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Monetary Finance

Do Not Touch, or Handle with Care?

Prepared by Itai Agur, Damien Capelle,
Giovanni Dell'Ariccia, and Damiano Sandri

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Contents

FIGURES

TABLES

BOXES

Executive Summary

Over the past decade and a half, the world economy has confronted two major crises—the global financial crisis (GFC) and the COVID-19 pandemic. In both, central banks responded by cutting interest rates and deploying unconventional monetary policy tools in several countries. These measures certainly helped to support economic activity and maintain financial stability. Yet various countries were pushed in a liquidity trap with interest rates close to zero while public debt rose to historic highs. Against this background, a debate ensued about whether central banks should take even more unorthodox measures, including reconsidering the well-established opposition to monetary finance (MF)—that is, the financing of the government via a permanent increase in the monetary base.

This paper reviews the theoretical arguments in favor and against MF and presents an empirical assessment of the risks that it may pose for inflation.

Those in favor of relaxing the prohibition for central banks to use MF argue that a fiscal stimulus financed with money creation would have a stronger effect on aggregate demand than a debt-financed one. This is because MF does not increase public debt and the associated expected future tax burden, coupled with the fact that a permanent increase in the monetary base should stimulate inflation and reduce real rates. Further, the academic literature has developed models wherein MF can also be used to avoid self-fulfilling runs on public debt.

Opponents of MF see it as a harbinger of fiscal dominance and a mortal risk to hard-won central bank credibility. Their key concern is that should central banks reveal some degree of tolerance for MF, fiscal authorities would push them to provide support well beyond what is appropriate for macroeconomic stabilization. Therefore, even modest MF operations could lead to a sharp increase in inflation expectations as investors and the broad public factor in the risk of fiscal dominance.

Quantifying the risks that MF may pose for inflation is an admittedly challenging issue, especially because one cannot easily identify historical episodes of MF given central banks' reluctance to openly use this tool. With this important caveat in mind, this paper attempts to shed some light on the inflationary risks arising from MF by using two complementary empirical strategies.

First, it analyzes the association between money growth and inflation in a large panel of countries. The strength of this relation varies significantly with the initial level of inflation, central bank independence, and fiscal position. When inflation is high, central bank independence is weak, or the fiscal deficit is large—elements that point to a heightened risk of fiscal dominance—increases in the monetary base are followed by considerable price increases. Otherwise, the association between money growth and inflation tends to be modest. The analysis also detects significant non-linearities, showing that inflationary pressures increase more than proportionally with the size of the monetary expansion.

Second, the paper investigates whether announcements of unconventional monetary policy (UMP) programs during the COVID-19 pandemic triggered an increase in inflation expectations. It focuses especially on emerging market and developing economies (EMDEs) where some of these programs resembled forms of MF as they included the purchase of government bonds in primary markets and the provision of government loans—often with the explicit goal to provide fiscal support. The paper does not find evidence that these announcements led to increases in inflation expectations. However, it is important to note that these programs were modest in size and were launched in response to the exceptional shock triggered by the pandemic, likely supporting confidence that these were one-off operations.

The decades-long taboo against MF has served countries well by helping to establish central bank independence and providing a barrier against fiscal dominance. Recent theoretical analyses suggest that breaking the taboo may present some benefits for countries that confront a prolonged liquidity trap or the risk of a self-fulfilling sovereign debt crisis. Furthermore, central banks' interventions akin to MF in EMDEs during the pandemic did not jeopardize price stability. Therefore, there seems to be merit in further examining and more openly debating about the costs and benefits associated with MF. Yet relaxing the taboo presents serious dangers to central bank independence and the credibility of monetary policy frameworks. Possible experimentation with this tool should, then, remain modest in size given the non-linearities uncovered by the analysis, be limited to countries with low inflation and sustainable fiscal positions, and be decided independently by central banks with the sole goal to enhance macroeconomic stability. History abounds with examples where MF used under fiscal dominance had devastating economic and social consequences.

Acronyms and Abbreviations

AEs ..... advanced economies

DGF ..... direct government financing

ELB ..... effective lower bound

EM ..... emerging market

EMDEs ..... emerging market and developing economies

GPD ..... gross domestic product

GFC ..... global financial crisis

MB ..... monetary base

MF ..... monetary finance

QE ..... quantitative easing

UMP ..... unconventional monetary policy

1. Introduction

In the early 2000s, central banks seemed to have found a simple and effective framework to ensure macroeconomic stability: targeting low and stable inflation was the best monetary policy could do for the economy (the "divine coincidence"). Operational independence from politically elected officials and a clear separation from fiscal authorities lent central banks credibility and contributed to their success. Following these principles, central banks defeated the inflationary pressures of the 1970s and were credited for contributing to the Great Moderation, a period of low business cycle volatility in the 1990s and first half of the 2000s (Blanchard and Simon 2001, Stock and Watson 2003, Bernanke 2004).

This monetary framework has been vigorously tested during the last 15 years as the world economy confronted two existential crises. The GFC challenged the view that all monetary policy had to do was to maintain low and stable inflation and hence a small output gap. It proved that dangerous imbalances (associated with high leverage and correlated risks) could grow under seemingly tranquil macroeconomic conditions (Blanchard, Dell'Ariccia, and Mauro 2010). The depth of the recession quickly pushed policy rates to zero in many advanced economies, sometimes even into negative territory. In response, central banks broadened their policy toolkit, engaging in large quantitative easing and credit support programs. These proved essential in preventing a full financial meltdown and provided moderate support to the recovery (Dell'Ariccia, Rabanal, and Sandri 2018, Kuttner 2018). Yet economic growth remained subdued in many countries and inflation persistently undershot target levels, raising the specter of secular stagnation (Summers 2013). The crisis showed the essential role that unconventional central bank tools could and had to play in a financial crisis but also the limits of monetary policy in providing decisive stimulus during deep recessions.

The COVID-19 pandemic confirmed these lessons. Where possible, central banks aggressively cut policy rates: by the end of 2020, policy rates were below 1 percent in more than 60 percent of the global economy, an indication that the world economy had entered a global liquidity trap (Gopinath 2020). To provide additional support, central banks in advanced economies embarked on new quantitative easing and credit support programs and several emerging markets' central banks engaged in asset purchases. Again, central bank actions staved off a full-fledged financial crisis but, alone, could not stabilize the economy.

Unlike during the GFC, this time fiscal policy played a critical role. The unprecedented economic contraction and the unique nature of the crisis created political support for fiscal stimulus. This proved highly successful in supporting the recovery and preventing social unrest. However, together with the revenue losses due to the recession, sovereign debt has reached historic highs in several countries. The expectation that real interest rates will remain low by historic standards in the foreseeable future bodes well for debt sustainability. However, the exceptionally high levels of public debt may constrain the viability of additional fiscal stimulus and could expose countries to the risk of self-fulfilling crises in case investors suddenly lose confidence in debt sustainability.

