in annualized percentage points. The public debt is expressed in percent of steady-state annual output. CB balance sheet reflects the market value of long-term bonds held by the central bank relative to total outstanding bonds issued by the fiscal authority. All variables are plotted as deviations from their initial (steady state) levels.

Tables

Table 1: APP announcement dates

Country	Dates
Brazil	26.06.2020, 21.07.2020
Canada	13.03.2020, 16.03.2020, 17.03.2020, 19.03.2020, 23.03.2020, 24.03.2020, 27.03.2020 30.03.2020, 31.03.2020, 06.04.2020, 09.04.2020, 15.04.2020, 30.04.2020, 19.05.2020 20.05.2020, 03.06.2020, 21.07.2020
Chile	16.03.2020, 19.03.2020, 08.04.2020
Colombia	23.03.2020, 14.04.2020, 15.05.2020
Hungary	16.03.2020, 07.04.2020, 28.04.2020, 21.07.2020
India	18.03.2020, 20.03.2020, 23.03.2020, 23.04.2020, 29.06.2020
Indonesia	02.03.2020, 19.03.2020, 31.03.2020, 21.04.2020, 06.07.2020
Israel	15.03.2020, 23.03.2020, 06.07.2020
Korea	19.03.2020, 26.03.2020, 09.04.2020, 10.04.2020, 24.04.2020, 20.05.2020
Mexico	12.03.2020, 20.03.2020, 21.04.2020, 15.07.2020
Norway	16.03.2020, 20.03.2020, 29.03.2020
Poland	16.03.2020, 17.03.2020, 20.03.2020, 08.04.2020, 28.05.2020, 14.07.2020
Romania	20.03.2020, 29.05.2020, 05.08.2020
South Africa	25.03.2020
Thailand	17.03.2020, 22.03.2020, 07.04.2020

Source: Fratto et al. (2021); Rebucci et al. (2020)

Table 2: Data used to calculate monetary policy shocks

Country	Interest rate tenors	Bloomberg tickers
Brazil	1m	BZAD1M Index
	1x2	BZAD1M Index, BZAD2M Index
	2x3	BZAD2M Index, BZAD3M Index
	3x6	BZAD3M Index, BZAD6M Index
	6x12	BZAD6M Index, BZAD1Y Index
	2y	GEBR02Y Index
	10y	GEBR10Y Index
Canada	1m	CDOR01 Index

Continued on next page

Table 2 – *Continued from previous page*

Country	Interest rate tenors	Bloomberg tickers
Chile	1x2	CDOR01 Index, CDOR02 Index
	2x3	CDOR02 Index, CDOR03 Index
	3x6	CDFR0CF Curncy
	6x9	CDFR0FI Curncy
	9x12	CDFR0I1 Curncy
	2y	GCAN2YR Index
	5y	GCAN5YR Index
	10y	GCAN10YR Index
	1m	CLTN30DN Index
	1x3	CLTN30DN Index, CLTN90DN Index
	3x6	I35103M Index, I35106M Index
	6x12	I35106M Index, I35101Y Index
	2y	I35102Y Index
	5y	I35105Y Index
Colombia	10y	I35110Y Index
	1m	COOVIBR1 Index
	1x3	COOVIBR1 Index, COOVIBR3 Index
	3x6	I21703M Index, I21706M Index
	6x12	I21706M Index, I21701Y Index
	2y	I21702Y Index
	5y	I21705Y Index
	10y	I21710Y Index
Hungary	1m	BUBOR01M Index
	1x2	BUBOR01M Index, BUBOR02M Index
	2x3	BUBOR02M Index, BUBOR03M Index
	3x6	HFFR0CF Curncy
	6x9	HFFR0FI Curncy
	9x12	HFFR0I1 Curncy
	3y	GHGB3YR Index
	5y	GHGB5YR Index
	10y	GHGB10YR Index
	Indonesia	1m
1x3		JIN1M Index, JIN3M Index

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Table 2 – *Continued from previous page*

