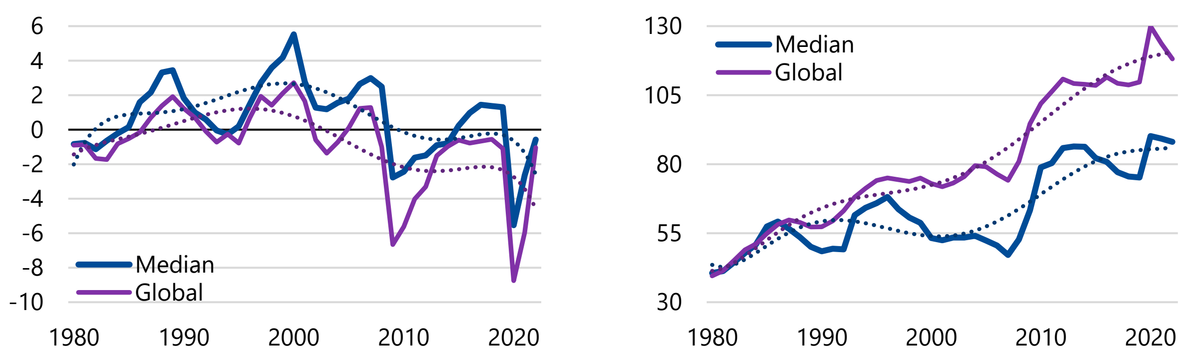
I. Introduction

Advanced economies (AEs) face challenging fiscal outlooks characterized by rising debt levels and spending pressures. Primary balances in AEs have been declining since the Global Financial Crisis (GFC) (Figure 1: panel A). This trend reflects spending related to the GFC and, more recently, the COVID-19 pandemic, as well as expenditures on longer-term structural issues, including rising entitlement spending related to aging, and funding the green transition and supply chain diversification (Gopinath 2021, 2023b). Among other factors, higher primary deficits have led to a surge in public debt ratios, with the mean and median values reaching almost 120 and 90 percent of GDP in 2022, respectively (Figure 1: panel B). Should additional downside risks materialize, fiscal sustainability challenges could become more acute, which in turn could warrant large and front-loaded fiscal adjustments to stabilize the public debt path at a time of waning domestic political cohesion, increasing geoeconomic fragmentation, and low potential growth.[1]

Figure 1. Debt and Primary Balance Dynamics in Advanced Economies[1]



[1] Global variables are weighted by nominal GDP expressed in current USD. Trendlines are sixth-order polynomial.
Source: World Economic Outlook, Public Finances in Modern History, World Bank Development Indicators, and authors' calculations.

The post-pandemic surge in inflation and interest rates reignited discussions on the implications of monetary policy for fiscal sustainability. Several authors noted that the possibility of higher-for-longer interest rates could have implications for fiscal sustainability in AEs.[2] For example, Gita Gopinath highlighted growing fiscal risks associated with rising expenditure pressures, higher-for-longer interest rates, and low growth (Gopinath, 2023a).[3] Olivier Blanchard similarly cited market expectations of higher real interest rates as portending more adverse interest-growth dynamics (Blanchard, 2023). Mario Draghi argued that amid spending needs and low potential growth, central banks should give governments "space" to invest in resilience-enhancing measures including for climate and supply chain spending (Reuters, 2024). Such observations underscore the importance of coherence between both policy levers for promoting long-term macroeconomic sustainability, among other goals.

[1] See Aiyar et al. (2023) on geoeconomic fragmentation and Jones (2023) on the long-term growth outlook.
[2] For recent evidence of upward shifts in natural rates of interest in AEs after COVID, see Benigno et al. (2024), Fernandez-Villaverde et al. (2024), and Lubik et al. (2024).
[3] Disyatat and Borio (2021) and Summers (2023) discuss similar issues, the latter with a focus on the United States.

The extent to which fiscal policy is passive contributes to the degree of fiscal-monetary tensions. As put forth by, inter-alia, Leeper (1991), fiscal policy is typically deemed "passive" when it is limited by other active policy authorities and market prices. Under a passive fiscal policy regime, debt sustainability is typically kept in check as the fiscal authority adjusts the primary balance upward in response to a rise in debt levels or real interest rates. Passive fiscal policy, in turn, allows monetary policy to play an "active" role, as pressures on fiscal sustainability arising from contractionary monetary policy are accommodated by primary balance adjustments, thereby alleviating potential fiscal-monetary tensions. Focusing on earlier sample periods, some studies (e.g. Bohn, 1998, 2005) have shown empirically that fiscal policy in the United States can indeed be characterized as passive, although more recent studies (e.g. Mauro et al., 2015) found that even before the GFC, AEs swung between periods of prudence (passive fiscal policy) and profligacy (active fiscal policy, whereby the primary balance tends to be set exogenously to the debt level).

This paper provides new evidence on the increasing "activeness" of fiscal policy in AEs after the GFC and the COVID-19 pandemic. Replicating the exercise of Bohn (1998) based on an extended sample period that includes the GFC and the pandemic, this paper shows that AEs' primary balances have become unresponsive to higher debt levels, especially after the pandemic. While some have argued that more favorable interest-growth differentials have made lower, and even negative, primary balances more sustainable (e.g., Blanchard, 2019), this paper documents that primary balances have failed to move closer to their debt stabilizing levels. As a result of this increasing activeness of fiscal policy, rising debt levels and potentially high-for-longer interest rates could have implications for fiscal sustainability, thereby motivating the empirical relevance of policy discussions on fiscal-monetary interactions.

It introduces the concept of "fiscal r-star" to better capture fiscal dynamics under "active" fiscal policy regimes. Under passive fiscal policy, a traditionally useful measure for gauging debt sustainability is the *debt-stabilizing primary balance*, defined as the level of primary balance that would achieve a stable ratio of public debt-to-GDP for a given debt stock, inflation target, trend growth rate of potential output, and interest rates. Under an active fiscal policy regime when the primary balance does not adjust endogenously to debt levels, a more relevant measure of debt sustainability is the *debt-stabilizing real interest rate* given the exogenously set fiscal path. Formally, this paper introduces "fiscal r-star" as the real interest rate that would achieve a stable ratio of debt-to-GDP for a given debt stock, inflation target, trend growth, and constant primary balance.

This paper also presents the concept of "fiscal-monetary gap" to measure of fiscal-monetary tensions. Fiscal r-star and its gap relative to the neutral rate of interest (i.e., monetary r-star)—termed the *fiscal-monetary gap*—is relevant for understanding fiscal and monetary policy interactions and their macroeconomic implications and helps frame emergent tensions between fiscal and monetary policy. To the best of the authors' knowledge, few measures currently exist that allow for quantifying the degree of fiscal-monetary tensions in a straightforward manner. Starting from standard frameworks, including the IS and Phillips curves and the law of motion of debt accumulation, it is shown analytically that when fiscal policy is passive, monetary r-star and fiscal r-star are equal. In such a regime, fiscal and monetary authorities can achieve goals of stabilizing debt and keeping inflation at target, respectively, without these goals being in conflict.[4] But when monetary r-star moves above fiscal r-star (for example, due to shifts in desired investment relative to savings), difficult policy trade-offs can arise. When the monetary authority sets its real policy rate to match monetary r-star, public debt dynamics could become explosive for a given trajectory of the primary balance, debt stock, and potential

[4] That said, the fiscal authority can have other goals beyond debt stabilization that could increase fiscal-monetary tensions even absent a binding interest rate constraint vis-à-vis monetary r-star.

output. Therefore, achieving a stable debt-to-GDP ratio would require a primary balance adjustment (i.e., move toward passive policy), which could be pro-cyclical in the context of "higher-for-longer" policy rates and declining growth momentum.[5,6] Alternatively, the monetary authority may "budge" and keep its policy rate below monetary r-star for fiscal purposes. Such a policy could have benefits for fiscal sustainability by reducing the pace of debt accumulation but could cause other challenges for price stability and macroeconomic stability, including financial stability.

There are several theoretical benefits offered by the fiscal r-star and fiscal-monetary gap framework. First, these concepts are grounded in established macroeconomic frameworks and therefore make it possible to compare fiscal-monetary tensions in a standard macroeconomic setting. Second, this theoretical framework provides empirically testable insights about the relationship between the fiscal-monetary gap and expected macroeconomic outcomes. These insights are corroborated by the paper's empirical work, which provides further evidence about the suitability of the theory. Third, fiscal r-star provides an implied price-based measure of fiscal sustainability that allows for clean comparisons between monetary r-star and fiscal dynamics (which traditionally use quantity-based assessments of fiscal sustainability, including the primary balance).

This study estimates fiscal r-star and the fiscal-monetary gap based on over 140 years of data from 16 AEs, highlighting their significant association with key macroeconomic outcomes. It makes two empirical contributions. First, it documents the degree of fiscal-monetary tensions over a relatively long period of modern history, covering World War I, the Great Depression, World War II, the Cold War, the Great Moderation, the GFC, and the pandemic and early post-pandemic period. Current estimates suggest that fiscal-monetary gaps are currently at historic highs last seen in the early 1950s, when AEs were dealing with the significant debt overhang from World War II. Second, local projections show that when the fiscal-monetary gap is high, a combination of rising debt levels, higher inflation, larger fiscal consolidations, exchange rate depreciations, and poorer bond returns tend to follow. There is also evidence of financial repression, with lower real interest rates and higher inflation leading to the liquidation of public debt burdens. In addition, countries with larger fiscal-monetary gaps face elevated risks of future debt, currency, and housing crises, among others. These results thus support the predictions that followed from this paper's theoretical framework.

The rest of this paper proceeds as follows. Section II provides a literature review. Section III motivates the paper's research questions and empirical strategy. Section IV derives formally fiscal r-star and the fiscal-monetary gap and discusses their underlying intuition. Section V estimates fiscal r-star and the fiscal-monetary gap for 16 AEs using over 140 years of data. Section VI analyzes historical developments in the fiscal-monetary gap and key macroeconomic outcomes using local projections. Section VII estimates current levels of the fiscal-monetary gap for a sample of AEs and EMs. Section VIII explores the policy implications that follow from this analysis. Section IX concludes. Annex I provides additional details on the paper's panel regressions on fiscal responsiveness. Annex II gives algebraic derivations of Bohn's test for active fiscal policy, the law of

[5] For example, should growth momentum stall while inflation remains above central banks' targets, then central banks with a price stability mandate (e.g., the ECB and the Federal Reserve) may opt for a restrictive policy stance until a durable disinflation is achieved, even if such a stance further contributes to softer growth. Under these conditions, higher nominal and real interest rates may reduce fiscal space available given the potential for higher funding costs for fiscal authorities. This reduction in fiscal space could cause fiscal authorities to reduce the primary balance, in turn compounding reduced growth momentum, depending on the fiscal multiplier. See Leeper et al. (2010) on potential policy levers and rules in response to higher debt loads.

[6] Fiscal r-star is distinct from the cyclical neutrality of the overall fiscal stance and is a separate but complementary concept to the debt-stabilizing primary fiscal balance.

motion of debt sustainability, fiscal r-star, and the fiscal-monetary gap. Annex III provides recent estimates of fiscal r-star and the fiscal-monetary gap after correcting for historical forecast errors.

II. Literature Review

This paper is situated within three broad strands of literature. These include 1) the theoretical literature on the activeness of fiscal policy and the related treatment of fiscal policy in existing theoretical models, 2) the empirical literature on the characterization of active fiscal policy, and 3) the theoretical and empirical literature related to fiscal-monetary interactions and, to a lesser extent, financial repression.

Following the work of Leeper (1991), policy authority is deemed passive when it is limited by other active authorities and market prices. In Leeper's conception, fluctuations in fiscal policy generally lead to concomitant changes in monetary policy and prices, thus limiting the ability of the fiscal authority to actively target the output level over the medium and long term.[7] By contrast, active policies can pursue their objectives freely, without other policy levels and price signals binding their actions. In this respect, fiscal policy is typically deemed active if it is set *exogenously to prevailing debt levels*. That is, the primary balance does not always respond in a way that would promote debt sustainability in the short, and sometimes, medium term.

Most macroeconomic models, including standard New Keynesian models, tend to assume passive fiscal policy. In such models, government budgets and deficits are assumed to satisfy an inter-temporal solvency condition, or budget constraint, in the long run. The intuition is that given the real interest rate path set by monetary policy, prior accumulated fiscal deficits (i.e., the total sovereign debt stock) cannot be financed by Ponzi-like arrangements, such that the discounted present value of future primary surpluses less seigniorage revenues is equal to or greater than the outstanding stock of debt (see Corsetti and Roubini, 1991). There is little scope for fiscal-monetary tensions under this setup in equilibrium, as any pressures on debt sustainability arising from contractionary monetary policy are assumed to be alleviated by adjustments in the primary balance, thereby satisfying intertemporal solvency. In general, tighter monetary policy forces the fiscal authority to adjust.

A strong characterization of active fiscal policy is the fiscal theory of the price level (FTPL). Under FTPL, as set forth by Woodford (1995) and Cochrane (2001, 2023), among others, the price level is determined by the value of real government debt, which is equal to the discounted present value of future primary surpluses.[8] As the expected fiscal path declines (i.e., moves further into deficit), it follows that in equilibrium, either the fiscal authority will accumulate greater nominal and real debt for a given inflation target, or unexpected inflation will increase to maintain a constant level of real debt even as nominal debt increases.[9] Cochrane's analysis was extended by Brunnermeier, Merkel, & Sannikov (2020), who proposed a model of the fiscal theory of the price level with a bubble term. In their model, the addition of a bubble term allows the fiscal

[7] For more, see Leeper (1991) and Chung, Davig, and Leeper (2007). For an analysis of fiscal pro-cyclicality in the United States, see IMF (2023c). For an accessible description of active and passive policy, see Haltom (2015).
[8] This key idea underpinning the FTPL dates back to at least Keynes (1923, p. 72-73), who argued in the context of the large post-WWI debt burden of France, "(…) *the level of the franc is going to be settled in the long run not by speculation or the balance of trade, or even the outcome of the Ruhr adventure, but by the proportion of his earned income which the French taxpayer will permit to be taken from him to pay the claims of the French rentier. The level of the franc exchange will continue to fall until the commodity-value of the francs due to the rentier has fallen to a proportion of the national income, which accords with the habits and mentality of the country.*" See also Sargent et al. (2019).
[9] Cochrane (2018) argues that in the presence of long-term debt, higher interest rates lead to temporarily lower inflation because they lower the nominal value of long-term securities, necessitating a decline in the price level to keep the real value of debt stable.

authority to finance itself with debt that yields less than the economy's overall growth rate. In turn, the fiscal authority can roll over its existing debt stock into perpetuity without a subsequent rise in inflation while taking advantage of favorable interest-growth dynamics.

Previous empirical studies characterized fiscal policy under different settings. This literature dates to the work of Bohn (1998), who finds that higher debt levels lead to higher primary surpluses in the United States, illustrating that U.S. fiscal policy satisfied intertemporal solvency.[10] Mauro et al. (2015) extend this analysis to assess the history of fiscal profligacy using a panel of 55 countries over two hundred years. These authors find that contrary to Bohn, AEs tended to swing between periods of prudence (where inter-temporal solvency was satisfied) and profligacy (where the budget constraint may not have been satisfied). More recently, Jiang et al. (2019, 2022), also find that the real returns on U.S. government debt fail to satisfy the budget constraint assumption, which suggests the U.S. fiscal authority pursued active fiscal policy.[11] Similarly, studying the fiscal history of the United Kingdom, Chen et al. (2022) also argue that reserve currency providers have latitude to calibrate fiscal policy that does not satisfy an inter-temporal solvency and in turn have more scope for discretionary fiscal policy.

This paper contributes to the above literatures on active fiscal policy and its treatment in macroeconomic models, both empirical and theoretically, in two respects. First, on the empirical front, this paper builds on the exercises of Bohn (1998) and Mauro et al. (2015) based on an extended sample period that includes the GFC and the pandemic. Especially during the pandemic, fiscal policy in AEs was significantly more active relative to earlier periods (see next section). The results hence corroborate the findings of Jiang et al. (2019, 2022) on the active nature of fiscal policy in the United States. Second, motivated by the paper's empirical findings, this paper presents a flexible framework based on standard New Keynesian macroeconomic blocs and accepted definitions of debt sustainability that allow for fiscal policy to be active. Using this framework, a new measure of fiscal sustainability—fiscal r-star—is derived. Under an active fiscal policy regime, the debt-stabilizing real interest serves as a better indicator of debt sustainability relative to the debt-stabilizing primary balance.

This paper also relates to the theoretical and empirical literature on fiscal-monetary interactions.[12] There is a growing body of work that highlights the importance of fiscal-monetary interactions related to stabilization policy, fiscal sustainability, price stability and other monetary policy goals, and financial stability. Earlier examples include Woodford (1998, 2001), who argues that fiscal sustainability is a requisite for price stability, and Chung, Davig, and Leeper (2007) and Davig and Leeper (2011), who use Markov switching models to study fiscal-monetary interactions under different policy combinations. In the wake of large-scale asset purchases by advanced economy central banks after the global financial crisis, authors such as Sims (2013) argued that fiscal-monetary interactions should be central to studies of inflation, monetary policy, and fiscal policy. Aizenman, and Jinjarak (2019) discuss fiscal dominance and analyze its impact on monetary and

[10] Mendoza and Ostry (2008) also find a robust positive conditional response of the primary balance to changes the debt stock for a panel emerging and AEs, although this positive reaction function diminishes at higher debt ratios. Ghosh et al. (2013) confirm the diminishing response for a group of AEs, dubbing this phenomenon "fiscal fatigue". See Willems and Zettelmeyer (2022) for a detailed discussion.