The severity of these challenges prompted calls for central banks to play an even broader role in sustaining economic activity and guarding against financial turbulence in sovereign debt markets. Most controversially, the boldest proposals argued in favor of monetary finance (MF), which involves the financing of the government via a permanent increase in the monetary base.[1] This challenges the cornerstone of modern central banking about the need for a strict separation between monetary and fiscal authorities.

[1] More precisely, MF involves a permanent increase of the monetary base beyond the level consistent with the inflation target. Furthermore, the central bank should not pay interest on the newly created monetary base. These issues will be discussed more thoroughly in Chapter 2.

More specifically, several scholars have advocated for the use of MF to provide macroeconomic stimulus when conventional monetary policy is constrained by the zero lower bound and fiscal space is limited (De Grauwe 2020, Galí 2020b, Gürkaynak and Lucas 2020, Kapoor and Buiter 2020, Turner 2020, Martin, Monnet, and Ragot 2021). Proponents argue that a money-financed fiscal stimulus is more effective in boosting aggregate demand than a debt-financed fiscal stimulus. This is because governments do not need to increase future taxes to repay newly issued debt, preventing Ricardian equivalence effects.

Some scholars have also argued that MF can prevent self-fulfilling sovereign debt crises in countries that issue debt in local currency (De Grauwe 2011a, 2011b). This idea gained prominence in the context of the 2011–12 European debt crisis when a sharp increase in sovereign yields threatened the solvency of several member countries. The reduction in sovereign spreads following the ECB's pledge to halt the crisis (President Draghi's "whatever it takes" speech)—standing ready to purchase distressed sovereign bonds—supported the notion that central banks can provide an effective liquidity backstop against self-fulfilling runs. These insights have been examined in recent academic research (Aguiar and others 2013; Corsetti and Dedola 2016; Bacchetta, Perazzi, and Van Wincoop 2018; Camous and Cooper 2019).

Yet calls for central banks to engage in MF are often met with skepticism, if not outright rejection. Skeptics argue that MF merely involves swapping government debt with central bank liabilities and thus does not carry tangible benefits in terms of economic stimulus and public debt sustainability if reserves are remunerated (Borio, Disyatat, and Zabai 2016; Cecchetti and Schoenholtz 2016; Blanchard and Pisani-Ferry 2020). MF may also fail to fend off self-fulfilling runs in the sovereign market if it instills concerns about systematic debt monetization.

Furthermore, MF often stokes fears about fiscal dominance and run-away inflation as also discussed in Adrian and others (2021). The concern is that MF may undermine central bank independence as it weakens the principle of strict separation between monetary and fiscal authorities. For example, the government may press the central bank to provide additional rounds of MF beyond those that could be warranted for macroeconomic stabilization. Or the government may call on the central bank to compress sovereign yields on a permanent basis, preventing the central bank from pursuing its price-stability mandate. Importantly, if MF undermines central bank independence, people could revise inflation expectations sharply as soon as this tool is deployed, triggering quick inflationary pressures.

This paper contributes to the debate on MF in two ways. First, it provides a conceptual overview of how MF operates from a theoretical standpoint, drawing on the insights provided by the academic literature and the public debate. More specifically, the paper will review the goals and transmission channels, the effects on central banks' balance sheets, the possible conflicts with inflation targeting, and the associated risks to price stability. The paper will also clarify how MF differs from central bank purchases of government bonds under quantitative easing programs.

Second, the paper tries to shed light on the inflationary risks that could arise from MF.[2] Identifying the effects of MF on inflation is a challenging task because central banks do not employ this policy tool in a transparent manner and following theory prescriptions. This implies that the analysis cannot easily pinpoint historical episodes of MF.[3]

[2] The empirical analysis focuses on the possible effects of MF on inflation because this is the key concern shaping the debate on MF. A complementary line of research could analyze the impact of MF on real variables to shed light on the potential benefits in terms of output stabilization.

[3] Ryan-Collins and van Lerven (2018) examine several historical examples of fiscal-monetary coordination resembling monetary finance and conclude that they stimulated economic growth without triggering excessive inflation. See also Chen and others (forthcoming) for an analysis of fiscal-monetary interactions during severe recessions.

Thus, two broader complementary approaches are used to provide suggestive evidence about the possible inflationary effects of MF. First, given that MF involves an increase in monetary aggregates, the paper examines the association between money growth and subsequent inflation using a large panel of countries with data going back to the 1950s. The analysis shows that the association between money growth and inflation crucially depends on economic conditions and institutional considerations. When inflation is low, the central bank is independent, and the fiscal position is healthy, an increase in the monetary base tends to be followed by modest price increases. On the contrary, when inflation is higher, central bank independence is in doubt, and the fiscal position is weaker—factors that signal a more severe risk of fiscal dominance—an increase in the monetary base is associated with a much stronger increase in the price level. The analysis also shows that the association between money growth and inflation displays considerable non-linearities, as inflationary pressures increase more than proportionally with the size of the monetary expansion.

Second, the paper examines how inflation expectations reacted to UMP announcements by central banks during the COVID-19 pandemic in 2020. The analysis focuses on EMDEs for two reasons. First, several EMDEs' central banks engaged in direct financing of the government—purchasing government bonds in primary markets and providing loans and transfers to the government—often with the explicit intention to provide fiscal support. As such, these operations tend to resemble forms of MF. Second, central bank independence is often less entrenched in EMDEs relative to advanced economies. Therefore, EMDEs provide a better testing ground for the risk that MF may trigger a rise in inflation expectations due to concerns about fiscal dominance. The analysis does not find evidence of systematic effects of central bank announcements on inflation expectations, alleviating concerns that MF is bound to trigger sharp price increases. Yet it should be noted that central banks' interventions in EMDEs during the pandemic were modest in size and likely understood as one-off events in response to an exceptional shock.

Based on the theoretical arguments reviewed in the paper and the results of the empirical analysis, there seems to be some merit in exploring further the circumstances under which MF may or may not be appropriate. However, the destructive historical examples of MF being used as an instrument of fiscal dominance—some of which are reviewed in this paper—suggests extreme caution. Possible experimentation with this tool should be modest in size, limited to countries with low inflation and sustainable fiscal positions, and used only in exceptional circumstances such as when confronting a persistent liquidity trap or the risk of a self-fulfilling sovereign debt crisis. Most importantly, as also underscored by Adrian and others (2021), operations that involve elements of MF should be decided independently by central banks and used exclusively for macroeconomic stabilization goals.