Country	Interest rate tenors	Bloomberg tickers	
Israel	3x6	JIN3M Index, JIN6M Index	
	6x12	JIN6M Index, JIN12M Index	
	2y	GIDN2YR Index	
	5y	GIDN5YR Index	
	10y	GIDN10YR Index	
	1m	TELBOR01M Index	
	1x3	TELBOR01M Index, TELBOR03M Index	
	3x6	ISFR0CF Curncy	
	6x12	ISFR0FI Curncy, ISFR0I1 Curncy	
	Korea	2y	I32502Y Index
5y		I32505Y Index	
10y		I32510Y Index	
1m		KRBO1M Index	
1x3		KRBO1M Index, KRBO3M Index	
3x6		KRBO3M Index, KRBO6M Index	
6x12		KRBO6M Index, KRBO12M Index	
2y		GVSK2YR Index	
5y		GVSK5YR Index	
10y		GVSK10YR Index	
Mexico	1m	MPTBA Curncy	
	1x3	MPTBA Curncy, MPTBC Curncy	
	3x6	MPTBC Curncy, MPTBF Curncy	
	6x12	MPTBF Curncy, MPTB1 Curncy	
	2y	GMXN02YR Index	
	5y	GMXN05YR Index	
	10y	GMXN10YR Index	
	Norway	1m	NIBOR1M Index
		1x2	NIBOR1M Index, NIBOR2M Index
		2x3	NIBOR2M Index, NIBOR3M Index
3x6		NIBOR3M Index, NIBOR6M Index	
6x12		G0078Z 6M BLC2 Curncy, G0078Z 1Y BLC2 Curncy	
2y		G0078Z 2Y BLC2 Curncy	
5y		G0078Z 5Y BLC2 Curncy	

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Table 2 – *Continued from previous page*

Country	Interest rate tenors	Bloomberg tickers
Poland	10y	G0078Z 10Y BLC2 Curncy
	1m	WIBR1M Index
	1x2	PZFR0AB Curncy
	2x3	PZFR0BC Curncy
	3x6	PZFR0CF Curncy
	6x9	PZFR0FI Curncy
	9x12	PZFR0I1 Curncy
	2y	POGB2YR Index
	5y	POGB5YR Index
	10y	POGB10YR Index
Romania	1m	BUBR1M Index
	1x3	BUBR1M Index, BUBR3M Index
	3x6	BUBR3M Index, BUBR6M Index
	6x12	BUBR6M Index, BUBR12M Index
	2y	ROMGGR02 Index
	5y	ROMGGR05 Index
	10y	ROMGGR10 Index
South Africa	1m	JIBA1M Index
	1x3	JIBA1M Index, JIBA3M Index
	3x6	SAFR0CF Curncy
	6x9	SAFR0FI Curncy
	9x12	SAFR0I1 Curncy
	2y	I09003Y Index
	5y	I09005Y Index
Thailand	10y	I09010Y Index
	1m	BOFX1M Index
	1x3	BOFX1M Index, BOFX3M Index
	3x6	BOFX3M Index, BOFX6M Index
	6x12	BOFX1Y Index
	2y	GTTHB2Y Govt
	5y	GTTHB5Y Govt
	10y	GTTHB10Y Govt

Table 3: Bloomberg tickers of stock indices

Country	Bloomberg ticker
Brazil	IBOV Index
Canada	SPTSX60 Index
Chile	IPSASD Index
Colombia	VLCOC Index
Hungary	BUX Index
Indonesia	JCI Index
Israel	TA-125 Index
Korea	KOSPI Index
Mexico	MEXBOL Index
Norway	OSEBX Index
Poland	WIG20 Index
Romania	BET Index
South Africa	TOP40 Index
Thailand	SET Index

Table 4: Data sources

Variable	Source
Industrial production Brazil, Canada, Chile, Colombia, Hungary, Israel, Korea, Norway, Poland Indonesia, Thailand Romania	OECD Bloomberg Eurostat
Production in total industry, including construction Mexico	OECD
Production in total manufacturing South Africa	OECD
Retail sales Brazil, Canada, Chile, Colombia, Hungary, Israel, Korea, Mexico, Norway, Poland, South Africa Indonesia Romania Thailand	OECD Bank of Indonesia Eurostat Bloomberg
GDP, private final consumption expenditure, government final consumption expenditure Brazil, Canada, Chile, Colombia, Hungary, Indonesia, Israel, Korea, Mexico, Norway, Poland, Romania, South Africa Thailand	OECD IMF Financial Statistics
Consumer price index Brazil, Canada, Chile, Colombia, Hungary, Indonesia, Israel, Korea, Mexico, Norway, Poland, South Africa Romania, Thailand	OECD IMF Financial Statistics
Real effective exchange rate Brazil, Canada, Chile, Colombia, Hungary, Indonesia, Israel, Korea, Mexico Norway, Poland, Romania, South Africa, Thailand	BIS
Interest rates, stock prices, exchange rate of the domestic currency against the USD Brazil, Canada, Chile, Colombia, Hungary, Indonesia, Israel, Korea, Mexico Norway, Poland, Romania, South Africa, Thailand	Bloomberg
Other variables VIX US industrial production, US GDP Mobility index	FRED OECD Google

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