[11] Berndt, Lustig, and Yeltekin (2012) find that surprise shocks to government spending are financed by a mix of the reduction in the market value of U.S. government debt and future primary surpluses, which is consistent with the notion that unexpected inflation can be used to ease the government's budget constraint. Sims (2013) identifies several strands of FTPL, including related to fiscal dominance, central bank balance sheet-fiscal linkages, nominal and real debt levels, among others. See also Barro and Bianchi (2023) who apply the FTPL to an analysis of post-COVID surges in inflation and government spending.

[12] See also Leeper (2023) for a summary of the state of the analysis of monetary-fiscal policy interactions.

exchange rate frameworks, finding evidence that policy rates tend to rise to counteract risk premia associated with higher debt loads.

Several authors develop these concepts in the post-COVID context. Bianchi and Melosi (2022) noted that achieving a sustained disinflation is not possible with monetary policy alone but will also depend on complementary fiscal policy to achieve a fiscal disinflation. These results were corroborated by Caramp and Silva (2023), who argued that fiscal contraction was needed to complement contractionary monetary policy to decisively bring down inflation through wealth effects. Chen et al. (2023) further found that tighter fiscal policy can support central banks' efforts to reduce inflation by, for example, reducing risk premia and signaling the authorities' commitment to price stability in small open EMs. Martin (2023) argued that debt-level targeting fiscal authorities can impose their will on central banks. Also, Bianchi, Faccini, & Melosi (2023) developed a general equilibrium model to show that debt-financed (i.e., unfunded) fiscal shocks contribute to persistent inflation. Platzer and Peruffo (2022) analyzed the drivers of monetary r-star using a heterogenous agent model of the United States and find that debt levels contribute to increases in r-star. Banerjee et al. (2023) further found that based on a panel of AEs over forty years, higher deficits increase the dispersion of future inflation outcomes, including raising the likelihood of high inflation. Looking at the Euro Area, Beyer et al. (2023) modelled the quantitative contribution to lower inflation from fiscal consolidation in the Euro Area, finding that fiscal policy can lower the burden on monetary policy including during periods of high inflation. Previously, Arena et al. (2020) analyzed the impact of lower natural interest rates in a sample of European countries on debt sustainability. Finally, Chen and Kemp (2023) analyzed fiscal-monetary interactions, including vis-à-vis debt management, interest rate risk, and financial stability, in the context of the 2022 Liability-Driven Investment Crisis in the United Kingdom.

Policymakers have increasingly focused on the fiscal-monetary-financial policy mix as well. Economic research examines the extent to which policy levers are consistent and, ideally, are mutually reinforcing. For example, during the pre-COVID period, several economists argued for expansionary fiscal policy given the lower-for-longer interest rate environment to combat risks of inflation expectations being de-anchored to the downside.[13] During the COVID crisis, so-called "modern monetary theory" (MMT) gained prominence by arguing that there are no financial limits to debt and deficits provided a country has its own monetary policy (such that it can print money to pay debt service due).[14] Recently, several authors have noted that the possibility of higher-for-longer interest rates could have implications for fiscal sustainability in AEs, which underscores the need for consistency between both policy levers.[15] Others noted potential challenges to fiscal policy posed by higher-for-longer real interest rates given the post-COVID inflation surge.[16]

This paper's contributions to the literature on fiscal-monetary interactions are two-fold. First, on the theoretical front, by embedding active fiscal policy into a New Keynesian macroeconomic model, this paper allows for the study of fiscal-monetary interactions and their implications for key macroeconomic outcomes in a

[13] See, for example, Buetzer (2022) for a defense of fiscal-monetary cooperation at the zero lower bound (ZLB). See Dalio (2019) on "Monetary Policy 3 (MP3)," which describes fiscal-monetary coordination as the next phase of monetary stimulus when it becomes clear that large-scale asset purchases (LSAPs) are no longer sufficient to increase aggregate demand. Marx, Majon, and Velde (2021) discuss the long-term decline in real interest rates in the pre-COVID context; see also Rachel and Summers (2019).
[14] For seminal texts in MMT, see Kelton (2020) and Mitchell, Wray, and Watts (2019). For critiques of MMT, see Mankiw (2020).
[15] For instance, see the points raised by Gopinath (2023) and Blanchard (2023) mentioned in the first section of this paper. In addition, the April 2023 *Fiscal Monitor* of the International Monetary Fund (IMF, 2023a) noted that fiscal policy should support monetary policy during periods of above-target inflation, including by cooling off demand via fiscal consolidation and reducing the potential for adverse fiscal-financial (and by extension, monetary) feedback loops. See also Schnabel (2022) on achieving the right fiscal-monetary policy mix during inflation surges in the Euro Area.
[16] See Arslanalp and Eichengreen (2023) and Summers (2023).

standard macroeconomic setting. To this end, this paper also introduces a new interest rate-based measure of fiscal monetary tensions, through the concept of the "fiscal-monetary gap," which is defined as the difference between the fiscal r-star and monetary r-star. It is shown that a change in this gap has important implications for key macroeconomic outcomes and discuss policy levers that could be used to close the gap. To the best of the authors' knowledge, few measures currently exist that allow for quantifying the degree of fiscal-monetary tensions in a straightforward manner. This paper provides one such attempt. Second, the paper's empirical contribution is in the estimation of the fiscal r-star and fiscal-monetary gap for AEs based on over 140 years of data. This allows for documenting the evolution of fiscal-monetary interactions over a relatively long period of modern history. Beyond providing estimates of such tensions, additional analyses on the impact of a rise in the fiscal-monetary gap on key macroeconomic outcomes are conducted, which show that this paper's theoretical predictions are indeed supported by the data.

Finally, this paper adds to the literature on financial repression as a mechanism to address fiscal-monetary tensions. Recent developments have rekindled interest in financial repression as a mechanism to reduce debt. Reinhart and Belen Sbrancia (2015) introduce the concept of *debt liquidation*, which is the use of negative real interest rates via financial repression to reduce the real value of outstanding debt stocks. Jeanne (2023) notes the historic tendency of governments to rely on debt liquidation and financial repression, presenting a theory of optimal financial repression. Hall and Sargent (2022) compare monetary-fiscal responses during the COVID crisis and earlier U.S. wars, including the use of *de facto* financial repression.[17] This paper contributes to this literature by showing that during periods when the measured fiscal-monetary gap is large, bond market returns tend to decline, while debt liquidation increases. Seen in this light, financial repression is one option among of a menu of choices historically used by to policymakers when debt stocks are high and primary balance adjustments could be challenging to implement, especially in a low-growth and higher-for-longer interest rate environment.

III. Motivation

This section provides motivating evidence on "active" fiscal policy in AEs. This analysis is relevant for the study of fiscal r-star because if it can be shown that fiscal policy does not respond to changes in the debt stock (and could thus be considered "active"), it follows that non-debt stabilizing primary balance paths can be considered into the medium term. Put differently, under active fiscal policy, the primary balance path is set *exogenously* to debt levels, which allows other variables in the debt accumulation equation, including the real interest rate, to be relevant for the fiscal path.

The analytical starting point is the standard equation for debt accumulation. The existing stock of debt (D_{t-1}) must be repaid with interest (applied at rate i_{t-1}) at the end of the period.[18] The government budget constraint in period *t* is given by $G_t + (1 - i_{t-1})D_{t-1} = T_t + D_t$, where G_t denotes nominal non-interest (or primary) expenditure and T_t denotes nominal tax revenues.[19] The change in a country's public debt-to-GDP ratio in a given year *t* (Δd_t) can be written as the law of motion of debt (equation (1)) below.

[17] Acalin and Ball (2023) examine the roles of primary budget surpluses, surprise inflation, and pegged interest rates before the Fed-Treasury Accord of 1951.
[18] By convention, a gross debt concept is used for debt sustainability equations. Potential mitigants of risks posed by higher gross public debt include gross government asset holdings (i.e., considering net debt). On the other hand, governments also face implicit liabilities such unfunded entitlements. Hence, this paper uses a gross government debt concept.
[19] For convenience, this paper assumes no non-tax revenues.

$$(\mathbf{1})\ \Delta d_t = \frac{r_t - g_t}{1 + \pi_t + g_t} d_{t-1} - pb_t$$

Debt dynamics thus improve with an increase in the growth rate g_t, an increase in inflation π_t, or an increase in the primary balance as a percentage of GPD pb_t. They get worse when real interest rate r_t increases.[20, 21]

The value of outstanding government debt can be expressed by a debt valuation equation in which the current debt stock is "backed" by the present value of future primary balances. If holders of government debt price bonds using a constant discount rate δ, debt is valued according to the following equation (2):

$$(\mathbf{2})\ d_{t-1} \frac{1 + i_{t-1}}{1 + \pi_t} = E_t \sum_{j=0}^{\infty} \frac{(1+g)^{j+1}}{(1+\delta)^j}\ pb_{t+j} + \lim_{T \to \infty} E_t \frac{(1+g)^{T+1}}{(1+\delta)^T} d_T\ ,$$

which follows from rearranging and iterating over the budget constraint in equation (1), where real GDP growth is assumed at a constant rate g. The first term on the righthand side is the present value of primary balances. The second term is a bubble term, which is usually assumed to be zero by invoking a private-sector transversality condition (Brunnermeier et al., 2022). When this equation is interpreted as an intertemporal solvency condition, the potential paths of primary balances are restricted to those that are consistent with the path of real interest rates and inflation in (2). Hence, standard New Keynesian frameworks, including dynamic stochastic general equilibrium (DSGE) models, assume that fiscal policy is passive: that is, in the long term the fiscal authority adjusts the primary balance in response to the debt ratio.[22]

The extent to which fiscal policy responds to public debt levels (and thus meets the aforementioned condition) is assessed through two regression exercises. First, following Bohn (1998) and Mauro et al. (2015), the degree to which fiscal policy is implemented to stabilize debt levels is assessed by exploring systematic relationships between the primary balance and the debt ratio. The following fiscal reaction function is imposed:

$$(\mathbf{3})\ pb_t = \rho_1 \cdot d_{t-1} + \alpha_1 (Q_t - Q_t^*) + \epsilon_t\ ,$$

[20] This assumes public debt consists of one-period bonds and that the stock of inherited debt must be repaid with interest at the end of the period. Revenues do not include interest income, and nominal GDP growth is assumed to be sufficiently low and there are no stock-flow adjustments. See Annex I for exact assumptions and derivation. For another assessment of how to assess debt sustainability via an intertemporal budget constraint, see Roubini (2021). It follows from the law of motion of debt that if r < g, then there is fiscal space to run primary deficits while still observing stable or declining debt-to-GDP ratios. For this argument applied to present-day debt dynamics in AEs, see Blanchard (2022). On the fiscal "growth dividend" provided by faster growth on debt-to-GDP ratios, see Bohn (2005).

[21] Decompositions of debt dynamics often use a residual stock-flow adjustment term, which includes potential discrepancies between actual public debt and recorded deficits (Weber, 2012). Traditionally, stock-flow adjustments include valuation effects through the impact of exchange rate changes on FX-denominated debt, recording effects (deficits are often recorded on an accrual basis while debt is a cash concept), and below-the-line financial transactions such as changes in government deposits, privatizations and realizations of contingent liabilities. Note that equation (1) does not include separate seigniorage income.

[22] The most obvious is to implement the fiscal stance that stabilizes the debt-to-GDP ratio taking monetary policy (and thus real interest rates) as given. This d*ebt-stabilizing primary balance* is given by rearranging equation (1) such that the primary balance equals $\frac{r_t - g_t}{1+g_t+\pi_t} d_{t-1}$. For a full treatment of the characterization of optimal fiscal policy in response to monetary policy, see Benigno and Woodford (2003).

where $Q_t - Q_t^*$ is the output gap. The first test is to estimate ρ_1. Bohn (1998) argues if ρ_1 is significantly larger than $\frac{1+\bar{x}}{\bar{x}}$, where $\bar{x}$ is the interest-growth rate differential, then the debt ratio is stationary and mean-reverting. If the interest-growth rate differential is zero, then this procedure simply testes whether $\rho_1 > 0$. For a detailed derivation of this condition, see Annex II.

A key condition for Bohn's result is the stationarity of the real interest-growth differential in equation (1). More formally, this expression is given by the following: $\frac{r_t - g_t}{1+\pi_t+g_t}$. Since Bohn introduced this test, there have been secular declines in neutral real interest rates and potential growth rates, especially in AEs (see, for example, Rachel and Summers, 2019; IMF, 2023; Obstfeld, 2023). The ensuing change in the difference between real interest rates and real growth rates (i.e., r - g) creates additional fiscal space and greater debt-carrying capacity (Blanchard, 2019, 2023). In practice, policymakers often rely on comparisons between the actual primary surplus and the primary surplus required to stabilize the debt ratio (Mauro et al., 2015). In the medium term, it should be expected that the following version of the *debt stabilizing primary balance* pb_t^{DS} is achieved to stabilize debt that is defined formally in equation (4), where pb_t^{DS} is the primary balance that stabilizes debt when the real interest rate equals the time-varying neutral rate r_t^*, output grows at its current trend growth rate of potential output ($\bar{g}_t$) and inflation is at target ($\bar{\pi}$):

$$(\mathbf{4})\; pb_t^{DS} = \frac{r_t^* - \bar{g}_t}{1+\bar{\pi}+\bar{g}_t} d_{t-1} \;.$$

In the second exercise, the activeness of fiscal policy is assessed using the following fiscal reaction function, represented below in in equation (5):

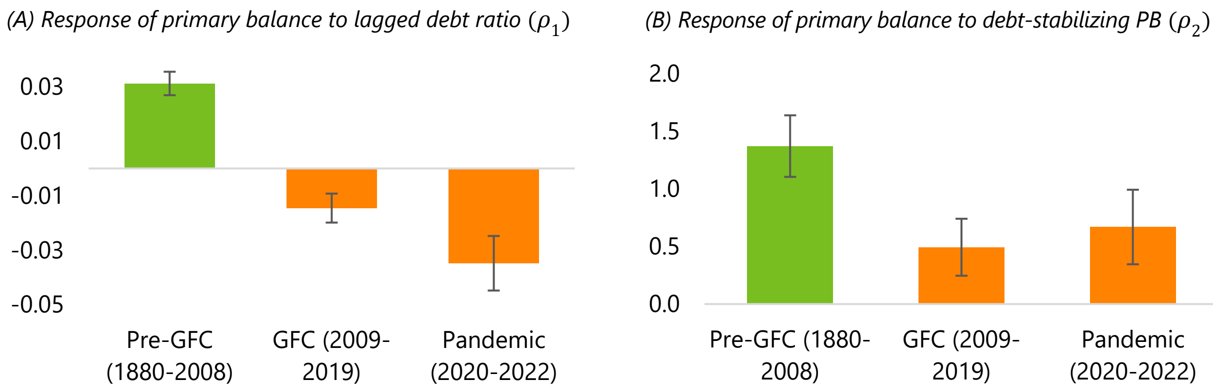
$$(\mathbf{5})\; pb_t = \rho_2 \cdot pb_t^{DS} + \alpha_2(Q_t - Q_t^*) + \epsilon_t \;\;.$$

The second test for fiscal policy, therefore, is whether the primary balance is expected to catch up with the debt-stabilizing primary balance, which occurs if ρ_2 is equal to one. If ρ_2 greater than one, then the debt ratio is stationary.[23,24]

Equations (3) and (5) are estimated using panel regressions. Based on a sample of 16 AEs over the period from 1880 to 2022, equations (3) and (5) are estimated using panel regressions using time and country fixed effects. To examine the activeness of fiscal policy over time, the responsiveness of the primary balance in three different sub-periods is captured, namely 1) pre-global financial crisis (GFC) (1880-2008), the post-GFC period (2009-2019), and the COVID pandemic (2020-2022).[25]

[23] The requirement that ρ_2 is greater than one has some similarities with the Taylor principle for monetary policy. Note that a fiscal policy that set the primary balance equal to the debt stabilizing primary balance such that $\rho_2 = 1$ does stabilize the debt ratio but does not guarantee that the debt ratio is stationary since it implies that the law of motion of debt has a unit root.
[24] See Annex II for the derivation.
[25] Additional details are provided in Annex I.

Figure 2. Responsiveness of Fiscal Policy to Debt and Debt Stabilizing Primary Balances[1]



[1] Solid lines indicate statistical significance at 10 percent significance level, where robust standard errors are used, clustered by year.
Source: Public Finances in Modern History, Jorda et al. (2017), Platzer et al. (2023), authors' calculations.

Results indicate that fiscal policy in AEs has become more "active" since the global financial crisis and especially during the pandemic. The estimates of ρ_1 and ρ_2 are plotted in Figure 2. Based on panel A, AEs' primary balances appear to respond positively to the lagged debt ratio during the pre-GFC period, indicative of passive fiscal policy and consistent with the findings in Bohn (1998, 2005). Such a response is economically and statistically significant, with a 1 percentage point higher debt ratio associated with a rise in the primary balance of 0.03 percentage points.[26] In contrast, such a response becomes negative but statistically insignificant during the GFC period, and negative *and* statistically significant during the pandemic. This negative response provides *prima facie* evidence against the notion of passive fiscal policy.[27] This conclusion is further confirmed based on the estimates of ρ_2 from equation (5) in panel B. These estimates suggest that while the primary balance moved more than one for one with the debt stabilizing primary balance during the pre-GFC period, such an endogenous response has become muted since the GFC. Both during the GFC and pandemic period, the response of the primary balance to the debt stabilizing balance was significantly smaller than one. There are several potential drivers of the increasing inelasticity of the primary balance to both the lagged debt stock and lagged primary balance, including discretionary spending pressures, waning social and political cohesion, as well as the lack of currently viable deficit-reduction coalitions, among other political economy causes.[28]

[26] This result is in line with the economic magnitude of the estimated coefficient in the Bohn (1998) paper, which estimates a coefficients ranging from 0.03 to 0.05 for the United States on data from 1916 to 1995.
[27] In practice, primary balances tend to be highly autocorrelated, which raises a concern on whether this autocorrelation could affect the estimation results. We also conduct the exercise after including the lagged dependent variable, and find the results to be robust.
[28] See, for example, Arslanalp and Eichengreen (2023).