2. Theoretical Underpinnings of Monetary Finance

This chapter describes how MF operates according to economic theory, differentiating between MF aimed at stimulating the economy and at avoiding self-fulfilling debt crises. More specifically, it discusses the policy objectives, transmission channels, effects on central banks' balance sheets, possible tensions with inflation targeting, and associated risks. To clarify how MF differs from government bond purchases under quantitative easing (QE), the chapter starts by reviewing the rationale and effects of QE. Table 1 summarizes the distinctive features of MF and QE from a theoretical standpoint. In the real world, the boundaries between these tools are often blurrier as will be discussed in the body of the paper.

The theoretical discussion assumes the presence of nominal rigidities, so that prices do not adjust instantly to monetary policy shocks. Otherwise, any stimulative effect on aggregate demand—no matter whether obtained though QE, MF, or conventional interest rate cuts—would only generate an immediate increase in prices with no impact on real output. The existence of nominal rigidities has been documented and analyzed using micro-level data in various studies (Klenow and Kryvtsov 2008, Nakamura and Steinsson 2008, Gopinath and Itskhoki 2010).

Table 1. Conceptual Differences Between Quantitative Easing and Monetary Finance

	Goals	Effects on Central Bank Balance Sheets	Departure from Inflation Targeting?	Main Risks
Quantitative easing	Macroeconomic stimulus	Large temporary expansion	No	Central bank losses
Monetary finance	Macroeconomic stimulus	Modest permanent expansion	Yes	Fiscal dominance
	Prevent self-fulfilling crises	Potentially large expansion off-equilibrium	Only off-equilibrium	Central bank losses, fiscal dominance

A. Quantitative Easing

Under QE, the central bank purchases large quantities of securities, generally long-term government bonds. These purchases occur through open-market operations which involve the exchange of bonds for cash in the form of newly created bank reserves. Therefore, QE involves an increase in the monetary base.

QE is used to provide monetary stimulus in a liquidity trap, that is when policy rates have reached the effective lower bound (ELB) so that short-term interest rates cannot decline further. Once the economy exits the liquidity trap and inflation increases back to target, the central bank is expected to reduce its holdings of government bonds and undo the expansion in the monetary base. As discussed more fully in the subsequent section, the central bank can also withdraw policy accommodation by starting to remunerate reserves rather than immediately reducing its holdings of government bonds. Note that QE does not involve a departure from inflation targeting because the central bank retains discretion to modulate asset purchases and interest rates to keep inflation at target.

QE is expected to provide macroeconomic stimulus by reducing long-term yields through two main channels. First, QE may signal that central banks are determined to keep policy rates low for an extended period. This makes long-term bonds more appealing to investors, reducing their yields. Second, large-scale purchases can affect prices if markets are segmented, for example because investors have a preference to hold government bonds over other securities. In this case, when central bank purchases reduce the supply of government bonds in the market, investors compete for the remaining bonds by bidding up prices and reducing yields.

QE programs have been deployed in various advanced economies in recent years. Japan pioneered these operations two decades ago. The sharp drop in real estate prices and stock valuations in the 1990s triggered a deep economic crisis coupled with strong deflationary pressures. After lowering policy rates to zero, the Bank of Japan launched QE in 2001. The GFC in 2008 prompted central banks in many other advanced economies—among which the euro area and the United States—to cut policy rates to zero and embark on QE programs. New rounds of QE were also launched after the COVID-19 pandemic.

The empirical and model-based evidence in the literature suggests that QE is effective in reducing government bond yields.[1] This is especially the case in periods of scarce liquidity when market segmentation is stronger, for example, in the early phases of the 2008 GFC. Existing studies also suggest that QE has stimulative effects on output and inflation, although the results are less definitive.

QE faces an obvious constraint in providing macroeconomic stimulus: once the yield curve is flat at the ELB, long-term bond purchases cannot reduce yields further. Central banks could provide additional stimulus by purchasing private sector assets but this exposes central banks to credit risk.

Regarding possible risks associated with QE, when this tool was deployed on a large scale after the GFC, some feared that it could lead to excessive inflation. However, these concerns proved to be unfounded in advanced economies, as many countries struggled on the contrary to bring inflation up to target. Another concern with QE is that it shortens the maturity of the consolidated public debt because the central bank buys long-term government bonds by issuing central bank reserves. Therefore, future increases in policy rates lead to a more immediate increase in the borrowing costs of the public sector. Furthermore, future interest rate hikes generate losses on the central bank's holdings of long-term bonds.[2] Central bank losses do not generally have material consequences for the conduct and effectiveness of monetary policy. Yet large losses could be used as a pretext to place the central bank under heightened political scrutiny. Related to this, in countries with less-established central bank independence, QE could also raise concerns about fiscal dominance, as governments may put pressure on central banks to continue bond purchases even when macroeconomic conditions no longer warrant it.

Finally, QE may entail some adverse effects that, however, can also arise from conventional monetary easing. For example, by reducing borrowing costs, QE tends to increase private sector leverage. While this is an important channel through which QE is expected to stimulate consumption and investment, it can also intensify financial stability risks. Furthermore, QE may exacerbate inequality as it boosts asset prices. Nonetheless, these adverse effects on inequality tend to be compensated through the positive effect of QE on employment (Bonifacio and others 2021).

B. Monetary Finance for Macroeconomic Stimulus

Monetary finance is often analyzed in the literature as a tool to provide macroeconomic stimulus, especially when monetary policy is constrained by the ELB and when the sustainability of additional debt-financed fiscal stimulus is in doubt because of high public debt. The core idea is that the central bank generates a permanent increase in the monetary base that can be passed to the public in several ways. Friedman (1969) provided the most vivid illustration using the analogy of a helicopter dropping newly printed paper money from the sky. In practice, MF is expected to occur through less imaginative means, generally via a government fiscal stimulus (Turner 2015). For example, the fiscal authority could cut taxes or increase

[1] See, for example, the survey papers by Dell'Ariccia, Rabanal, and Sandri (2018) and Kuttner (2018).

[2] Note, however, that if future increases in policy rates do not happen sooner and faster than markets anticipate, future losses on the holdings of government bonds should be largely compensated by the interest rate earnings seized beforehand, as the central bank finances the purchases of higher-yield long-term bonds with lower-yield central bank reserves.

spending temporarily while the central bank transfers cash to the Treasury to cover the associated costs. Or the Treasury could finance a fiscal stimulus by issuing bonds that are purchased and held indefinitely by the central bank.[3]

Views about the merits and drawbacks of MF to provide macroeconomic stimulus have evolved considerably over time, as discussed in Annex 1. For example, the stagflation experience in the 1970s led to strong opposition against MF as it became associated with the notion of fiscal dominance—a regime where monetary policy is subordinated to provide fiscal support. The idea that MF could be used as a legitimate tool to provide stimulus gained traction in the academic literature after Japan entered a liquidity trap in the 1990s (Krugman 1998, Bernanke 2002, 2003; Eggertsson and Woodford 2003, Auerbach and Obstfeld 2005). These ideas were further developed in the years after the 2008 GFC when many other advanced economies confronted anemic growth and deflationary headwinds despite zero or negative interest rates (Buiter 2014, 2020, Turner, 2015, Galí, 2020a, English, Erceg, and Lopez-Salido 2017). Calls for MF have also emerged during the COVID-19 pandemic given the large fiscal needs to meet the health crisis and support households and firms during lockdowns (De Grauwe 2020, Galí 2020b, Yashiv, 2020).

Regarding the transmission channels of MF, several papers emphasize its ability to overcome Ricardian equivalence effects, as shown formally in Annex 2 (Buiter 2014, 2020, Turner 2015). If the government finances a tax cut by issuing government bonds, households could be reluctant to increase consumption because they understand that the tax cut will imply higher taxes in the future to pay for the bonds and accrued interests.[4] If instead the tax cut is financed by the central bank with a permanent increase of the monetary base, Ricardian equivalence does not apply because of two crucial features that differentiate fiat money from government bonds. First, money does not pay interest. Therefore, MF reduces the government interest bill compared to a bond-financed tax cut, at least in so far as government bonds carry a positive interest rate. Second, money is an irredeemable liability of the public sector. In other words, the government never has to increase taxes to retrieve the outstanding stock of money.

The emphasis on the Ricardian equivalence and the interest rate savings associated with MF raises several considerations:

- *Liquidity trap*. When a country is in a liquidity trap, government bonds pay an interest rate close to zero. Therefore, MF generates interest savings over a debt-financed stimulus only because the increase in the monetary base persists after the country exits the liquidity trap when interest rates become positive.

- *Remuneration of central bank reserves*. MF is expected to increase the monetary base mostly through an increase in central bank reserves. Therefore, MF entails interest rate savings only if central bank reserves—or at least the additional reserves created through MF—are not remunerated.[5] Otherwise, MF finance would simply involve replacing government bonds with equally remunerated reserves, failing to deliver fiscal savings (Borio, Disyatat, and Zabai 2016, Cecchetti and Schoenholtz 2016, Blanchard and Pisani-Ferry 2020).

- *Timing of fiscal stimulus*. MF is generally associated with the idea of an immediate fiscal stimulus financed via money creation. However, if agents are forward looking and smooth consumption over time in a way that is consistent with Ricardian equivalence, a permanent increase in the monetary base can boost aggregate demand even without a contemporaneous fiscal stimulus. For example, assume that the central bank

[3] Note that since the bonds are held forever by the central bank, it does not matter whether they are interest bearing. This is because the central bank would rebate possible interest payments back to the Treasury in the form of higher central bank profits.

[4] Ricardian equivalence assumes that consumers smooth consumption over time, have rational expectations, have access to perfect capital markets, and care equally about themselves and their offspring. These are clearly strong assumptions. Empirical evidence about the validity of Ricardian equivalence is mixed (see, for example, Hayo and Neumeier (2017) and references therein).

[5] To ensure that MF is effective, De Grauwe (2020) calls on central banks to refrain from remunerating reserves as that involves an arbitrary distribution of seigniorage revenues to the banking sector. Alternatively, Bernanke (2016) suggests taxing banks to recover the interest payments earned by banks on the additional stock of reserves created through MF.

provides a monetary transfer to the government that reduces the need to issue government bonds. By reducing interest rate payments, this operation should stimulate private consumption no matter whether the government uses the associated savings to provide fiscal stimulus immediately or in the future.

The narrative about the interest rate savings from MF is developed using a partial equilibrium logic that ignores the effects of changes in the monetary base on interest rates and prices. This perspective is helpful to think about the first-round transmission channels of MF before general equilibrium effects are set in motion. Furthermore, it could be a good description of how people may think in the real world about the effects of a fiscal stimulus that does not carry the expectation of higher future taxes.

Yet a general equilibrium framework is warranted to fully understand the effects of MF. Galí (2020) provides such a framework by analyzing the effects of MF using a New Keynesian DSGE model. He shows that in general equilibrium an increase in the monetary base reverberates through the economy by lowering interest rates and raising inflation.[6] If the economy is in a liquidity trap—in which case nominal rates cannot decline—MF can still stimulate demand as it lowers real rates by raising the prospects of future inflation. This general equilibrium perspective, highlighting the effects of the monetary base on real interest rates, provides two important insights:

- *MF as an interest rate rule*. Because in general equilibrium changes in the monetary base map into changes in interest rates, MF can be interpreted as an interest rate rule that delivers the desired increase in the monetary base. English, Erceg, and Lopez-Salido (2017) elaborate on this point. They show that MF is equivalent to an interest rate rule that targets a higher price path when the government undertakes a fiscal expansion. These considerations dispel some of the mystery that often surrounds the effects of MF, showing that it can be analyzed just as one of the various interest rate policy rules that are recurrently examined in the literature.

- *MF versus inflation targeting*. In general equilibrium, outside of a liquidity trap the central bank cannot choose the monetary base and set policy rates as independent instruments.[7] Therefore, if the central bank wants to deploy MF by committing to a permanent increase in the monetary base, it must depart, at least temporarily, from an interest-rate rule that would adjust money supply to keep inflation at target. This implies accepting that inflation may rise temporarily above target. Whether this is warranted or not depends on the state of the economic cycle. If the economy is in a liquidity trap, a temporary shift to MF, which may lead in the future to a temporary inflation overshooting, could be beneficial to lift economic activity and facilitate exit from the liquidity trap. If instead MF is used when inflation is at or above target, it would lead to undesirable price pressures.

To better understand the properties of MF, it is helpful to compare it against QE. Monetary finance and QE share several common features. For example, they both aim to provide macroeconomic stimulus in a liquidity trap and they both involve an increase in the monetary base. The key distinction pertains to whether the initial monetary expansion is expected to be unwound in the future or if it is perceived as permanent.

- In the case of QE, the central bank is expected to reduce the monetary base once the economy exits the liquidity trap. This can be accomplished by selling government bonds back in the market or by not rolling over maturing government bonds. Alternatively, the central bank can start to remunerate reserves

[6] Similar insights are presented in Bianchi, Faccini, and Melosi (2020), who analyze the effects of a fiscal stimulus that is partly inflated away by the central bank.