IV. Defining Fiscal R-Star and the Fiscal-Monetary Gap

This section introduces the concepts of fiscal r-star and the fiscal-monetary gap. It is motivated by previous empirical evidence on the increasing activeness of fiscal policy. Under an active fiscal regime, the debt stabilizing real interest rate—what is termed "fiscal r-star"—serves as a more relevant measure of debt sustainability relative to the more common approach of calculating the debt stabilizing primary balance, since fiscal policy is less responsive to debt loads and the primary balance under active fiscal policy. In addition, a new measure of fiscal-monetary tensions is introduced: the "fiscal-monetary gap." By constructing such a measure from standard macroeconomic frameworks, this paper provides a theoretically justified measure of fiscal-monetary tensions. This section also examines the theoretical implications of rising fiscal-monetary tensions as proxied by the fiscal-monetary gap for macroeconomic outcomes, including how such gaps can be closed via different policy levers.

Fiscal R-Star

The *debt-stabilizing real interest rate* for a given fiscal path—termed "fiscal r-star"— is a useful measure of debt sustainability and a crucial input for assessing fiscal-monetary tensions. Given the active nature of fiscal policy documented in the previous section, the expected fiscal path is taken as given (i.e., holding the path of expected primary balances fixed). It is thus possible to back out the implied real interest rate that would stabilize the debt-to-GDP ratio at a terminal level. More formally, fiscal r-star is the unobserved real interest rate that would achieve a stable ratio of public debt to GDP ($\bar{d}$) for a given inflation target ($\bar{\pi}$) and expected constant path of the primary balance as a percentage of potential GDP ($\overline{pb}$) and the trend growth rate of potential output ($\bar{g}$) at a given time.[29] Rewriting equation (1) accordingly gives the following equation for fiscal r-star (equation (6)), where fiscal r-star increases when target (i.e., terminal) debt-to-GDP ratios decline or the primary balance, inflation target, and real growth rate increase:[30]

$$\textbf{(6)}\ r_f^* = \bar{g} + (1 + \bar{\pi} + \bar{g})\frac{\overline{pb}}{\bar{d}},$$

Inserting this definition back into equation (1) gives the debt accumulation equation as a function of fiscal r-star (equation (7)):

$$\textbf{(7)}\ \frac{\Delta d_t}{\bar{d}} = \frac{r_t - r_f^*}{1 + \bar{\pi} + \bar{g}} - \frac{pb_t - \overline{pb}}{\bar{d}}\ .$$

[29] Fiscal r-star includes the inflation target because it is relevant for the debt-stabilizing primary balance in standard definitions as most debt sustainability analyses use the nominal debt concept—a convention followed in this paper. The debt ratio used in this paper is the ratio of the nominal stock of accumulated debt relative to the current nominal flow of GDP. If the debt stock would be discounted relative to the flow of GDP, the definition of fiscal r-star would change to $r_f^* = \bar{g} + \frac{\overline{pb}}{\bar{d}}$.

[30] See Annex II for the full derivations of fiscal r-star and the fiscal-monetary gap. This paper defines a real interest rate as the difference between a nominal interest rate and the ex-post inflation rate, i.e., the real interest rate on government debt is defined as $r_t \equiv i_{t-1} - \pi_t$. This definition gives rise to the inflation term in equation (6). The definition of fiscal r-star does not include the inflation target if the real interest rate is defined as the ratio of the gross nominal interest rate and the gross inflation rate, i.e., as $1 + r_t \equiv \frac{1+i_{t-1}}{1+\pi_t}$.

In frameworks with an explicit role for money, fiscal r-star represents the real interest rate that keeps the growth of the money supply in line with the inflation target while also stabilizing the debt ratio. This definition follows from inserting fiscal r-star in the government budget constraint that includes money (i.e., following from Brunnermeier et al., 2020), if output is growing at potential and the primary balance is active at $\overline{pb}$, the law of motion of government liabilities relative to GDP collapses to equation (8), below:[31]

$$\textbf{(8)}\ \Delta d_t + \frac{\mu_t - \pi_t - \bar{g}}{1 + \pi_t + \bar{g}} \cdot m_{t-1} = \frac{(\pi_t - \bar{\pi})}{1 + \pi_t + \bar{g}} \cdot \overline{pb}$$

where μ_t is the growth rate of the nominal money stock and m_{t-1} is the ratio of the initial money stock to GDP. Provided velocity is constant in the equation of exchange, the central bank can set $\mu_t = \bar{\pi} + \bar{g}$ such that inflation is at target ($\pi_t = \bar{\pi}$) and the debt ratio is constant ($\Delta d_t = 0$).

Fiscal r-star can also be interpreted as the real discount rate required for the private sector to absorb the current stock of government debt and stabilize inflation. Ruling out the bubble term and holding the primary balance fixed, equation (2) collapses to equation (9), such that the debt ratio and inflation are stable and at target if the discount rate equals the sum of the real interest rate and the inflation target, i.e., $\delta = r + \bar{\pi}$.):[32]

$$\textbf{(9)}\ d_{t-1}(1 + r_t) = \overline{pb} \cdot \frac{1 + \delta}{\delta - g},$$

This equation implies the definition of fiscal r-star in equation (6). Fiscal-monetary tensions arise if the real interest rate is too low relative to the real discount rate needed to stabilize the debt ratio.

When fiscal policy does not necessarily react to stabilize the debt ratio, fiscal r-star becomes a useful concept within standard frameworks with IS and Phillips curves.[33] Assuming the dynamics of prices and output fall within the standard aggregate supply-aggregate demand frameworks (e.g., Gali, 2008), and abstracting from cost-push shocks, inflation evolves according to equation (10):

$$\textbf{(10)}\ \Delta \pi_t = \Phi_t - \phi(r_t^P - r_m^*);$$

Equation (10) is obtained from combining the equations governing the standard IS and Phillips curves: ϕ is the sensitivity of inflation to changes in the real policy rate r_t^P, and, importantly, r_m^* is the natural rate of interest or conventional r-star—that is, the real interest rate at which output is at potential and inflation is at target.[34] To distinguish this real interest rate measure from fiscal r-star, this paper henceforth refers to this natural rate of

[31] In this case, the government budget constraint is $G_t + (1 + i_{t-1})D_{t-1} + (1 + i_{t-1})M_{t-1} = T_t + D_t + M_t$, and fiscal r-star is defined as $r_f^* = \bar{g} + (1 + \bar{\pi} + \bar{g})\frac{\overline{pb}}{d + \bar{m}}$, where $\bar{m}$ is a given ratio of the nominal money stock to GDP.
[32] A bubble can be ruled out if the risk-free real rate is large than the real growth rate. See Jiang et al. (2019) and Brunnermeier et al. (2020) for a discussion. Note that going from (2) to (9) uses the approximation $\frac{1+i_{t-1}}{1+\pi_t} \approx r_t$.
[33] These derivations and definitions are consistent with debt sustainability models put forth in IMF staff guidance (see, for example, IMF (2022)).
[34] See Annex II for a derivation. Note that equation (4) implicitly assumes that the GDP deflator and consumer price index (CPI) are roughly equal. Also note that equation (4) combines the IS and Phillips curves into one equation.

interest as the *monetary* r-star.[35] Inflation expectations also matter for inflation dynamics in (10) through the term Φ_t, which reflects the deviation of expectations of future inflation from its past reading.[36]

The choice of terminal debt-to-GDP ratios is a critical determinant of fiscal r-star, but identifying the appropriate level requires judgment. At first instance, as terminal debt levels rise, the right-hand side term in equation (6) declines, thus lowering fiscal r-star. However, choosing optimal debt-to-GDP ratios can be arbitrary, and there is ambiguity regarding optimal debt levels for countries, which depends on a country's debt carrying capacity, indicators of both liquidity and solvency, debt profile, and credibility with market participants, among other factors. One of the advantages of the fiscal r-star framework is that it can accommodate different debt targets, as reflected in variable $\bar{d}$.

For the purposes of this exercise, monetary r-star is treated as exogenously determined. In the closed-form solution of fiscal r-star and the fiscal-monetary gap, it is assumed that monetary r-star is not affected by the fiscal stance. Treating monetary r-star as exogenous to the fiscal stance is a simplifying assumption, which may not be relevant either in closed or large open economies, where changes to the fiscal stance can impact public savings, savings-investment balances, and thus equilibrium interest rates. Furthermore, changes in the fiscal balance can also impact growth levels, which can impact inflation and short-term real interest rates.

From the above equations, it follows that fiscal r-star helps frame fiscal and monetary policy interactions, goals, and conflicts. When monetary r-star and fiscal r-star are equal (and inflation is at target), fiscal and monetary policy can achieve their policy goals without any adjustments in either the primary balance (fiscal authority) or real monetary policy rate (monetary authority). But when monetary r-star is higher than fiscal r-star (e.g., due to shifts in desired investments relative to savings, or following shocks to the debt stock), fiscal and/or monetary policy would need to either adjust their stance or they will not be able to achieve their goals. When the monetary authority moves its policy rate in line with the increase in monetary r-star, public debt dynamics could become explosive for a given trajectory of the primary balance, existing debt stock, and potential output. Moreover, concerns over the pricing of government bonds could arise because the real stock of debt is no longer sufficiently backed by the net present value of future primary balances as real interest rates increase, in turn violating inter-temporal solvency. Therefore, maintaining a stable debt-to-GDP ratio would require a primary balance adjustment when monetary r-star is greater than fiscal r-star. Such an adjustment could be pro-cyclical (compounding declining growth momentum) in the context of "higher-for-longer" policy rates and given a positive fiscal multiplier. The monetary authority may also "budge" and keep its policy rate below the new r-star to help the fiscal authority reduce its borrowing costs. Such a policy could have fiscal sustainability benefits by reducing the cost and pace of debt accumulation but could cause other challenges in terms of price stability and potentially financial stability, depending on whether financial repression was used to increase the government's debt carrying capacity.

[35] It is important to note that monetary r-star is not independent of fiscal dynamics. Rather, monetary r-star can depend on the overall balance and the debt level (see, for example, Rachel & Summers, 2019; Mian, Straub, & Sufi, 2022; Campos et al., 2024). But for the purposes of this theoretical exercise, it is assumed that monetary r-star is set exogenously as per the closed-form solution derived in this section, while for future research can address this issue in a micro-founded model.
[36] Formally, $\Phi_t \equiv \beta E\pi_{t+1} - \pi_{t-1}$. If inflation expectations are fully adaptive (i.e., $\beta E\pi_{t+1} = \pi_{t-1}$) then (2) reflects an underlying accelerationist Phillips curve. If inflation expectations are fully anchored (i.e., $\beta E\pi_{t+1} = \bar{\pi}$) then Φ_t dampens inflation dynamics by pushing down inflation when it is above target.

The Fiscal-Monetary Gap

Using the above definition of fiscal r-star, an expression for the *fiscal-monetary gap*—an indicator of fiscal-monetary tensions—can follow. [37] The *tension* between fiscal and monetary policy is defined as a situation in which the stance of fiscal policy makes it more difficult for the central bank to stabilize inflation, or when the stance of monetary policy worsens the ability of the fiscal authority to stabilize the debt ratio. Combining equations (7) and (10), it is possible to see how the difference between r_m^* and r_f^* provides an intuitive quantitative indicator for tensions between monetary and fiscal policy. The difference between these terms $(r_m^* - r_f^*)$ is defined formally as the *fiscal-monetary gap* (equation (11)), where $\tau_t^* \equiv r_t - r_t^P$ is the spread between the real effective interest rate on government debt and the real policy rate:

$$(\mathbf{11})\; r_{m\,t}^* - r_{f\,t}^* = \frac{\Delta d_t}{\bar{d}}(1+\bar{\pi}+\bar{g}) + \frac{1}{\phi}(\Delta\pi_t - \Phi_t) + \frac{pb_t - \overline{pb}}{\bar{d}}(1+\bar{\pi}+\bar{g}) - \tau_t^*.$$

Equation (11) thus shows the policy tradeoffs faced by the monetary and fiscal authorities when the fiscal-monetary gap is positive. A larger fiscal-monetary gap indicates that one of four outcomes (or a combination of them) should occur. First, when neither the fiscal nor monetary authority changes its stance, debt will grow, as summarized in the first term. Second, if the monetary authority accommodates fiscal policy by lowering the monetary policy real interest rate for a given monetary r-star, inflation will rise above target (second term). Third, a positive fiscal-monetary gap can also be closed by fiscal consolidation, or when the primary balance is adjusted upwards as per the third term in equation (11). Fourth, the last term (τ_t^*) implies that the fiscal authority can lower the spread between the real effective interest rate on government debt and the real monetary policy rate. This reduction can be achieved through several factors, such as financial repression (where there are a mix of official and unofficial taxes on savings to help drive down government borrowing costs) or through changing the mix of debt issuance, such as by lowering the term premia of the debt stock by issuing shorter maturity debt. These policy options are discussed in more detail below.[38]

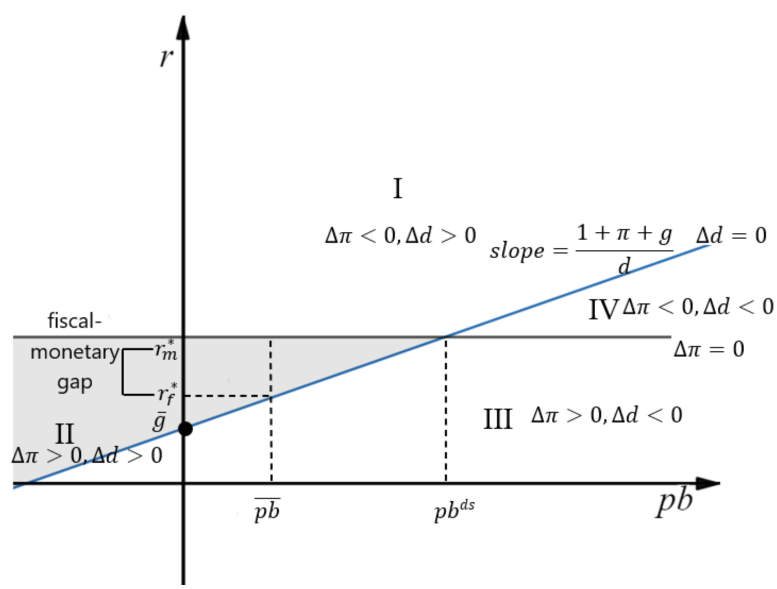
As flexible concepts, fiscal r-star and the fiscal-monetary gap can be incorporated in standard open models and policy frameworks. In the current framework, borrowing premia of the fiscal authority relative to monetary r-star are captured in term τ_t^* in equation (11), which could include factors such as the sovereign risk premia, term premium of issuing longer dated obligations, liquidity premia, and external risk and currency premia. Term τ_t^* could also capture uncertainty about underlying fiscal variables (i.e., the fiscal path) as well as any additional premia. For a small open economy for which r-star is set exogenously, and assuming basic interest rate parity conditions hold, then exchange rate premia (i.e., expected exchange rate depreciation) could be incorporated formally into term τ_t^*. Moreover, the closed economy IS-LM framework discussed previously could be modeled using a more traditional Mundell-Fleming framework, including with frictions (see Box 1).

[37] Hauner, Leigh, and Skaarup (2007) study fiscal sustainability in G-7 countries using a gap analysis of the debt-target primary gap and the intertemporal primary gap, which helps them identify adjustment magnitudes and costs in light of aging populations.
[38] A critical assessment of the relative tradeoffs and optimum mix of policies given the above-mentioned policy options is beyond the scope of this paper. Still, subsequent sections show empirically that a combination of these four factors tend to follow periods of elevated fiscal-monetary tensions as measured by the fiscal-monetary gap.

Graphical representations and comparative statics

Figure 3 summarizes these dynamics in a phase diagram made up of two schedules. The diagram includes axes for the primary balance and real interest rates. First, there is a balanced debt accumulation schedule (where the change in debt in each period is zero), which is a positive function between real interest rates and the primary balance. This schedule can be thought of as the debt stabilizing real interest rate for a given level of the primary balance. For simplicity, it is assumed that the real effective interest rate on government debt equals the real policy rate, such that $\tau = 0$. The intuition of this curve is that as the real interest rate rises, the primary balance required to maintain an unchanged debt level goes up. The second, flat schedule follows from the theoretical treatment of the standard IS and Phillips curves and represents the exogenously given real interest rate at which inflation is stable (monetary r-star).[39]

Figure 3. Phase Diagram of Fiscal-Monetary Dynamics



Source: Authors.

The phase diagram yields four areas, which give intuition about inflation and debt dynamics based on different real interest rate scenarios. Area I indicates combinations of the real interest rate and primary balance where inflation is falling while debt accumulation is positive. Area II shows combinations of the real interest rate and primary balance where both debt and inflation are growing. Area III shows combinations of the primary balance and real interest rate where inflation is rising while debt is falling. And finally, area IV indicates where both inflation and debt are falling.

[39] For the purposes of illustration, this schedule is presented as inelastic to changes in the primary balance. It is also possible to conceptualize this schedule as a negative function of the primary balance with asymptotic convexity as the primary balance declines (goes further into deficit). The intuition is that ever-larger primary deficits require equilibrium real interest rates to rise due both to their potentially stimulative and crowding out effect and due to the need for potentially higher risk premia required amid increasing fiscal risks, as proxied by larger primary deficits.