[7] This statement assumes that central bank reserves are not remunerated and that agents can freely choose between holding money or investing in other securities. If reserves are remunerated, the central bank has more leeway to adjust the stock of reserves while retaining control on interest rates. However, as previously discussed, MF fails to deliver interest rate savings if reserves are remunerated.

to restrain bank lending and guide interest rates to the levels consistent with keeping inflation at target.[8] Therefore, QE does not entail a departure from inflation targeting as the central bank retains discretion to unwind its balance sheet and raise interest rates to prevent inflation from increasing above target.

- In the case of MF, the increase in the monetary base is expected instead to be permanent. This implies that the central bank implicitly commits not to tighten monetary conditions when the economy exits the liquidity trap, thus accepting the possibility that inflation may temporarily increase above target.

Why should central banks consider using MF instead of QE? One reason is that MF is expected to provide stronger macroeconomic stimulus than QE because it increases the monetary base permanently rather than temporarily. This has important implications for the future path of real interest rates. QE compresses interest rates during a liquidity trap, without affecting interest rates afterward because the central bank is expected to undo the monetary base expansion.[9] MF aims instead also to lower policy rates once the country exits the liquidity trap because it involves a permanent increase in the monetary base. As shown in the literature (Krugman 1998, Eggertsson and Woodford 2003, Auerbach and Obstfeld 2005), the expectation of lower future policy rates can be a powerful mechanism to stimulate the economy during a liquidity trap.[10] The stronger effectiveness of MF becomes particularly appealing when the yield curve is flat because QE has little room to further reduce term premia. The stronger impact of MF implies that the central bank can deliver a desired level of stimulus through a smaller—albeit more prolonged—expansion of the monetary base and thus of the central bank's balance sheet. This reduces the capital losses that the central bank will bear when interest rates eventually increase. By limiting the increase of the central bank balance sheet, MF also implies a smaller footprint of the central bank in asset markets, which may alleviate concerns about asset price distortions and market corrections. Finally, by allowing inflation to rise above target, MF lowers real interest rates and alleviates debt burdens. This is a particularly appealing feature for countries with high public debt and private sector leverage.

The distinction between QE and MF is to a large extent one based on advertised policy intentions (and hence their effect on expectations) rather than on the specific tools employed to implement them. Put differently, while the modalities in which the two policies are implemented make it easier or harder for the central bank to reabsorb the increase in monetary base, announced plans can be altered. Holdings of sovereign bonds acquired through QE could be rolled over indefinitely leading to a permanent increase in the monetary base. And even helicopter money could be sterilized (at a cost) in the future through the emission of central bank notes.

It follows that MF raises two opposite concerns. On the one hand, MF can fail to deliver strong stimulus because the central bank may be unable to commit to a permanent increase in the monetary base. For example, consider an economy in a liquidity trap and assume that the central bank purchases government bonds arguing that they will be permanently rolled over or written off consistent with MF. Yet once the economy exits the liquidity trap, the central bank could renege on this promise, by selling government bonds back in the market or starting to remunerate central bank reserves. This would reduce the stimulative impact of MF. In fact, if people expect central banks to behave in that manner, they will interpret MF as delivering only a temporary increase in the monetary base, having equivalent effects to QE.

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[8] Note that this is how the US Federal Reserve reacted when the US economy exited the liquidity trap in 2015. Prior to the GFC, the Federal Reserve did not remunerate reserves. Central bank reserves increased sharply between 2009 and 2014 through various round of quantitative easing. When the Federal Reserve decided in 2015 to tighten monetary conditions, it did so by raising the interest rate paid on reserves before starting to reduce its holdings of government bonds.

[9] In the years after the GFC, several central banks in advanced economies have complemented QE with forward guidance about their intention to avoid premature and sharp tightening in monetary conditions. As discussed in English, Erceg, and Lopez-Salido (2017), MF could be interpreted as a form of forward guidance whereby the central bank commits not to withdraw monetary accommodation.

[10] For example, Jacobson, Leeper, and Preston (2019) show that the decision by the Roosevelt administration to launch a fiscal stimulus coupled with an expansion of the monetary base played a crucial role in pulling the US economy out of the Great Depression.

On the opposite extreme, MF stokes fears about run-away inflation. These concerns are generally linked to the expectation that MF leads to fiscal dominance—a situation where monetary policy is subordinated to financing government spending rather than targeting price stability. As previously discussed, these concerns may also apply to QE, especially for countries with weaker monetary frameworks and central bank independence. Yet they are more acute in the case of MF because of the direct association with fiscal stimulus. The concern is that if the central bank opens the door to MF, the government may eventually force the central bank to engage in additional rounds of MF that could de-anchor inflation from target.[11] Note that a de-anchoring of inflation expectations could also lead to an increase in real rates as investors require compensation against the inflation risk. This would in turn raise the cost of newly issued debt, worsening debt sustainability.

These concerns are directly proportional to fiscal pressures (the size of the deficit and more generally the lack of fiscal space) and inversely proportional to the degree of central bank independence and the strength of the framework governing monetary and fiscal policies. It follows that while as discussed above different forms of government financing (purchases on the primary versus secondary markets, loans, grants etc.) can act in similar ways in simple models, in practice, their implications for governance and transparency may critically matter. For instance, direct government loans with off-market pricing and opaque conditions carry a greater risk of being interpreted as harbinger of fiscal dominance than transparent secondary market purchases.

C. Monetary Finance to Prevent Self-Fulfilling Debt Crises

Central banks can also use MF to provide a sovereign backstop against self-fulfilling debt crises. This idea gained prominence after President Draghi's assertion in 2012 that the ECB was ready to do "whatever it takes" to preserve the euro. A prevailing interpretation of those events is that markets were coordinating on a self-fulfilling bad equilibrium. Fearing a debt restructuring or default in several euro countries, markets started to demand high sovereign yields. This worsened the countries' fiscal position through higher interest payments on sovereign debt and, perhaps more critically, by tightening local financial conditions and thus exacerbating the recession. In turn, weaker fiscal prospects increased the likelihood of an adverse event on debt markets, "justifying" the higher spreads. The ECB commitment to halt these perverse dynamics—standing ready to purchase distressed sovereign bonds by expanding the monetary base—helped to coordinate the market on the good equilibrium with lower sovereign yields, easier financial conditions, and sustainable debt.

These mechanics have been analyzed in Aguiar and others (2013) and Camous and Cooper (2019) using models of self-fulfilling sovereign debt crises. If markets lose confidence in debt sustainability and the central bank does not intervene, the country can only either fully repay the maturing debt through fiscal consolidation or default. If the debt burden is too high, the country finds it preferable to default. If sovereign debt is issued in local currency, the central bank can prevent this outcome because it can alleviate the repayment burden of the sovereign by deflating the real value of debt. More specifically, the central bank can purchase government bonds or provide direct financing to the government by expanding the monetary base. In turn, the monetary base expansion raises inflation which eases the repayment burden for the government and avoids a default.