Different monetary and fiscal r-star combinations can be applied to the phase diagram, which, combined with current levels of the primary balance, provide intuition for fiscal-monetary tensions. As is shown in Figure 3, for a given primary balance ($\overline{pb}$), prevailing real interest rates would need to be equal to fiscal r-star to stabilize debt. If the monetary and fiscal authorities indeed could engineer an effective fiscal financing cost of r_f^*, such that the monetary policy rate is less than r_m^*, then it should be expected that this primary balance level would lead to an increase in inflation but without an increase in debt stocks. If the real interest rate faced by the fiscal authority were greater than r_f^*, then debt would increase along with inflation (provided the monetary policy rate were less than r_m^*), such that inflation and debt stocks would continue to rise. These challenges become more acute as the fiscal and monetary authorities move further to the left on the phase diagram where the locus of region II grows.

The phase diagram can help visualize shifts in overall dynamics, which can explain how fiscal-monetary tensions evolve. Some comparative statics are presented in Figure 4 and described below:

- Should *monetary r-star increase exogenously* (Figure 4, panel A), for instance due to a change in global savings and investment schedules, the inflation target curve shifts upward, which would imply that for any given primary balance, the fiscal-monetary gap is larger, ceteris paribus. Rising global neutral interest rates make the trade-off between stabilizing debt and achieving the inflation target more acute.
- When *potential growth increases*, two effects occur: first, the y-intercept of the debt accumulation line rises, which can be thought of as the direct effect of faster nominal GDP growth (i.e., the sum of the inflation target and real growth), which makes it easier to sustain larger primary balances without higher debt accumulation due to relatively more favorable interest-growth dynamics (i.e., r - g). At the y-intercept, with a primary balance of 0, then debt accumulation is simply the interest-growth differential, and the debt-stabilizing real interest rate equals the potential growth rate. The slope of the debt accumulation line also pivots leftward toward the y-axis due to a steeper slope caused by to higher growth (see Figures 3 and Figure 4, panel B). The intuition of this pivot is that the elasticity of the primary balance with respect to borrowing costs goes down due to higher potential growth: said another way, as the real interest rate increases, less of a change in the primary balance is required to stabilize debt when potential growth is higher, ceteris paribus. Overall, an increase in potential growth makes the trade-off between stabilizing debt and achieving the inflation target less acute.
- An *increase in the inflation target* leads to a steeper zero debt accumulation line (see Figure 3 and Figure 4, panel C), which would decrease the elasticity of balanced debt relative to the primary balance—i.e., with a higher inflation target, less of a fiscal effort would be required to stabilize debt dynamics. For a given fiscal-monetary gap, a higher inflation target would reduce fiscal-monetary tensions.[40]
- Lastly, an *increase in the spread between the real effective interest rate on government debt and the real policy rate* is presented in Figure 4, panel D. A higher spread increases the real interest rate on government debt relative to the real policy rate. Thus, it pivots the debt accumulation equation

[40] Here, the government's financing needs are lower because its deficit is partly financed by collecting a higher "inflation tax." Over time, the scope for collecting this inflation tax is limited, since, when inflation rises, the private sector will reduce its real money holdings and there will be upward pressure on monetary r-star. For discussions of the impact of a higher inflation target on monetary policy space, see Leigh (2009), Blanchard et al. (2010), Gagnon and Collins (2019), Blanchard (2022), and Gagnon (2022).

downward, such that, for a given fiscal-monetary gap, a higher spread increases fiscal-monetary tensions.

Fiscal-monetary dynamics can become non-linear if inflation expectations respond to the tensions between fiscal and monetary policy. Anchoring long-term inflation expectations at the inflation target requires commitment by the monetary authority that it will, on average, set the nominal policy rate such that the real policy rate tracks monetary r-star.[41] While formally modeling agents' expectations formation can take different forms, many authors have argued that inflation expectations depend, in part, on iterative learning by which market participants interpret the reaction function of the central bank and, over time, view the central bank's commitment to price stability as credible (e.g., Bullard and Mitra, 2002; Gaspar et al., 2011). This credible commitment helps anchor expectations on both the upside and downside. When fiscal-monetary tensions arise, the central bank's credibility could be put to the test, and it may accumulate a track record of missing its inflation target. Misses could occur, for example, because of unexpected increases in monetary r-star, pressures to keep debt dynamics contained due to fiscal dominance by the fiscal authority or via moral suasion (enabled by a lack of central bank operational independence), or concerns over the valuation of government debt and the financial strength of the central bank after periods of large-scale asset purchases. After long-term inflation expectations move up, the only way to bring them back to target is to move the real policy rate above monetary r-star for a sustained period. However, without complementary fiscal adjustment, this would make debt dynamics even more unfavorable, leading to even greater pressure on the central bank and greater concerns over the valuation of government debt. In other words, the fiscal-monetary gap may become subject to non-linear dynamics when fiscal policy remains active and able to exert sufficient pressure on the monetary authority to accommodate unexpected inflation (such as by adjusting the inflation target upward). Over time, sufficiently high fiscal-monetary tensions could lead to adverse feedback loops that culminate in fiscal dominance or an erosion in central bank independence.

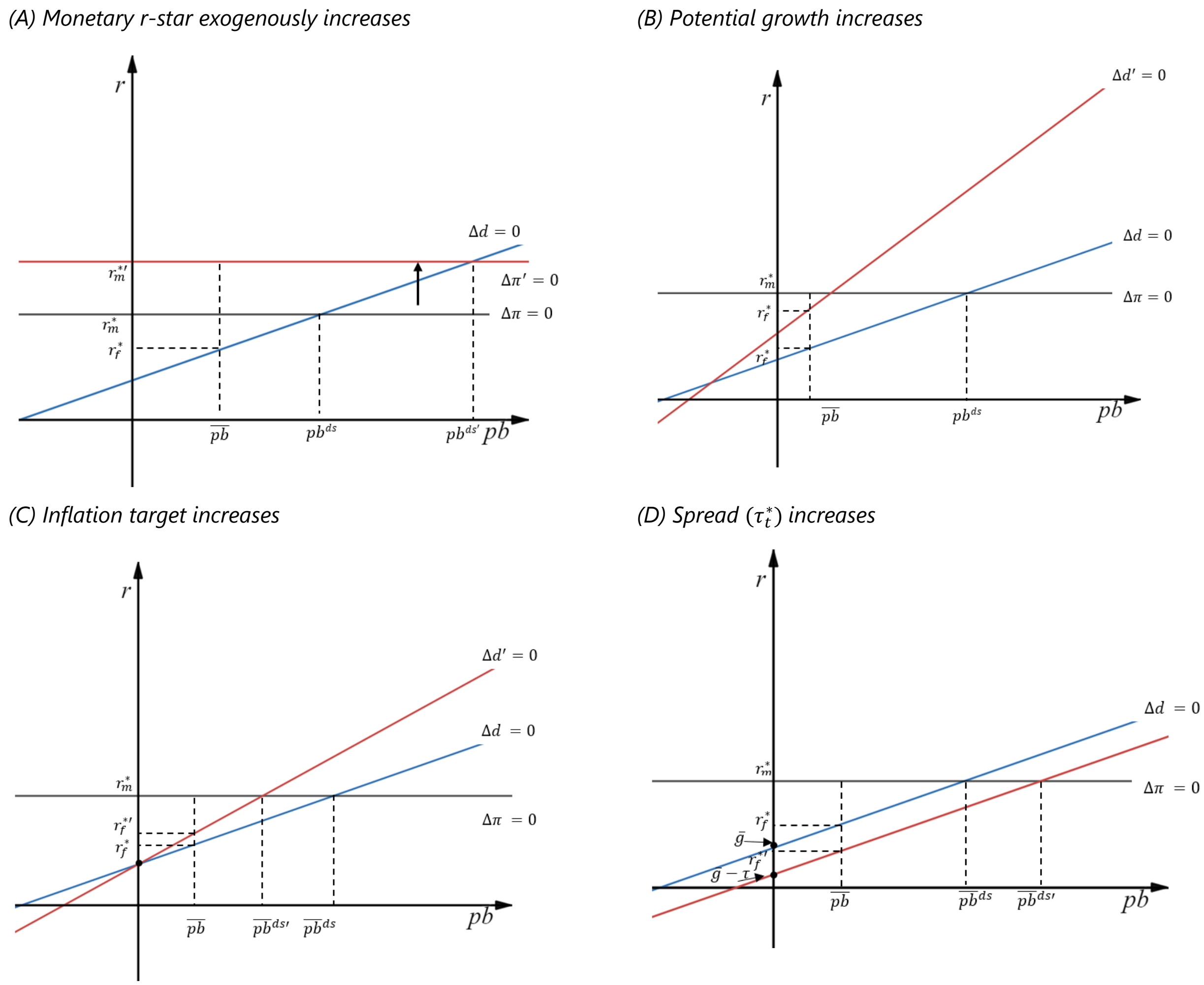
The fiscal-monetary gap can be closed by a combination of policy actions. First, the fiscal authority can undertake a primary balance adjustment, in turn making fiscal policy passive, which would raise fiscal r-star. Second, the fiscal authority can engage in debt management operations, such as shortening the weighted-average maturity of debt issuance when faced with an upward-sloping interest rate term structure. This would lower the effective cost of debt and take advantage of differences in nominal interest rates across the term structure, though it could increase rollover risks. Third, both the fiscal and monetary authorities could engage in various forms of financial engineering and ultimately, financial repression, to decrease monetary r-star and in turn fiscal financing costs, such as through macroprudential and capital flow measures designed to increase the captive pool of savings available to the fiscal authority than would otherwise be available at the fiscal authority's preferred borrowing cost, in turn reducing the effective cost of debt for a given monetary policy.[42] It follows from the distinction between fiscal and monetary r-star that the monetary and fiscal authorities can achieve their goals—even if there is a substantially positive fiscal-monetary gap neither policy adjusts—provided the interest rate paid by the government is substantially lower than the interest rate faced by the

[41] This follows from the Phillips and IS curves underpinning equation (10), which imply that long-term inflation expectations are $\frac{\phi}{\beta+\phi-1}(E_t i_\infty^P - r_m^*)$ where $E_t i_\infty^P$ is the permanent component of fluctuations in the nominal policy rate. For β close enough to one, this implies that for inflation expectations to remain anchored, the real policy rate should track monetary r-star.

[42] Reinhart, Kirkegaard, and Belen (2011) define financial repression as a situation in which a government uses macroprudential tools to generate directed lending from captive domestic audiences. Some tools of financial repression include interest rate caps, capital controls, moral suasion, and reserve and capital requirements. The potential use of financial repression is discussed further below in the context of how governments could deal with significant post-COVID debt overhangs.

private sector.[43] These shifts can be visualized as various movements along the existing schedules toward equilibrium in Figure 3.

Figure 4. Comparative Statics in Fiscal-Monetary Dynamics



Source: Authors.

[43] Equivalently, seen through the debt valuation equation in (6), financial repression would lower the real stochastic discount factor of holders of government debt such that the present value of primary balances is zero, but holders still value the debt. This is akin to generating a bubble term which represents a fiscal resource to the government. It can "mine the bubble" and never has to raise taxes to fully fund all government expenditures (Brunnermeier et al., 2020).

Box 1. Fiscal R-Star in an Open Economy

Fiscal r-star and the fiscal-monetary gap are implicitly modeled in a closed economy setting as many of the countries studied are large AEs that are reserve currency issuers. However, fiscal r-star and the fiscal-monetary gap are flexible concepts that can be used to model more formally the fiscal-monetary tensions in a small open economy setting. This box explains the intuition.

An open economy version of the framework presented could first account for open economy dynamics, including the effects of the real exchange rate on the output gap in the IS curve and domestic inflation in the Phillips curve. This formulation generates additional channels through which monetary policy impacts inflation. Hence a parsimonious Mundell-Fleming version of the fiscal r-star and fiscal-monetary gap models would include the following equation for inflation (Box equation (1)), where $q_t - q^*$ is the country's real exchange rate gap and η is the elasticity of inflation with respect to this gap, reflecting both the impact of expenditure switching on the output gap and imported inflation in the Phillips curve.:

$$(\textbf{Box eq. 1})\ \Delta\pi_t = \Phi_t - \phi(r_t^P - r_m^*) + \eta(q_t - q^*)\,;$$

The above equation can be the starting point to compute an open economy version of fiscal r-star and the fiscal-monetary gap.

Then, the law of motion of debt sustainability can more explicitly account for local- and foreign-currency-denominated debt to model real exchange rate implications for debt sustainability. Whereas most AEs issue debt in their own currency and, in many cases, are reserve currency providers, many EMEs issue debt in foreign currency in addition to local currency. Exchange rate depreciations can thus adversely impact fiscal sustainability by raising the real value of external debt service.[1] These effects are reflected in the debt sustainability equation (Box equation (2)), which includes explicit reference to the share of foreign currency debt α_{t-1}, the foreign currency real interest rate r_t^f, and the growth rate of the real exchange rate Δq_t, where a positive value indicates a real depreciation (such that a real depreciation increases the pace of debt accumulation).:[2]

$$(\textbf{Box eq. 2})\ \Delta d_t = \frac{\alpha_{t-1} r_t^f + (1 - \alpha_{t-1}) r_t^d - g_t + \alpha_{t-1}\Delta q_t (1 + r_t^f)}{1 + g_t} d_{t-1} - pb_t$$

In this case, fiscal r-star is a function of the share of FX-denominated debt and the foreign interest rate as per box equation (3), where α is the long run value the share of foreign currency debt and $\zeta \equiv \frac{1}{1-\alpha}$:

$$(\textbf{Box eq. 3})\ \ r_f^* = \zeta\overline{g} + \zeta(1 + \overline{g})\frac{\overline{pb}}{\overline{d}} - \zeta\alpha r^f,$$

Thus, the open economy fiscal r-star is decreasing in the foreign interest rate, where the debt ratio can only be stable if the higher costs of foreign currency debt are offset by a lower interest rate on domestic debt. The importance of the foreign interest rate is greater for countries with higher shares of foreign currency debt. Note that when the share of foreign currency debt is zero, Box equation (3) collapse to equation (6).[3]

Box 1. Fiscal R-Star in an Open Economy (cont.)

Open financial accounts can exacerbate fiscal-monetary tensions and trigger nonlinearities when domestic real interest rates diverge from foreign real interest rates. If policymakers in an open economy accommodate active fiscal policy and allow substantially large interest rate differentials to exist, capital outflows could trigger a real exchange rate depreciation, further pushing up the debt ratio through exchange rate valuation effects, lowering fiscal r-star and further increasing the fiscal-monetary gap. The market's perception of the additional risk associated with investing in foreign assets (alternatively, the additional compensation demanded by investors to hold foreign assets) could push up the country's risk premium. This premium is influenced by active fiscal policy, adversely impacting investors' perceptions about the riskiness of a country's institutions (e.g., central bank independence), including through fears of fiscal dominance.

Some policy actions available in a closed economy become less effective in an open economy setting, which could tempt policymakers to revert to other nonconventional tools. Accommodative monetary policy cannot fully offset a higher interest burden if a large share of debt is denominated in foreign currency. Similarly, the impact of surprise inflation on the debt ratio is smaller if it is offset by a nominal currency depreciation that pushes up the stock of FX-denominated debt. Forcing domestic savers to hold government debt through financial repression is less effective if a larger share of the debt stock is held by nonresidents or if domestic savers can substitute foreign assets for domestic assets. Therefore, as policy actions focused on domestic actors become less effective, policymakers could be tempted to resort to policies that distort capital flows, including foreign exchange intervention (FXI) and capital flow measures (CFMs).

[1] On the impact of exchange rates and debt sustainability, see Carrera & Vergara (2012).
[2] The stock-flow adjustment term is omitted. Annex II contains a derivation.
[3] Subject to an approximation term, which leads to differences in the denominator of the first term of the debt accumulation equations.

V. Estimation of Fiscal R-Star and the Fiscal-Monetary Gap

This section presents the results of the estimation of fiscal r-star and the fiscal-monetary gap. This analysis uses annual data over the last 140 years, as described below. The sample consists of 16 AEs, including Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom, and United States.

Data sources and methodology

As suggested by equation (7), constructing fiscal r-star requires data on several variables. These data include the long-term (or cyclically adjusted) primary balance ($\overline{pb}$), growth rate of potential output ($\bar{g}$), the inflation target ($\bar{\pi}$), and the debt level target ($\bar{d}$). To estimate these variables, the Jordà-Schularick-Taylor (JST) database is used as it provides macroeconomic data for these 16 countries from 1878 to 2020 (Jordà et al., 2017). These data are complemented with fiscal data from the Public Finances in Modern History (PFMH) database on government expenditures, revenues, interest expenses, and public debt (Mauro et al., 2015). To estimate the fiscal-monetary gap, an estimate of monetary r-star is required. The data source for monetary r-star is Platzer et al. (2023), who apply the Laubach and Williams (2003) methodology to estimate the natural rate of interest for our sample of countries using the JST database.

The baseline estimation of the different variables proceeds as follows. To obtain the long-term primary balance, a Hodrick-Prescott (HP) filter is applied to the primary balance series. For output growth, estimates provided by Platzer et al. (2023) are used to ensure consistency with their monetary r-star estimates. For the debt target, the five-year moving average of the public debt to GDP ratio is used.[44] For inflation expectations, an official inflation target is used where appliable. Where there is no official inflation target, the five-year moving average of the country's inflation is used. A primary advantage of using the JST dataset based on simple filtering techniques to estimate these variables is the ability to document the evolution of the estimated fiscal r-star and the fiscal-monetary gap over a long period—over a hundred and fifty years. This allows the analysis to cover several interesting historical episodes concerning debt sustainability, such as during the Great Depression and World War II.[45]

Estimation results

The estimated results of fiscal r-star and the fiscal-monetary gap are presented in Figure 5. The results offer several insights. First, the fiscal-monetary gap peaked during World War II amid war-era fiscal strains. Second, the fiscal-monetary gap in 2020 is the highest measured since the early 1950s, when AEs were dealing with the significant debt overhang from World War II. The post-war boom and demobilization reduced

[44] An alternative method for choosing an appropriate level of terminal debt $\bar{d}$ is to assume constant real interest rate expenses as a share of GDP, as per Furman & Summers (2020), or to adopt a debt anchor that would calibrate a debt limit using an interest and revenue levels below a certain threshold (see, for example, Comelli et al., 2023).
[45] In section VII, an alternative approach in estimating these variables is explored—one based on expert forecasts of the underlying variables. The estimates from this alternative approach, based on more recent data, indicate that the results are robust to the two approaches used.

the gap, which hit a historic low in the mid-1970s. Third, after historic lows in the 1970s, the gap remained low and relatively constant from the early 1980s through the mid-2000s, due primarily to the decline in monetary r-star after the early 1980s disinflation. The fiscal-monetary gap has been on an upward trajectory since the mid-2000s.[46] Overall, fiscal r-star is generally faster-moving and more volatile than monetary r-star, which follows from the algebraic construction of fiscal r-star: specifically, because fiscal r-star is a function of the primary balance, it is subject to policy discretion. By contrast, monetary r-star is a function of the market for loanable funds, for which investment and savings are relatively slower moving.[47]

The change in fiscal r-star over time can be written using the below decomposition (equation (12)). The first term captures the impact of the change in the potential growth rate; the second term captures the impact of the change in the ratio of the primary balance and the debt level; and the last term captures their covariance. Historical decompositions of fiscal r-star relative to its average show that the decline in fiscal r-star during the first half of the Twentieth Century coincided with significant spending needs associated with the two World Wars, with primary balances and debt accounting for most of this increase (see Figure 6). From the early 1930s to late 1960s, trend growth positively contributed to the increase in fiscal r-star. Post-2000, the decline in fiscal r-star was due both to declining potential growth and to deteriorating debt and primary balance dynamics, whereas fiscal policy (i.e., debt and deficits) was less of a drag on fiscal r-star from the early 1970s through the late 1990s.

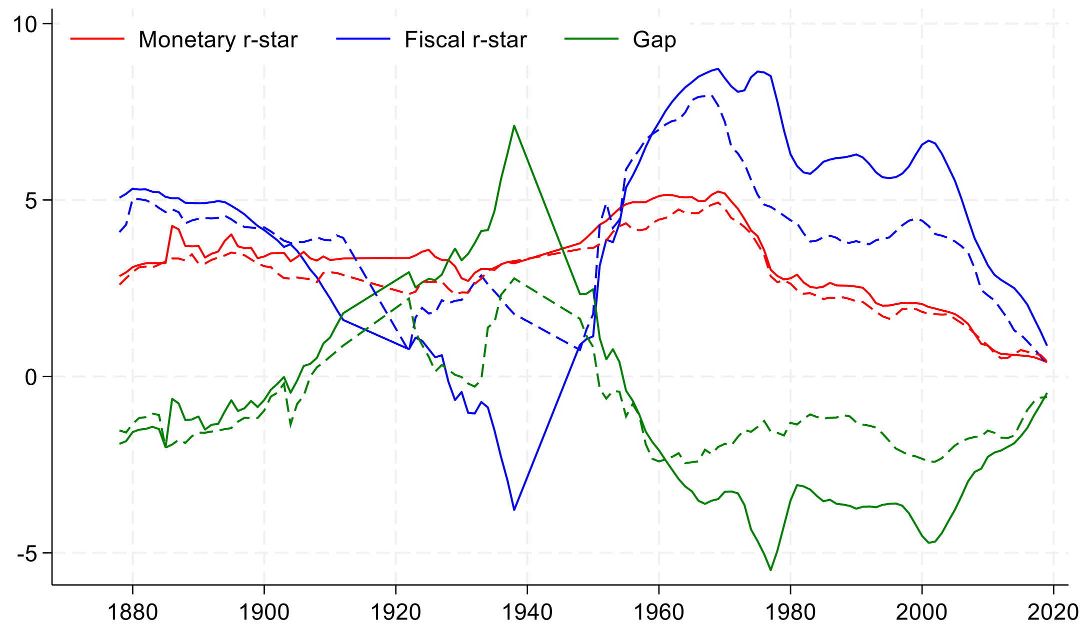
$$(\mathbf{12})\ r_{f,t}^{*}-\bar{r}_{f}^{*}=\ (\bar{g}_t-\bar{\bar{g}})\left(1+\frac{\overline{\overline{pb}}}{\bar{\bar{d}}}\right)+\left(\frac{\overline{pb}_t}{\bar{d}_t}-\frac{\overline{\overline{pb}}}{\bar{\bar{d}}}\right)(1+\bar{\pi}+\bar{\bar{g}})+(\bar{g}_t-\bar{\bar{g}})\left(\frac{\overline{pb}_t}{\bar{d}_t}-\frac{\overline{\overline{pb}}}{\bar{\bar{d}}}\right)$$

Correlates of fiscal r-star show that the drivers of fiscal r-star are in line with what would be theoretically expected (see Table 1). Fiscal r-star is negatively associated with higher terminal debt levels $\bar{d}$, falling by 0.04 to 0.02 percentage points for every 1 percentage point of debt to GDP. Similarly, fiscal r-star is positively associated with both the long-term primary balance $\overline{pb}$ and trend growth rate $\bar{g}$ including and omitting country fixed effects. A one percentage point higher long-term primary balance is associated with a more than two percentage point higher fiscal r-star. A one percentage point higher trend growth rate is associated with a 1.2 to 1.4 percentage point higher fiscal r-star. Combining the debt stock, primary balance, and growth rate along with country fixed effects has intuitive results with broadly correct signs—the primary balance and growth rate are positively associated with a higher fiscal r-star. The debt stock is negatively associated with fiscal r-star, but this result is not statistically significant, possibly because primary balance (i.e., flow) dynamics are collinear with debt (stock) levels. Fiscal r-star and monetary r-star show strong co-movement historically, with fiscal r-star increasing by 0.75 to 0.90 percentage points for a one percentage point higher monetary r-star. The correlates of the fiscal-monetary gap are shown in Table 2.

[46] Note that Figure 5 presents both means and medians. Although the medians show less volatility in the series due to fewer outliers being included in the sample, they show broadly similar overall trends.

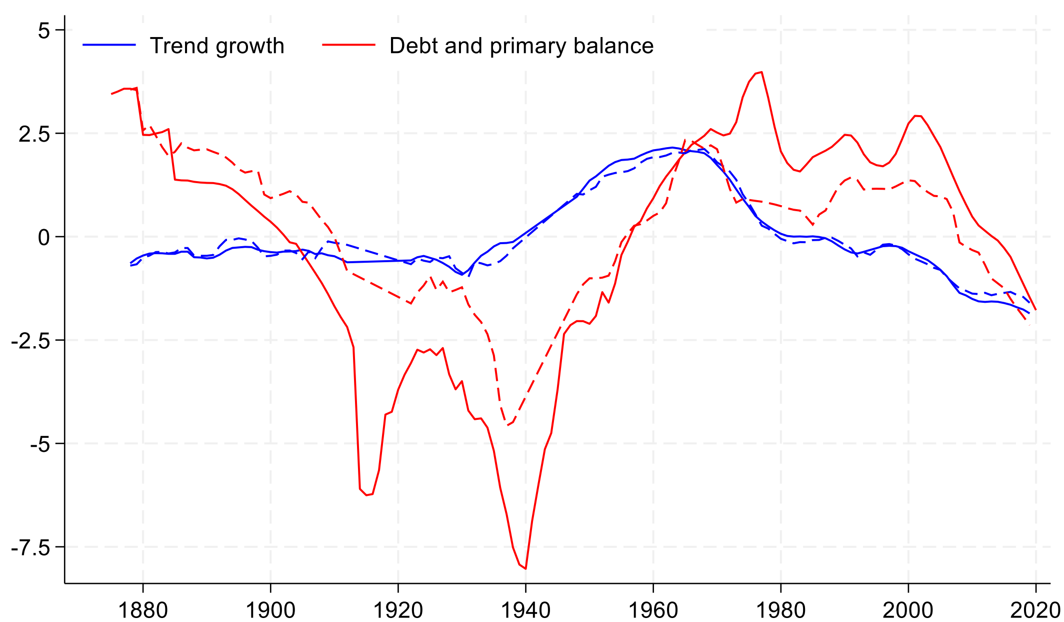
[47] It is worth noting that, strictly speaking, comparing fiscal r-star across different time periods should be interpreted with caution, as variations in the term premia and other variables could impact actual fiscal financing costs. Due to the lack of data availability, the term premia were not included in the calculation of fiscal r-star, and such inclusion is left for future research.

Figure 5. Historical Estimates of Fiscal R-Star and the Fiscal-Monetary Gap[1]



[1] Dashed lines represent medians of samples, while solid lines represent unweighted means.
Source: Jorda et al. (2017) and authors' calculations.

Figure 6. Historical Decompositions of Fiscal R-Star Relative to Its Country Average[1]



[1] Dashed lines represent medians of samples, while solid lines represent unweighted means.
Source: JST database (Jorda et al., 2017) and authors' calculations.

Table 1. Correlates of Fiscal R-Star[1]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	r_f^*	r_f^*	r_f^*	r_f^*	r_f^*	r_f^*	r_f^*	r_f^*	r_f^*	r_f^*
$\bar{d}$	-0.040***	-0.024					-0.018	-0.012		
	(0.013)	(0.018)					(0.013)	(0.012)		
$\overline{pb}$			2.22***	2.13***			2.24***	2.19***		
			(0.33)	(0.39)			(0.31)	(0.37)		
$\bar{g}$					1.41***	1.22**	1.24***	1.20***		
					(0.39)	(0.42)	(0.20)	(0.18)		
r_m^*									0.75***	0.90***
									(0.22)	(0.27)
R^2	0.05	0.27	0.57	0.64	0.09	0.31	0.67	0.71	0.06	0.31
Country FE	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

[1] OLS regressions of fiscal r-star on drivers for full JST sample (1700 observations), with and without fixed effects. Robust standard errors in parentheses, clustered at country level. All variables winsorized at 1 percent tails.
*** p<0.01, ** p<0.05, * p<0.1

Table 2. Correlates of the Fiscal-Monetary Gap[1]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	$r_m^* - r_f^*$	$r_m^* - r_f^*$	$r_m^* - r_f^*$	$r_m^* - r_f^*$	$r_m^* - r_f^*$	$r_m^* - r_f^*$	$r_m^* - r_f^*$	$r_m^* - r_f^*$	$r_m^* - r_f^*$	$r_m^* - r_f^*$
$\bar{d}$	0.018	-0.013					0.014	-0.0076		
	(0.012)	(0.012)					(0.014)	(0.015)		
$\overline{pb}$			-2.18***	-2.056***			-2.18***	-2.05***		
			(0.34)	(0.39)			(0.34)	(0.40)		
$\bar{g}$					-0.32	-0.12	-0.21	-0.34*		
					(0.32)	(0.36)	(0.18)	(0.18)		
r_m^*									0.28	0.12
									(0.20)	(0.25)
R^2	0.01	0.28	0.58	0.66	0.005	0.28	0.59	0.66	0.009	0.28
Country FE	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

[1] OLS regressions of fiscal-monetary gap on drivers for full JST sample (1700 observations), with and without fixed effects. Robust standard errors in parentheses, clustered at country level. All variables winsorized at 1 percent tails.
*** p<0.01, ** p<0.05, * p<0.1

VI. Associations between the Fiscal-Monetary Gap and Macroeconomic Outcomes

In this section, the relationships between fiscal r-star and the fiscal-monetary gap and selected macroeconomic outcomes are investigated. The empirical strategy exploits variation in the fiscal-monetary gap across time and countries and links this variation to subsequent changes in macroeconomic outcomes, asset prices, and the probability of different types of crises.

A set of local projections is estimated (Jorda, 2005). Variable i is used to index countries, and h to index the horizon in years. $y_{i,t+h}$ is the response of an outcome variable relative to its initial value $y_{i,t-1}$ with respect to the initial level of the fiscal-monetary gap in the following linear specification, as presented in equation (13):

$$(\mathbf{13})\ y_{i,t+h} - y_{i,t-1} = \beta^h gap_{i,t} + \alpha_i^h + \sum_{k=1}^{3} \delta_k^h y_{i,t-k} + \boldsymbol{\Gamma^h X_{i,t}} + u_{i,t+h}\ , \qquad h = 0, \dots, H\ .$$

The intercept α_i^h is a country-specific fixed effect which accounts for time-invariant factors driving changes in the outcome variable. Two sets of controls that control for confounding factors that are potentially correlated with both the fiscal-monetary gap and changes in the outcome variables are included. The first set includes three lags of the outcome variable. The second set includes lags of the debt level, business cycle variables (i.e., trend output growth and inflation), policy variables (the primary balance and real policy rate) and monetary r-star. Including monetary r-star ensures that the impact of the fiscal-monetary gap rather than the interest rate environment generally is captured. β^h is the coefficient of interest, which captures the elasticity between fiscal-monetary gaps and subsequent outcomes. Put differently, it summarizes the predictive power of the fiscal-monetary gap for outcomes at different time horizons. Hence β^h does not necessarily carry a causal interpretation. Throughout this section, significance and confidence intervals are reported based on standard errors that are robust with respect to heteroskedasticity, cross-sectional correlation, and serial correlation across years (Driscoll and Kraay, 1998). By focusing on the dynamic impulse responses to changes in fiscal-monetary gaps, the estimates potentially capture possible feedback effects between policy and outcomes. Estimates should not necessarily carry a causal interpretation, because variation in fiscal-monetary gaps does not generally result from exogenous shocks. It is more appropriate to interpret these estimates as evidence that the relative level of the fiscal-monetary gap serves as a useful indicator for understanding the likelihood of future macroeconomic events.

A rise in the fiscal-monetary gap is associated with a rising debt ratio, higher price level, weaker exchange rates, and fiscal consolidation (see Figure 7). For general macroeconomic indicators for a given country and conditional on the controls, when the fiscal-monetary gap is one percentage point higher, the debt ratio (Figure 7A) and price level (Figure 7B) rise by around 1.5 percentage points after ten years. Furthermore, a one percentage point higher fiscal-monetary gap predicts a cumulative nominal depreciation relative to the U.S. dollar (Figure 7B) and relative to a commodity basket (Figure 7D) by around 2 percent and 1.5 percent after ten years, respectively.[48] Finally, such a rise also appears to be subsequently associated with fiscal consolidation (Figure 7E), although the amount of fiscal consolidation (0.02 cumulative percentage points after ten years) is small.

A higher fiscal-monetary gap also predicts liquidation of government debt, which is a symptom of financial repression. Debt liquidation can be thought of as the change in the debt ratio that results from the real interest rate being below monetary r-star and inflation being above target. More specifically, following from the approach put forward by Reinhart and Sbrancia (2015), who put forth a measure of the liquidation of government debt relative to what is expected ex-ante, the liquidation effect in a given year *t* is presented in equation (14):

$$(\mathbf{14})\ LE_t = \left(\frac{r_t - g_t}{1 + \pi_t + g_t} - \frac{r^*_{m,t} - g_t}{1 + \bar{\pi} + g_t}\right) d_{t-1}$$

It is possible to then iterate the cumulative liquidation effect over years such that the cumulative effect between t and 0 given by equation (15):

$$(\mathbf{15})\ CLE_{t,0} = CLE_{t,-1,0} + LE_t(d_0 - CLE_{t-1,0})$$

Figure 7F shows that when the fiscal-monetary gap is higher, there is a statistically significant impact on debt liquidation, which could be interpreted as a greater propensity of countries to undertake financial repression. A 1 percentage point higher fiscal-monetary gap is associated with cumulative liquidation of government debt by 0.6 percentage points ten years later.