The literature provides further important insights on the use of MF to prevent self-fulfilling runs on sovereign bonds:

[11] To guard against this risk, Bartsch and others (2019) and Yashiv (2020) argue that MF should be implemented within a stringent legal framework to ensure that MF is used only temporarily to achieve well-defined macroeconomic stabilization goals. Martin, Monnet, and Ragot (2021) argue that the risk of fiscal dominance is considerably less severe if the central bank transfers newly created money directly to the public.

- *MF backstops as an off-equilibrium path*. If the central bank is credible in its commitment to use MF as a backstop, it can prevent self-fulfilling runs from occurring in the first place. In this case, markets automatically coordinate on the good equilibrium and the central bank never has to intervene in equilibrium and jeopardize inflation stability. In practice, the central bank may need to prove its resolve to prevent a sovereign debt crisis by undertaking at least some debt purchases or providing some direct government financing.

- *Inflation tolerance*. A MF backstop is credible only if the central bank has some tolerance for inflation. Markets should believe that the central bank is ready to endure sufficient inflation to prevent a default in case markets coordinate on the bad equilibrium.[12] At the same time, central banks should not be excessively prone to alleviate fiscal burdens via MF. Otherwise, investors would fear inflation even outside of self-fulfilling crises and require higher interest rate compensation. This may lead to a perverse equilibrium featuring permanently higher inflation and more frequent defaults.

- *Sterilized backstops*. The previous narrative assumes that the central bank provides a sovereign backstop by expanding the monetary base and generating inflation. In principle, a sovereign backstop can also involve sterilized operations that are not inflationary and do not represent forms of MF. For example, the central bank could purchase government bonds by selling foreign exchange reserves. The central bank of a monetary union, such as the ECB, could also support the sovereign debt market of a member country by selling government bonds of other countries. Finally, the central bank could finance the purchase of government bonds by issuing interest-bearing liabilities, for example remunerated reserves, consistent with inflation stability (Corsetti and Dedola 2016). This latter option assumes that investors do not fear a de facto default by the central bank—which could happen for example through financial repression, forcing banks to hold reserves—even if they are concerned about public debt sustainability.

Regarding the risks associated with the use of MF for sovereign backstops, a first concern is about possible losses for the central bank. This relates to the challenges in distinguishing self-fulfilling sovereign debt crises from those linked to fundamental problems. The central bank could purchase large quantities of sovereign bonds believing that markets are overestimating the risk of default and then realize that default is unavoidable because of severe economic problems or political economy considerations. In this case, central bank purchases of government bonds would shift default losses from private investors to the central bank, likely leading to worse inflationary consequences.

The use of MF to prevent self-fulfilling runs also raises concerns about fiscal dominance. For example, once the central bank commits to provide backstops, the government could put pressure on the central bank to reduce spreads even if they increase because of fundamental concerns about debt sustainability rather than self-fulfilling runs. The central bank may thus be forced to provide continuous MF to the government, compromising its ability to control inflation.

[12] The necessary increase in inflation could be considerable. For example, using a quantitative model with New Keynesian features, Bacchetta, Perazzi, and Van Wincoop (2018) find that inflation may have to increase to double digits for a protracted period to fend off default risks.

3. Historical Evidence on the Association Between Money and Inflation

As previously described, MF involves an expansion of the monetary base. Therefore, to provide some perspectives on the possible inflationary consequences of MF, this chapter examines the historical association between monetary expansions and inflation. Of course, this is not to say that all monetary expansions in the past have been the result of MF, although coordinated monetary and fiscal support was quite prevalent until the 1980s (Ryan-Collins and Van Lerven 2018). Yet studying the association between monetary expansions and inflation as well as the factors that shape its strength can provide a first tentative assessment of how monetary expansions under MF may affect inflation.

A. Empirical Approach

The association between monetary aggregates and the price level is at the core of the quantity theory of money. Assuming that money circulates in the economy at a stable velocity v and that it does not affect real output *Y* at least in the long run, an increase in the money supply *MS* should lead to a proportional increase in the price level *P* according to the following relation:

$$MS \times v = P \times Y$$

In turn, the money supply is assumed to be proportional to the monetary base *MB* according to

$$MS = m \times MB$$

where m is the so-called money multiplier.

The empirical analysis builds on these theoretical relations by exploring the association between monetary aggregates and inflation while controlling for real GDP. However, it does not assume a stable money velocity or a constant money multiplier. The analysis uses flexible local projections à la Jordà (2005) to assess the relation between monetary aggregates and inflation at different horizons. The local projections capture the association between money growth at time t in country i, $d\log M_{it}$, and the level of inflation h years in the future, π_{it+h}, by estimating the following regression:

$$\pi_{it+h} = \beta_{h0} d\log M_{it} + Z_{it}\Gamma_h + \varepsilon_{it+h}$$

The regression contains a set of controls Z_{it} which includes lagged values of money growth and inflation, the growth rate of real GDP, $d\log Y_{it}$, and country and year fixed effects, respectively, $\kappa_i + \tau_t$.

$$Z_{it}\Gamma_h = \sum_{l=1}^{10} \beta_{hl} d\log M_{it-l} + \sum_{l=1}^{10} \rho_{hl}\pi_{it-l} + \sum_{l=0}^{10} \gamma_{hl} d\log Y_{it-l} + \kappa_i + \tau_t$$

This specification is estimated using annual data from the 1950s to 2020 for a panel of up to 157 countries.[1] Two monetary aggregates are considered: the monetary base—including currency in circulation and bank reserves held at the central bank—and the money supply. The latter is measured using M2, which includes currency in circulation and deposits in checking and saving accounts.

[1] The data sources used in the analysis are listed in Annex 3.

The empirical analysis faces significant identification challenges. A primary concern is that changes in MB are decided by the monetary authority and are thus endogenous to economic conditions. The empirical framework alleviates these identification challenges by controlling for past levels of money growth, inflation, and real GDP growth. Because these variables are key determinants of monetary policy decisions, controlling for them helps to isolate exogenous changes in monetary decisions. The identification challenges are more severe when analyzing the association between M2 and inflation because fluctuations in M2 reflect both policy decisions (money supply) and people's behavior (money demand). For example, M2 may increase because the central bank expands the monetary base or because people autonomously decide to increase money balances, for example for precautionary motives during a crisis. Controlling for recent dynamics in money growth, inflation, and real GDP growth should also capture some of the demand factors driving M2. Yet, endogeneity concerns remain, requiring caution in the interpretation of the results.[2]

B. Empirical Results

Figure 1 illustrates the results of the local projections. Panel 1 shows the association between a 10 percent increase in MB or in M2 and the rate of inflation up to 10 years ahead. A 10 percent increase in MB is associated with an increase in inflation by about 1.5 percentage points on impact and in the subsequent year. The point estimates suggest a slightly stronger effect of M2, with inflation rising by about 2 percentage points. Panel 2 shows the implications for the price level. After 10 years, a 10 percent increase in MB and M2 is associated with an increase in the price level by about 6 and 8 percent, respectively. The 90 percent confidence bands around the point estimates for M2 are much wider, possibly reflecting the more severe identification challenges arising from fluctuations in money demand. For this reason, the rest of the analysis will focus on the link between MB and inflation which appears to be estimated more precisely. Nonetheless, the key results are robust to considering M2.

The estimates in Figure 1, panel 2 are not that far from the implications of the quantitative theory of money, according to which a 10 percent increase in monetary aggregates should eventually lead to a 10 percent increase in the price level. These findings are consistent with early empirical studies providing some support for the quantity theory of money (Vogel 1974, Lucas 1980, Geweke 1986, McCandless and Weber 1995). However, as shown in the rest of the analysis, the association between monetary aggregates and inflation is heavily shaped by several factors that are ignored in the quantitative theory of money.

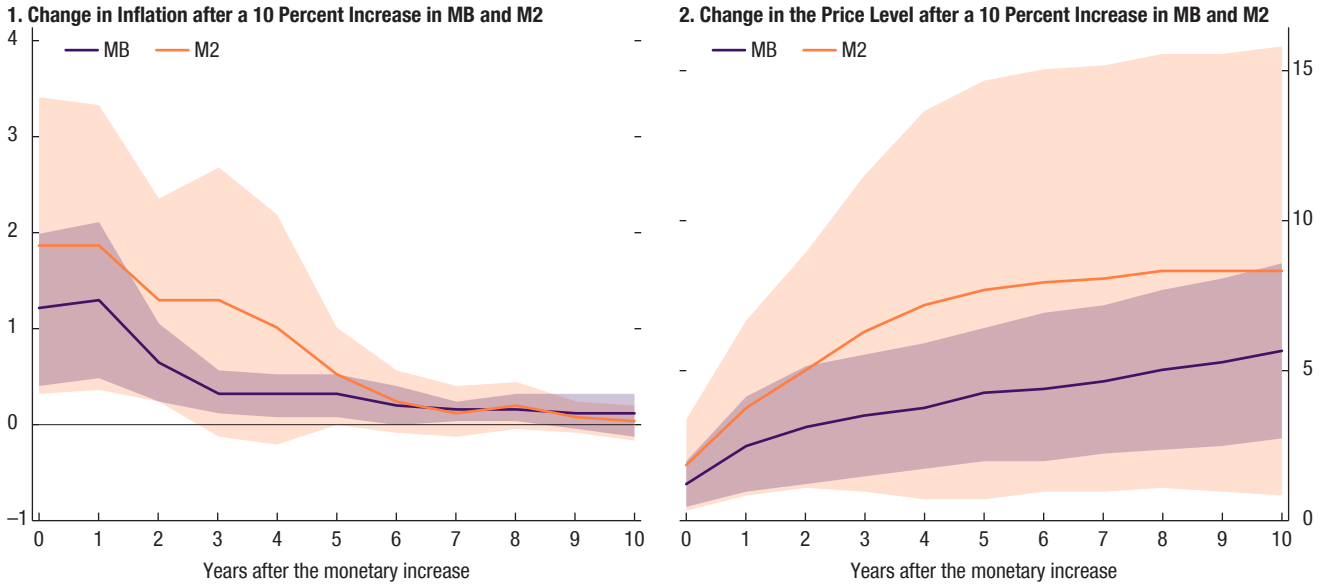
For example, the association between MB and inflation is affected by the size of the monetary expansion which can be captured by including a quadratic term for money growth in the local projections.[3] Figure 2 shows that a 1 percent increase in MB is associated with only a 0.3 percent increase in the price level after 10 years. A 100 percent increase in MB is instead associated with a much higher increase in the price level, up to 94 percent. This suggests that the inflationary risks posed by a monetary expansion under MF may increase more than proportionally with the size of the program.

The association between MB and inflation is also heavily shaped by economic conditions and institutional factors. For example, the initial level of inflation strongly affects the extent to which an increase in MB is followed by higher inflation. To capture this aspect, the local projections are augmented with an interaction term between money growth and the one-year lagged inflation rate. Panel 1 in Figure 3 shows that this

[2] State-of-the-art empirical methods to identify monetary policy shocks involve looking at high-frequency movements in interest rates around policy announcements or using a narrative approach to identify exogenous policy decisions. The analysis cannot use these strategies because high-frequency market data and shocks identified using narrative approaches are not available over the long period and for the large country sample used here.

[3] The empirical specifications used for this exercise and for the subsequent ones in this section are reported in Annex 4.

Figure 1. Monetary Growth and Inflation
(Percentage points)

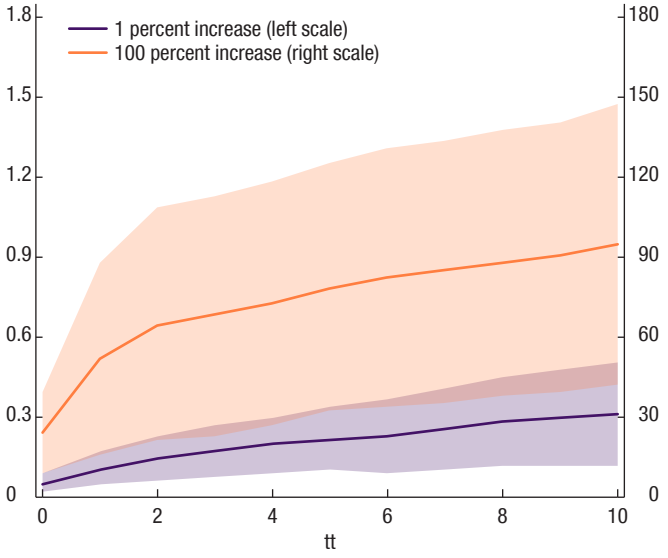


Source: See Annex 3 for sources.

interaction coefficient is positive and statistically significant on impact. This implies that inflation rises more strongly after an increase in MB if inflation is high to begin with. Panel 2 illustrates this finding. If inflation is very elevated–growing at an annual rate of 100 percent–a 10 percent increase in MB is associated with an additional increase in inflation by 9 percentage points. If instead inflation is initially contained, for example at 2 percent, a 10 percent increase in MB is associated with a very modest increase in inflation, by at most 0.9 percentage points one year ahead. These findings echo those of De Grauwe and Polan (2005) and Teles, Uhlig, and Valle e Azevedo (2016) who find that the correlation between money growth and inflation is strong only in countries with high average inflation.[4]

A possible interpretation of these findings is that periods and countries with low inflation demonstrate that the central bank is committed and capable of keeping inflation at bay. In these circumstances, a temporary increase in the mon-

Figure 2. Change in Inflation after a 1 and 100 Percent Increase in the Monetary Base
(Percentage points)



Source: See Annex 3 for sources.