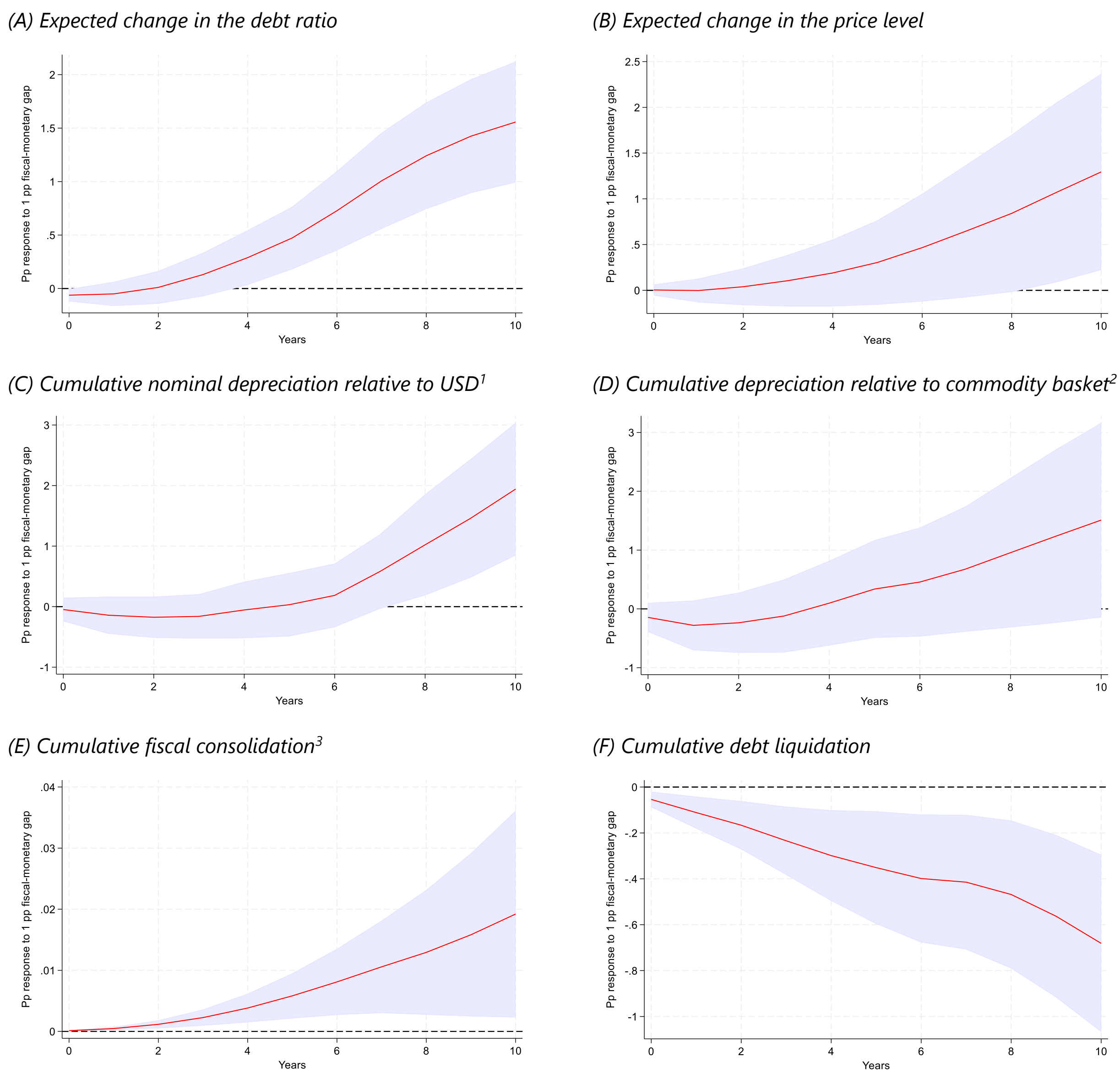
These results are consistent with asset price-related impulse responses. A one percentage point higher fiscal-monetary gap is associated with 2 and 1 and percentage points and lower returns on bonds (Figure 8A) and real cash (Figure 8D) after ten years, respectively, which is consistent with the results regarding the greater propensity to engage in debt liquidation. Real housing returns (Figure 8C) fall initially but are relatively unchanged with a after ten years. Real equity returns (Figure 8B), while having higher risk premia than bonds, are associated with better performance relative to bonds. This result could be driven by financial repression and the subsequent liquidation of government debt.

Additionally, an increase in the fiscal-monetary gap tends to be associated with a greater probability of economic crises (see Figure 9)**.** Results show that a one percentage point higher fiscal-monetary gap is associated with 0.7 and 1.1 percentage points higher probabilities of external and domestic debt crises within ten years (Figures 9A and 9B). The cumulative probability of inflation crises and currency crises are 1.6 and 1.3 percentage points higher (Figure 9D and 9E). Systemic financial crises are almost 2 percentage points more likely to occur (Figure 9F). Bond crises, defined as years in which real bonds returns are less than negative 10 percent, are also significantly more likely in the years following an elevated fiscal-monetary gap (Figure 9G). The same result applies to the probability of a housing crisis (Figure 9H), though more work is needed to reconcile this result with real housing returns presented in Figure 8C. The likelihood of sharp drops in real

[48] Fiscal r-star and the fiscal-monetary gap are presented in a closed economy setting. It is possible to extend its treatment in an open economy setting as described in Box 1. The empirical results corroborate the intuition presented in Box 1, namely that a higher fiscal-monetary gap is linked to exchange rate depreciation, possibly relating to a higher sovereign risk premia associated with a looser fiscal stance, and nominal depreciation to offset higher inflation to maintain purchasing power parity-implied real exchange rates.

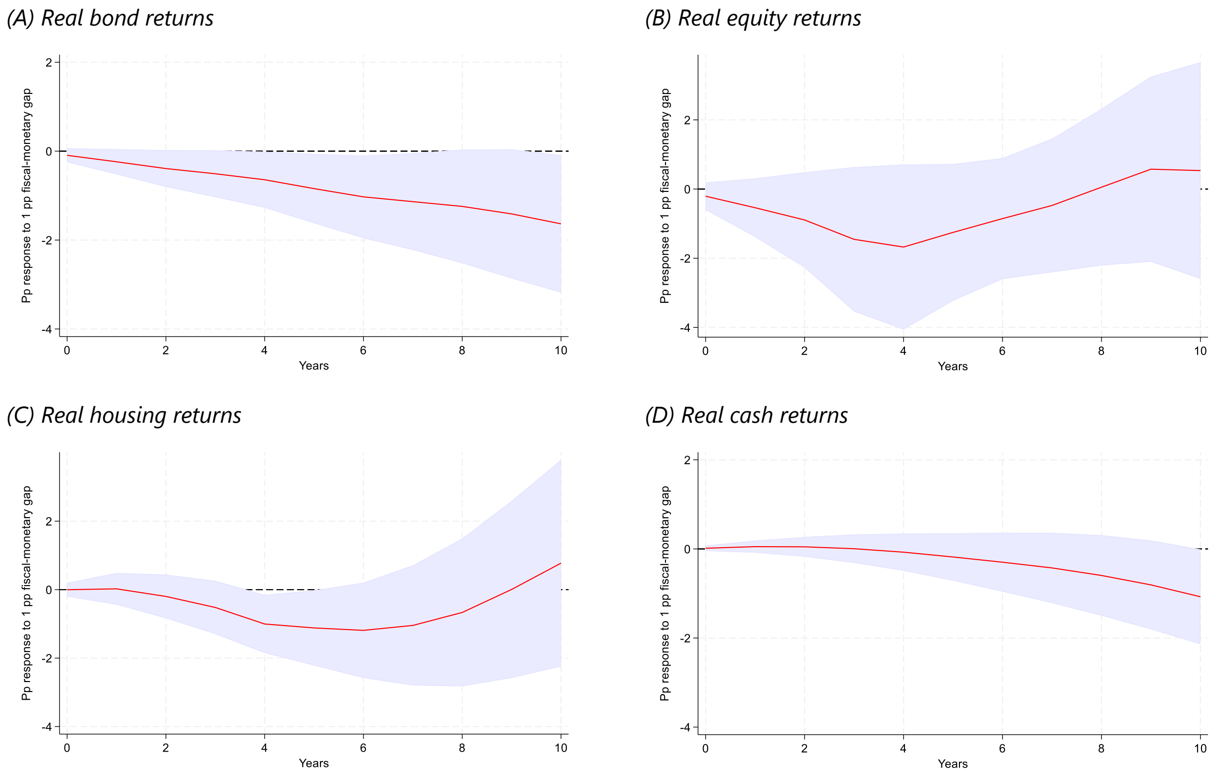
equity returns increases somewhat in the first few years, but this association is insignificant after ten years (Figure 9I). Recessions are about 1 percentage points more likely to occur following a one percentage point higher fiscal-monetary gap (Figure 9J). These results are again consistent with those presented in Figures 7 and 8: as the fiscal-monetary gap goes up, fixed income assets would be expected to underperform. However, stock prices limited little vulnerability to an increase in the fiscal-monetary gap, which is again consistent with the relative impact of increases in the fiscal-monetary gap and stock and bond returns presented in Figure 8.

Figure 7. Shocks to the Fiscal-Monetary Gap and Macroeconomic Indicators



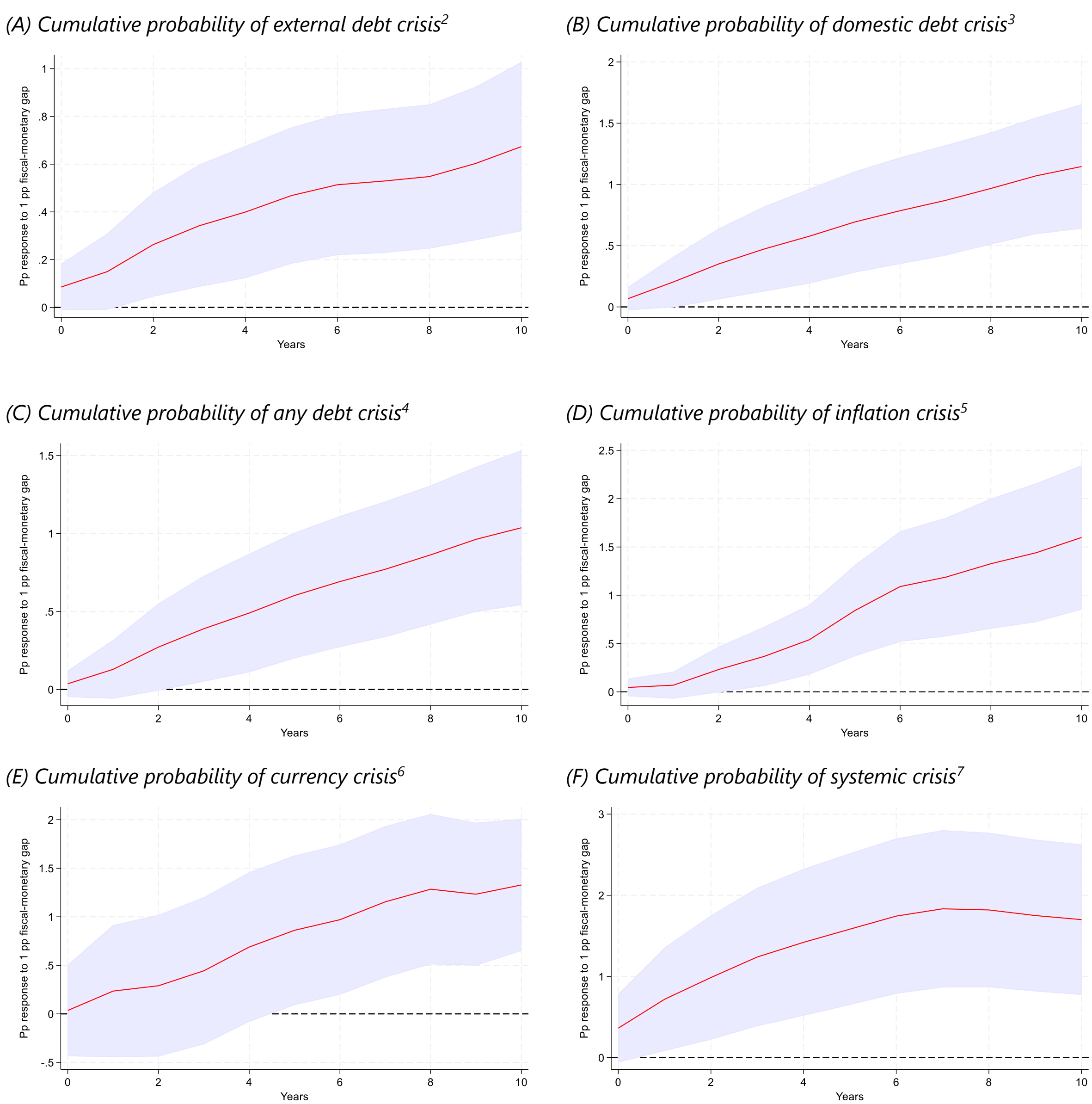
[1] USA not included in sample. Units expressed in foreign currency units per 1 unit USD.
[2] Units expressed in foreign currency unit per 1 unit of basket, equal weighed 27 commodities, including beef, hides, lamb, pork, coal, petroleum, barley, corn, rice, rye, wheat, copper, lead, nickel, steel, tin, zin, gold, silver, cocoa, coffee, cotton, palm oil, sugar, tea, tobacco, wool.
[3] Measured as the cumulative sum of the primary balance.
Source: Authors' calculations

Figure 8. Shocks to the Fiscal-Monetary Gap and Asset Prices[1]



[1] Expected change in returns due to a 1 percentage point increase in the fiscal-monetary gap.
Source: Authors' calculations

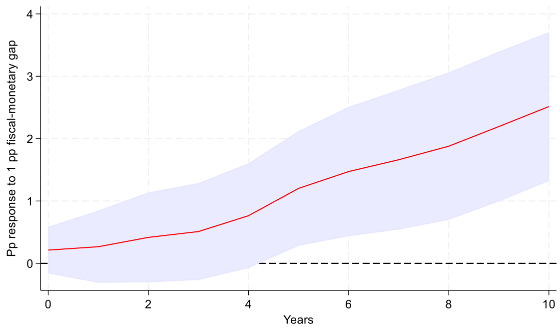
Figure 9. Shocks to the Fiscal-Monetary Gap and Changes to the Probability of Crises[1]



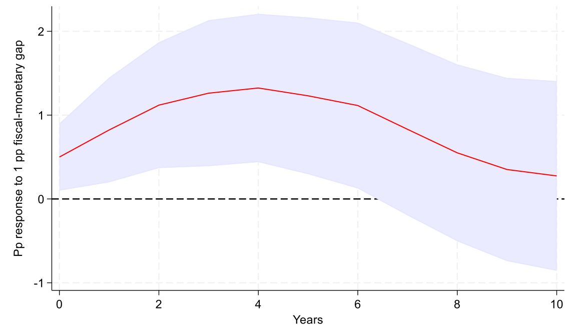
[1] Expected difference in cumulative probability of crisis within time window due to a 1 p.p. increase in the fiscal-monetary gap.
[2,3,4] Debt crisis if either in domestic or external default according to data by Carmen Reinhart.
[5,6,7] Definitions from same dataset. A systemic crisis is defined following Caprio et al. (2005), who characterize modern systemic crises as "those episodes where there are bank runs, a significant share of non-performing assets, bank liquidations, and large-scale policy intervention to support banks" (Reinhart and Rogoff, 2014).
Source: Authors' calculations

Figure 9. Shocks to the Fiscal-Monetary Gap and Changes to the Probability of Crises (cont.)

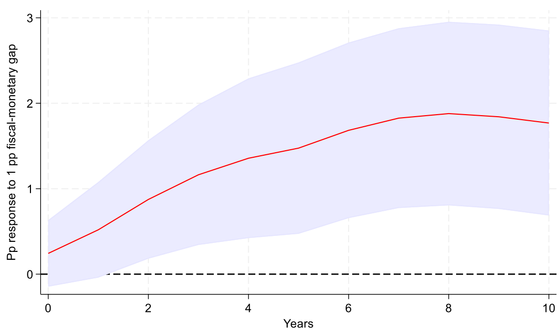
(G) Cumulative probability of bond crisis[1]



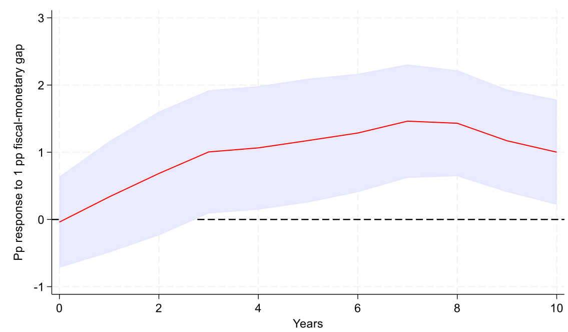
(H) Cumulative probability of stock market crisis[2]



(I) Cumulative probability of housing crisis[3]



(J) Cumulative probability of recession[4]



[1, 2, 3] Crisis if real asset returns are less than negative 10 percent in a given year within the time window.
[4] Recession if real GDP falls in a given year.
Source: Authors' calculations

VII. Current Measures of Fiscal R-Star and the Fiscal-Monetary Gap

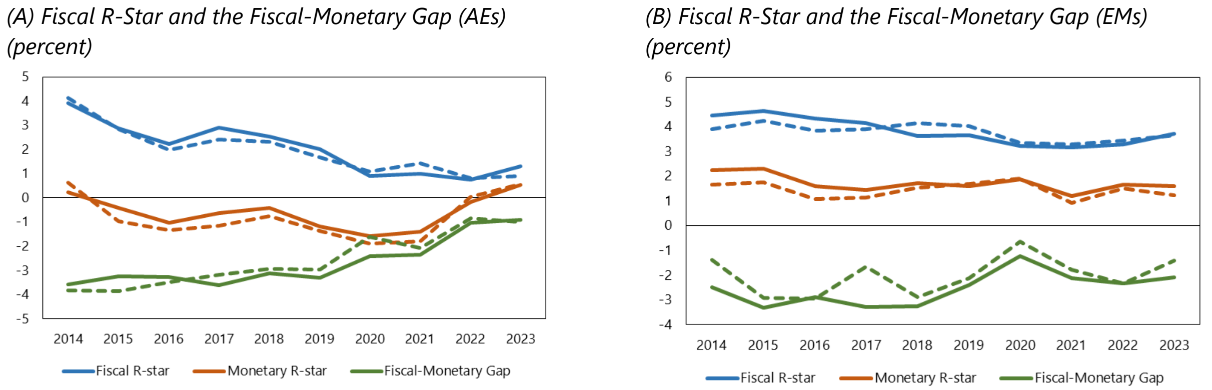
In this section, forward-looking estimates of fiscal r-star and the fiscal-monetary gap are presented. Relative to the estimates in Section V, which provide estimates of the two variables of interest until 2020 based on historical data from the JST database, this section provides forward-looking estimates based on an alternative dataset for the more recent period, covering the last decade (2014-2023, inclusive).

Data from the IMF's World Economic Outlook (WEO) dataset is used to obtain these estimates. The WEO database contains information on the *n*-year ahead projections of key macroeconomic variables through 2023. The underlying assumption is that these projections serve as reasonable approximations of their long-term trends. An advantage of this approach relative to that employed in Section V is the focus on the forward-looking aspect of the underlying macroeconomic variables. In addition, the WEO dataset also includes a broader sample of countries—in addition to the 16 AEs considered in the previous section, the sample is expanded to include 37 EMEs in this section. Finally, being model-free, this approach is robust to end-point problems inherent in filtering techniques used to estimate potential output and monetary r-star in Section III. Given the focus on the endpoints (that is, estimates of the relevant variables in the recent years) in this section, this aspect could yield more reliable estimates for the recent data points relative to the estimates in Section V.

The estimation of recent levels of fiscal r-star and the fiscal-monetary gap proceeds as follows. The sample period is for 2014-2023. For each year, 5-year ahead projections of GDP growth, government primary balance, and debt level are used to capture $\bar{g}$, $\overline{pb}$, and $\bar{d}$, respectively. To estimate monetary r-star, the 5-year ahead projections of the policy rate minus $\bar{\pi}$ is used. For countries that lack an official inflation target, inflation ($\bar{\pi}$) is measured in the same manner; otherwise, the official inflation target is used.

Based on these more up-to-date data, fiscal r-star and the fiscal-monetary gap are at historic levels, which could present difficult policy tradeoffs. Results show that fiscal r-star has declined significantly for AEs over the past decade, resulting in a corresponding rise in the fiscal-monetary gap to a historic high; for EMs, the trends are more stable. For AEs, there is a significant downward trend in the level of fiscal r-star, from around 4 percent in 2014 to around 1 percent in 2023 (left-hand panel of Figure 10). Inspecting the evolution of its components over the same period (left-hand panel of Figure 11), such a decline is driven by a combination of lower potential GDP growth, higher terminal debt, and most importantly the declining primary balance, especially during the COVID-19 pandemic. Coupled with the recent increase in monetary r-star on the back of rising global interest rates, this decline has resulted in a corresponding rise in the fiscal-monetary gap to historically high levels (left-hand panel of Figure 10). By contrast, the decline in fiscal r-star for EMs is more gradual, driven by a moderate fall in potential GDP growth and inflation target, and a moderate post-Covid increase in terminal debt. With relatively stable monetary r-star, the fiscal-monetary gap for EMs has increased at a more measured pace. Finally, recognizing that the results may be subject to forecast errors, the results are estimated after correcting for historical forecast errors for potential growth, primary balances, and debt levels. As shown in Annex Figure 1, after adjusting for such errors, the recent estimates for the fiscal r-star are even lower compared to those shown in Figure 10 for both AEs and EMs, resulting in even higher estimates for the fiscal-monetary gap. These results would imply that WEO-derived baseline results may understate the ultimate level of the fiscal-monetary gap today, which further underscores the presence of post-pandemic fiscal-monetary tensions.

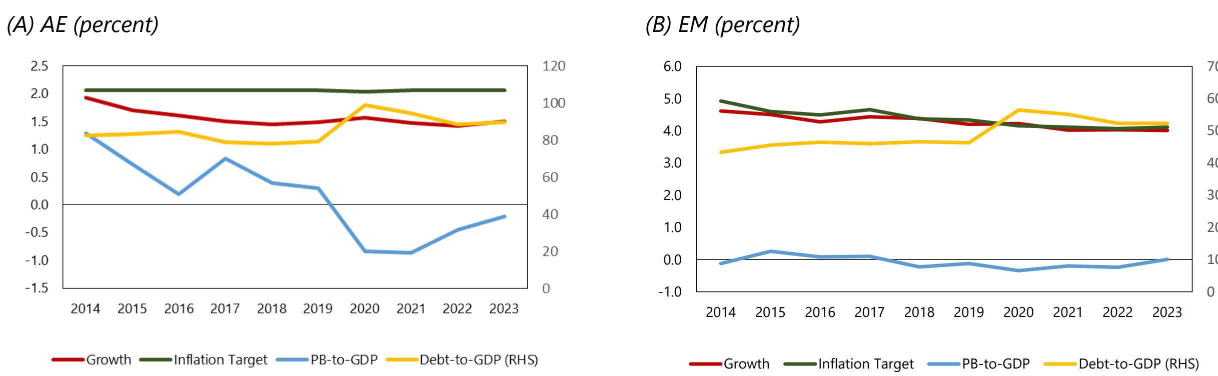
Figure 10. Recent Estimates of Fiscal R-Star and the Fiscal-Monetary Gap (AEs and EMs)[1]



[1] Dashed lines represent medians of samples, while solid lines represent unweighted means (excluding top and bottom 10% outliers).

Source: Authors' calculations

Figure 11. Evolution of Components of Fiscal R-Star (AEs and EMs) (percent)



Source: Authors' calculations

VIII. Policy Implications

This paper's concepts can provide a framework for thinking about the appropriate policy mix. For instance, this paper's empirical findings help illuminate how potentially higher-for-longer real interest rates may impact fiscal sustainability and help better inform decisions on the timing and pace of fiscal adjustment. The results of this paper could also inform policy discussions on the potential adjustments to bring fiscal and monetary policy in balance.

In general, policymaking implicitly requires an ex-ante assessment of the likely trajectory of fiscal and monetary r-star, from which adjustment paths can be chosen. Calibrating fiscal policy requires an implicit assessment of the likely trajectory of monetary r-star. If it is expected that monetary r-star will remain lower for longer, then the necessity of a large, upfront fiscal adjustment to restore sustainability may be mitigated. By contrast, if monetary r-star is expected to be higher for longer, then fiscal adjustment may be needed depending on the trend of primary balances and existing debt stock. Juxtaposing these scenarios of lower- and higher-for-longer monetary r-star and different combinations of fiscal r-star yields a matrix of different adjustment scenarios. Using this framework, while being mindful of the potential adverse effects of a protracted period of elevated fiscal-monetary tensions, can help policymakers assess the relatively likelihood of different fiscal and monetary r-star scenarios, in turn guiding the need for adjustment (see Figure 12).

Figure 12. Managing Policy Given Potential Fiscal and Monetary R-Star Dynamics[1]

Fiscal r-star \ Monetary r-star	*Lower-for-longer*	*Higher-for-longer*
Low	**I.** Weak fiscal adjustment; backloaded	**II.** Strong fiscal adjustment; front-loaded[1]
High	**III.** No adjustment needed	**IV.** Potential fiscal adjustment needed

[1] In quadrant II, there could be a temptation to resort to financial repression to engineer a reduction in the fiscal-monetary gap without a concomitant fiscal adjustment. As explained in Section VI, historically large fiscal-monetary gaps were accompanied by combination of rising debt levels, higher inflation, financial repression, and lower real asset returns, with elevated risks of crises.
Source: Authors.

Given the historically high fiscal-monetary gap especially for AEs, policy adjustments may be needed to avoid rising inflation, financial repression, and elevated risks of crises. The results of this paper would indicate that should current fiscal trajectories remain unchanged (and absent an exogenous decline in monetary r-star), undesirable economic consequences may ensue. To avoid these adverse potential outcomes, different policy levers could be used in a preemptive manner. These policy levers are set forth in equation (13) and include growth-enhancing reforms to reduce the fiscal-monetary gap while increasing both fiscal and monetary space. These reforms are all-the-more urgent given current tepid growth prospects.[49]

Fiscal consolidation is needed to reduce fiscal-monetary tensions, although its implementation may be limited by political economy constraints. As discussed by several authors (for example, Alesina, et al., 1998; Price, 2010; and Arslanalp et al., 2024), political economy considerations could play an important role in affecting countries' debt dynamics. Arslanalp et al.'s case study of Jamaica's sustained debt reduction could be relevant to the current period given Jamaica's then high inherited debt and unfavorable interest-growth dynamics. Arslanalp et al. (2024) find that Jamaica's debt reduction was achieved via a series of fiscal responsibility mechanisms and consensus-building exercises, enabled by a reduction in political polarization that enabled trust-building and fair burden sharing. It is currently unclear, however, whether advanced economies have the requisite social cohesion necessary to achieving a politically sustainable fiscal consolidation plan.[50]

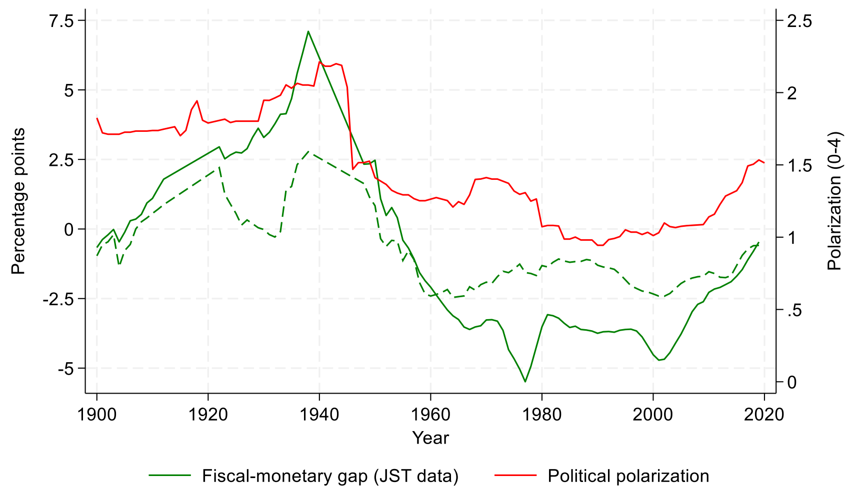
The fiscal-monetary gap and political polarization exhibit co-movement, indicating that there could be a two-way relationship between polarization and fiscal-monetary tensions. Based on a measure of political polarization provided in the Varieties of Democracy database, the degree of such polarization in the sample of AEs used in this paper is at highs not seen since the 1940s (Figure 13). Historically, political polarization and the fiscal-monetary gap have moved together, rising in the first half of the 20th century and the first two decades of the 21st century. A potential explanation of this outcome is that as societies become more polarized, implementing the fiscal adjustments required to reduce the fiscal-monetary gap become more challenging (Roubini and Sachs, 1989a,b; Alesina and Tabellini, 1990; Alesina and Drazen, 1991), which leads to greater tensions over time as debt and interest burdens accumulate. The pressures posed by fiscal-monetary tensions may in turn feed back into polarization (Gabriel et al., 2023; Hubscher et al., 2023).

Since monetary policy accommodation could reduce fiscal-monetary tensions, continued efforts to safeguard central bank independence could be needed amid periods of elevated tensions. Monetary accommodation was historically associated with periods of higher fiscal-monetary tensions. In some cases, this arrangement was explicit, such as during World War II (Romero, 2013). Constructing standard Taylor rules (Taylor, 1993) using the JST database indicates that episodes of heightened fiscal-monetary tensions historically coincide with periods in which the monetary policy rate deviated below the interest rates given by Taylor rules (Figure 14).[51] More specifically, policy rates appear to be low relative to Taylor rule levels in the 1930s-1950s, when fiscal-monetary gaps were at historic highs. Such deviations of actual policy rates from rules-based rates are consistent with this paper's theoretical framework, in which heightened fiscal-monetary gaps can be accommodated by looser monetary policy.[52] It is important to note, however, that central bank institutional independence could prevent fiscal authorities from undermining the central bank's ability to play an active role in stabilizing inflation. Therefore, such independence should be safeguarded to preserve price stability. Moreover, such independence can have fiscal dividends: when inflation expectations are well-anchored, inflation risk premia on government debt would be reduced, thereby enhancing fiscal sustainability.

[49] See IMF (2024)
[50] See also Balasundharam et al. (2023) for a stock taking on difficulties of achieving successful fiscal consolidations.
[51] Following Hofmann and Bodanova (2012), we set the nominal policy rate in the Taylor (1993) rule as $i_t^P = r_{m,t}^* + 1.5(\pi_t - \bar{\pi}) + 0.5(Q_t - Q_t^*)$, where the last variable is the output gap. All variables are expressed in percent or percentage points.
[52] Similarly, Hofmann and Bogdanova (2012) discuss the "Great Deviation", in which policy rates were below levels given by the Taylor Rule for advanced economies in the period following the Global Financial Crisis. This period coincided with a rise in fiscal-monetary gaps across advanced economies.

Also, de-anchoring of inflation expectations resulting from overly accommodative monetary policy could subsequently necessitate even tighter monetary policy that increase fiscal-monetary tensions even more.

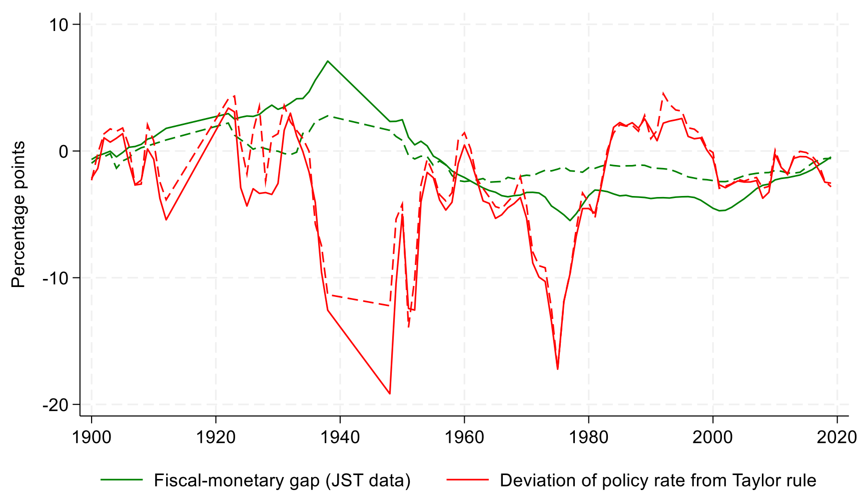
Figure 13. Political Polarization and the Fiscal-Monetary Gap[1]



[1] Sample includes Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom, and United States

Source: Varieties of Democracy Dataset (version 13) and authors' calculations. Political polarization is measured via a survey-based approach, whereby survey respondents in each country are asked questions to elicit the degree to which society has separated into distinct, antagonistic political camps based on the likelihood of disparate groups to engage in friendly interactions with non-likeminded parties.

Figure 14. The Fiscal-Monetary Gap and Deviations of Policy Rates from Equilibrium Rates



[1] Sample includes Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom, and United States

Source: JST database.

Financial repression (both de facto and de jure) has historically been used to lower fiscal financing costs, but similar measures today would be challenging. Historically, countries have resorted to using financial repression during episodes of large fiscal-monetary gaps, particularly when fiscal pressures (e.g., due to wars and other exogenous shocks) are acute. That said, policymakers should be mindful of the adverse spillovers of financial repression, including to households, firms, and capital formation. On a practical level, the strength of organized financial interests that would lobby against financial repression (due to suppressed returns) and global capital mobility (making it more difficult for authorities to "lock in" capital) could reduce the potential efficacy of financial repression.[53] Still, if fiscal-monetary tensions remain elevated into the medium term, while political cohesion and social consensus to achieve fiscal consolidations is lacking, then financial repression may increasingly become a preferred tool of choice of countries facing heightened tensions.

Going forward, the extent of fiscal-monetary tensions will likely depend, in part, on the speed of fiscal adjustment and trajectory of monetary r-star. It is possible that an easing of pandemic and geopolitical supply shocks and a return to pre-COVID "low-for-long" inflation and real interest rate dynamics could reduce monetary r-star and, with it, mitigate fiscal-monetary tensions barring significant shifts in fiscal policy. On the other hand, a "higher-for-longer" monetary r-star would imply a more urgent need for raising fiscal r-star to close the fiscal-monetary gap, which could be achieved through fiscal consolidation, among other policy actions (including financial repression). In either scenario, preserving central bank independence would be critical to ensuring that short- and long-term fiscal-monetary tensions do not manifest in erosion of central banks' operational autonomy and abandonment of inflation targets, especially when the fiscal dividend of these actions would be elevated relative to historical standards (see Gopinath (2022)). As an increase in potential growth can attenuate fiscal-monetary tensions, as shown in Figure 4B, growth-enhancing structural reforms would be useful to increase growth and ease policy tradeoffs while enhancing policy space, as argued by Budina et al. (2023). In either case, the lack of policy actions will make higher inflation and continued increases in debt levels more likely.

In AEs, the impact of fiscal-monetary tensions could also depend on global demand and supply for safe assets. As explained by, inter-alia, Arslanalp and Eichengreen (2023), the possibility of non-linear and adverse dynamics in financing costs caused by unsustainable, Ponzi-like debt issuance depends on the ability of global savers—including domestic, foreign, private, and official sector—to absorb the new net issuance and debt rollovers. While the rate of debt issuance has increased in recent years, so too has the global supply of loanable funds. As Arslanalp and Eichengreen argue, much of the recent decline in official foreign demand for safe assets has been offset by demand for the private sector. Thus, the extent of adverse spillovers from heightened fiscal-monetary tensions will depend on the additional spread (or yield) demanded by savers relative to monetary r-star, which follows from the total demand for safe assets. The sustainability of large fiscal-monetary gaps may also depend on the willingness of global savers to accept negative real returns on their safe asset holdings caused by persistent fiscal-monetary tensions. This dynamic will depend on the stability of the international monetary system (IMS) and the durability of the current reserve currency composition despite heightened fiscal-monetary tensions. Future research can study how persistent fiscal-monetary gaps may implicate the IMS.

[53] See Arslanalp and Eichengreen (2023).

IX. Conclusions and Extensions

This paper introduced the concept of fiscal r-star and the fiscal-monetary gap. The premise of this approach is based on the empirical observation that fiscal policy does not respond to debt sustainability dynamics in a manner that ensures fiscal sustainability and is thus "active". Fiscal r-star was defined as the implied debt-stabilizing real interest rate at which output is at potential and inflation is at target. It can be measured using widely available data and is a useful reference point that can be used to study tensions between fiscal and monetary policies. The paper also expressed fiscal r-star relative to the neutral rate of interest (i.e., *monetary* r-star) to introduce the concept of the "fiscal-monetary gap". It showed how standard equations for the IS curve, Phillips curve, and debt accumulation imply that when the fiscal-monetary gap is high, fiscal-monetary tensions could also be high, such that simultaneously achieving a stable debt-to-GDP ratio and inflation at target could require significant policy adjustments.

When the fiscal-monetary gap is high, certain macroeconomic outcomes and policy adjustments were more likely. Specifically, countries with elevated fiscal-monetary gaps subsequently experienced a combination of rising debt levels, higher inflation, and currency depreciation. These countries tended to liquidate their debt burdens by keeping real interest rates low relative to the natural rate of interest, leading to poor real asset returns and elevated risks of future debt, currency, and housing crises.

Several caveats remain, which can be further explored in future research. The closed-form solution in this paper provides several theoretical predictions regarding the relationship between fiscal r-star and monetary r-star, which are corroborated by the paper's empirical findings. That said, the paper's theoretical framework assumes treats trend growth rates and monetary r-star as exogenously determined from the fiscal stance. In reality, fiscal policy can impact trend growth and equilibrium real interest rates by, for example, changing the supply of loanable funds or boosting productivity and potential growth. More work needs to be done to better account for this endogeneity, which can be the subject of future research. Additionally, future research can provide greater detail on the paper's empirical associations, including through more refined identification strategies to identify causality between the fiscal-monetary gap and key macroeconomic outcomes. The policy implications should similarly be interpreted with caution—although this paper presents historical associations, short-term policy decisions should be guided by country-specific factors consistent with existing institutional arrangements (e.g., central bank independence).

The paper opens several avenues of theoretical research related to fiscal-monetary interactions. Further work can attempt to refine the fiscal r-star framework by incorporating the concept into existing micro-founded macroeconomic models to better account for the potential endogeneity of monetary r-star to an economy's fiscal stance. One potential avenue could be building a DSGE model calibrated to a representative advanced economy with active fiscal policy to examine how shocks to the fiscal-monetary gap impact macroeconomic aggregates. It would be possible to build a model with an exogenous primary balance path, from which a Wicksellian r-star (determined by the market-clearing real interest rate of savings and investment) could be computed. This market-clearing interest rate with active fiscal policy could be compared to the shadow fiscal r-star that would stabilize the debt path. Deriving an open economy version of the fiscal r-star and fiscal-monetary gap framework, including by building on the insights in Box 1, would further refine this paper's theoretical framework.

The paper's empirical work can also be refined and extended. Future empirical research can study the relationship between interest-growth differentials (i.e., "r-g"), active fiscal policy, and fiscal consolidation.[54] Subsequent research can also examine the role of financial repression in dealing with periods of elevated fiscal-monetary tensions. For example, the results of this paper can be used to develop a proxy for financial repression.[55] Future studies can also attempt to map fiscal-monetary gaps to measures of sovereign stress, including debt restructuring episodes, as a type of "early warning indicator" for debt distress. This paper also opens future research avenues on the empirical determinants of fiscal r-star and fiscal-monetary gaps, especially from a structural perspective, by examining the relevance of factors such as aging populations and rising dependency ratios, political polarization, among others. Future research can also consider how fiscal-monetary tensions may have implications for the IMS, including for the supply and demand for safe assets. More work can be done to analyze the relationship between fiscal-monetary gaps, deviations from rules-based monetary policy frameworks, and potential infringements on central bank independence. Finally, future research can attempt to add granularity to the analysis of the association of the fiscal-monetary gap with key macroeconomic outcomes, including by decomposing changes in the gap into changes in monetary r-star and changes in fiscal r-star separately.

Fiscal r-star complements other real interest rate reference points, which can guide future research and policy advice related to various real interest rate anchors. As mentioned previously, central banks developed the concept of "r-star" as a guide for monetary policy, which is the unobserved real interest rate at which output is at potential and inflation is at target. This monetary r-star is thus considered the *neutral* rate of interest for the economy, where the monetary policy stance is neither expansionary nor contractionary.[56] Subsequently, several authors developed the concept of a financial stability interest rate, or "r-double-star" at which neither financial vulnerabilities are building nor financial stability risks are posed (e.g., Akinci et al., 2020). Divergences between r-star and r-double-star and their future paths have helped inform discussions of policy tradeoffs posed by the potential for higher-for-longer interest rates, on one hand, and the buildup of COVID-era duration risk on bank balance sheets, on the other.[57] Future research can study the interaction of all three star variables, within the constraints of data availability, to consider the sustainability of the overall fiscal-monetary-financial policy mix. Policymakers can develop granular policy advice based on holistic assessments of fiscal-monetary-financial space, informed by both theory and country-specific circumstances. Future research can also study the pass-through of changes in monetary policy to changes in fiscal financing costs in regimes with active fiscal policy.

The results of this paper can contribute to assessments of fiscal-monetary interactions and various policy space assessments. Calculations of fiscal r-star, monetary r-star, and the fiscal-monetary gap can be used to assess the degree of fiscal-monetary tensions in countries with active fiscal policy. For example, the IMF's Consistent Policy Assessment (CPA) uses estimates of r-star and the CAPB as variables for measuring the monetary and fiscal stance. Using the gap between r-star and fiscal r-star would add a proxy for fiscal-monetary tensions to the CPA. Further work should be done to operationalize the theoretical frameworks set forth in this paper, including by integrating them into existing policy space frameworks.

[54] For instance, Arena et al. (2020) shows how, in Europe, monetary r-star declined faster than potential growth after the GFC.
[55] The proxy could be computed using the following equation: (monetary r-star – actual policy rate)/(monetary r-star – fiscal r-star). The intuition is that when the policy rate is closer to fiscal r-star amid a higher monetary r-star, this would imply that the central bank prioritizes debt sustainability. This work could build on the work of Reinhart and Sbrancia (2015) as well as Acalin and Ball (2023).
[56] See, inter-alia, Laubach and Williams (2003), Holston, Laubach, and Williams (2017), Powell (2018), McCulley (2008). On differences between neutral and natural rates, see Platzer, Tietz, & Linde (2022).
[57] See IMF (2023c) on the potential realization of duration risks and concomitant banking sector losses caused by higher interest rates in the United States. For an ex-post assessment of the 2023 banking turmoil, see BIS (2023).

Annex I. Panel Regressions on Fiscal Responsiveness

Two panel regression exercises are conducted in Section III to assess the extent to which fiscal policy responds to public debt levels. The first exercise, which follows the fiscal function in equation (3), involves estimating the following panel regression, as set forth in equation (A.1):

$$(\mathbf{A.1})\ pb_{i,t} = \rho_1 \cdot d_{i,t-1} + \omega_1 \cdot otherperiod_t \cdot d_{i,t-1} + \alpha_1 \cdot Q\_gap_{i,t} + \delta_t + \beta_i + \epsilon_{i,t},$$

where $Q\_gap_{i,t} \equiv Q_{i,t} - Q^*_{i,t}$, the variables $pb_{i,t}$, $d_{i,t-1}$, $Q_{i,t}$and $Q^*_{i,t}$ are defined in the same manner as in Section III for country i in year t, and δ_t and β_i are time and country fixed effects, respectively. To capture the difference in the responsiveness of $pb_{i,t}$ to $d_{i,t-1}$ across three sub-periods (pre-GFC, GFC, and the COVID pandemic), three separate regressions were run. While the full sample period (1880-2022) in all the three regressions was included, the above specification introduces a time dummy $otherperiod_t$ which equals 1 if the year t does not fall within the period of interest, and 0 otherwise.[58] Under the above specification, ρ_1 can thus be interpreted as the responsiveness of fiscal policy during the sub-period of interest.

The second exercise, which follows the fiscal function in equation (5), then involves estimating the following panel regression:

$$(\mathbf{A.2})\ pb_{i,t} = \rho_2 \cdot pb^{DS}_{i,t} + \omega_2 \cdot otherperiod_t \cdot pb^{DS}_{i,t} + \alpha_2 \cdot Q\_gap_{i,t} + \delta_t + \beta_i + \epsilon_{i,t},$$

where $pb^{DS}_{i,t}$ is the debt-stabilizing primary balance defined in the same manner as in Section III for country i in year t. Again, three separate regressions are run for the three sub-periods, with the dummy variable allowing for ρ_2 to be interpreted as the responsiveness of fiscal policy during the sub-period of interest.

Both regressions use the following sample and data sources. The sample of 16 AEs is the same as that used in Section VI. Data on primary balances and debt levels are obtained from the Public Finance in Modern History database (Mauro et al., 2015). To construct $pb^{DS}_{i,t}$, trend growth and monetary r-star data are obtained from Platzer et al. (2013), respectively. For the debt stabilizing balance, we set inflation at 2 percent for all countries. The full regression results are presented in the table below.

[58] More specifically, for the pre-GFC, GFC, and Covid regressions, the dummy variable $otherperiod_t$ equals 1 if the years fall within 2009-2022, 1880-2008 and 2020-2022 and 1880-2019, respectively.

Annex Table 1. Responsiveness of Fiscal Policy to Debt and Debt-Stabilizing Primary Balances

	Response to Debt Levels			Response to Debt-Stabilizing PB		
	(1)	(2)	(3)	(4)	(5)	(6)
	pre-GFC	GFC	COVID	pre-GFC	GFC	COVID
Lagged Debt Level	0.031***	-0.015***	-0.035***			
	(0.003)	(0.003)	(0.006)			
Lagged Debt Level * Other Period	-0.053***	0.041***	0.058***			
	(0.006)	(0.006)	(0.007)			
Output Gap	0.014	0.018	0.013			
	(0.019)	(0.020)	(0.020)			
Debt Stabilizing Primary Balance (DSPB)				1.37***	0.49***	0.67***
				(0.16)	(0.15)	(0.20)
DSPB * Other Period				-0.86	0.75***	0.46*
				(0.21)	(0.21)	(0.24)
Output Gap				0.005	0.004	0.005
				(0.019)	(0.020)	(0.020)
Time FEs	Yes	Yes	Yes	Yes	Yes	Yes
Country FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1796	1796	1796	1796	1796	1796
R-squared	0.40	0.37	0.37	0.36	0.36	0.36

Note: Panel regressions of countries' primary balances on selected regressors. Robust standard errors, clustered by year, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' calculations

Annex II. Derivations

Bohn's test for passive fiscal policy

Test 1. First, it will be helpful to define the interest-growth differential as

$$(\mathbf{A.3})\ \Gamma_t \equiv \frac{r_t - g_t}{1 + \pi_t + g_t}$$

Inserting the fiscal reaction function in equation (3) into the law of motion of debt in equation (1) and rearranging gives

$$(\mathbf{A.4})\ d_t = [\Gamma_t + (1 - \rho_1)] \cdot d_{t-1} - \alpha_1(Q_t - Q_t^*) - \epsilon_t$$

Since $Q_t - Q_t^*$ and ϵ_t are assumed to be stationary, the debt ratio is stationary if (i) Γ_k is stationary and (ii) $\rho_1 > E[\Gamma_t]$. In this case, the debt ratio is expected to converge to zero.

Test 2. It follows from the previous condition for stationarity of the debt ratio that if the permanent component of the interest-growth differential changes during the sample period, test 1 loses its potency for gauging whether fiscal policy sets the primary balance to stabilize the path of the debt ratio.

$$(\mathbf{A.5})\ \bar{\Gamma}_t \equiv \frac{r_t^* - \bar{g}_t}{1 + \bar{\pi} + \bar{g}_t}$$

Inserting the fiscal reaction function in equation (5) into the law of motion of debt, and rearranging gives

$$(\mathbf{A.6})\ d_t = [\Gamma_t + (1 - \rho_2 \cdot \bar{\Gamma}_t)] \cdot d_{t-1} - \alpha_1(Q_t - Q_t^*) - \epsilon_t$$

It follows that the debt ratio is stationary if (i) $E[\Gamma_t] = \bar{\Gamma}_t$ and positive, and (ii) $\rho_2 > 1$. Again, if this is the case, the debt ratio is expected to converge to zero.

Fiscal R-Star

Fiscal r-star is derived algebraically below. We can rewrite the law of motion using the difference between revenues and primary expenditure, as per equation (A.7):

$$(\mathbf{A.7})\ D_t = (1 + i_{t-1})D_{t-1} - PB_t$$

where $PB_t \equiv T_t - G_t$ is the primary balance. Dividing both sides by nominal GDP yields equation (A.8):

$$(\mathbf{A.8})\ d_t = \frac{1 + i_{t-1}}{(1 + \pi_t)(1 + g_t)} d_{t-1} - pb_t$$

where small letters denote variables relative to nominal GDP. π_t and g_t are the growth rates of the GDP deflator and real GDP. We define the real interest rate on government debt as the difference between the nominal interest rate and the inflation rate, i.e., $r_t \equiv i_{t-1} - \pi_t$. The change in the debt-to-GDP ratio can be written as in equation (A.9) as:

$$(\mathbf{A.9})\ \Delta d_t = \frac{r_t - g_t}{1 + \pi_t + g_t} d_{t-1} - pb_t + o_t$$

where o_t is a convenient residual term which approximates zero for sufficiently low growth rates of nominal GDP.[59]

Fiscal r-star is the real interest rate that stabilizes debt-to-GDP at level $\bar{d}$ when output grows at potential rate $\bar{g}$, inflation is at target $\bar{\pi}$ and the fiscal authority runs the primary balance $\overline{pb}$. It's derived by inserting these variables into equation (A.10) and setting $\Delta d_t = 0$:

$$(\mathbf{A.10})\ r_f^* = \bar{g} + (1 + \bar{\pi} + \bar{g}) \frac{\overline{pb}}{\bar{d}}\ .$$

The Fiscal-Monetary Gap

The fiscal-monetary gap is derived algebraically below. Inserting equation (A.10) into equation (A.9) gives the following:

$$(\mathbf{A.11})\ \Delta d_t = \frac{r_t - g_t}{(\pi_t - \bar{\pi}) + (g_t - \bar{g}) + \left(r_f^* - \bar{g}\right)\bar{d}/\overline{pb}} d_{t-1} - pb_t$$

Using $g_t = \bar{g}$, $d_{t-1} = \bar{d}$ and $(\pi_t - \bar{\pi})\frac{\overline{pb}}{\bar{d}} \approx 0$, this simplifies to

$$(\mathbf{A.12})\ \Delta d_t = \frac{r_t - \bar{g}}{r_f^* - \bar{g}} \overline{pb} - pb_t$$

Adding and subtracting $r_f^* \overline{pb}$, rearranging, using the definition of fiscal r-star in the denominator, and dividing by $\bar{d}$ gives equation (A.13).

$$(\mathbf{A.13})\ \frac{\Delta d_t}{\bar{d}} = \frac{r_t - r_f^*}{1 + \bar{\pi} + \bar{g}} - \frac{pb_t - \overline{pb}}{\bar{d}}$$

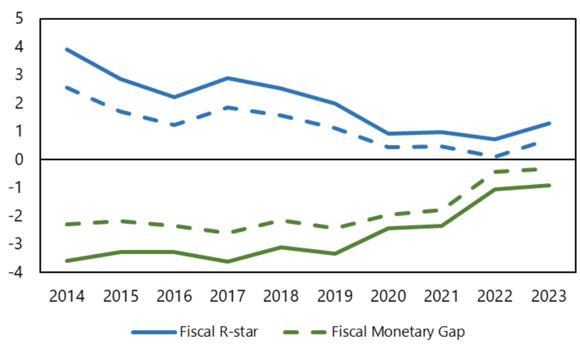
Finally, using $\tau_t \equiv r_t - r_t^P$ and inserting equation (10) and rearranging gives the fiscal-monetary gap as in equation (11).

59 Specifically, $o_t = \left(\frac{r_t - g_t - \pi_t g_t}{1 + \pi_t + g_t - \pi_t g_t} - \frac{r_t - g_t}{1 + \pi_t + g_t}\right) d_{t-1}$.

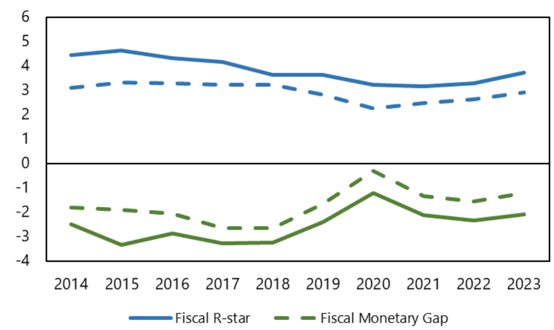
Annex III. Additional Results

Annex Figure 1. Recent Estimates of Fiscal R-Star and the Fiscal-Monetary Gap (AEs and EMs) after Correcting for Historical Forecast Errors (percent)[1]

(A) Fiscal R-Star and the Fiscal-Monetary Gap (AEs)



(B) Fiscal R-Star and the Fiscal-Monetary Gap (EMs)



[1] Solid lines represent baseline (unweighted mean) estimates in Section VI, while dashed lines represent estimates after correcting for historical forecast errors over the sample period for nominal GDP growth, primary balances, and debt levels. This is done by first computing the yearly forecast error for each country as the difference between the WEO forecast 5 years before and the realized value for each year, taking the country-specific average of these errors across the years, and then adding this average forecast error back to the 5-year ahead forecast for each of the mentioned variable.
Source: Authors' calculations

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