[4] The analysis in this paper innovates relative to the literature along three dimensions. First, it contains 20 more years of data and additional countries. Second, it examines the association between money growth and inflation using local projections with a rich lag structure rather than relying on simple correlations. Third, it also investigates how the association between money growth and inflation depends on central bank independence and the fiscal balance.

etary base is unlikely to trigger a surge in prices. To further examine this hypothesis, the local projections are re-estimated using an interaction term between money growth and the de jure index of central bank independence provided by Garriga (2016). Panel 3 in Figure 3 shows that this interaction is negative and statistically significant, implying that central bank independence dampens the association between money growth and inflation. For example, a low level of independence—at the 25th percentile of the distribution in the regression sample—implies an increase in inflation which is three times as large relative to a high independence level—equal to the 75th percentile (panel 4). This also implies that a highly independent central bank can sustain an increase in the monetary base three times as large relative to a central bank with low independence while experiencing the same price pressures.[5]

The ability of the central bank to deliver stable inflation may also depend on the fiscal position of the country. A weaker fiscal position may increase the risk of fiscal dominance because the government is more likely to put pressure on the central bank to preserve debt sustainability by keeping interest rates low. To examine this possibility, money growth is interacted with a dummy capturing a fiscal deficit larger than three percent of GDP. Figure 3, panel 5 shows that this interaction is positive and significant, revealing that a large fiscal deficit magnifies the association between money growth and inflation. Indeed, panel 6 shows that when the fiscal deficit is below 3 percent, there is no statistically significant association between MB and inflation. On the contrary, when the fiscal deficit exceeds 3 percent—with an average of 6.2 percent in the regression sample—an increase in MB is associated with a significant and persistent increase in inflation.[6]

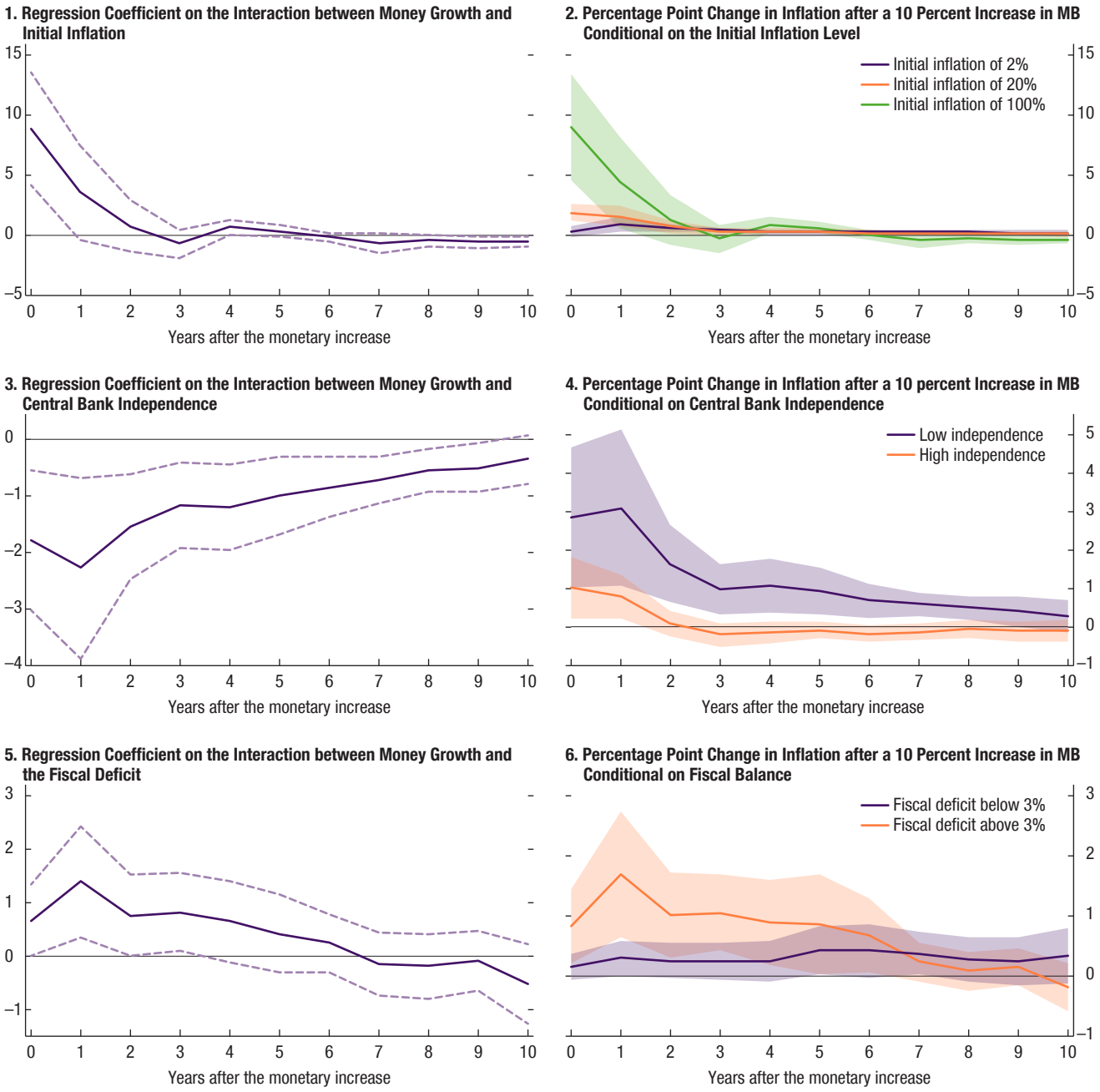
These findings are robust to several tests. First, one may worry that the strong association between MB and inflation at high levels of inflation, weak central bank independence, and high fiscal deficits could be driven by hyperinflation episodes. On the contrary, both the magnitude and the statistical significance of these results are robust to dropping observations with an annual rate of inflation above 100 percent (see Annex 5). Second, one may suspect that the weak relation between MB and inflation at low inflation levels is driven by periods of quantitative easing in advanced economies. However, the results are unchanged if these episodes are removed from the sample. Thirdly, the level of inflation and the degree of central bank independence also influence the association between M2 and inflation. Finally, the results hold even if the interactions of money growth with inflation, central bank credibility, and the fiscal deficit are included together in the same specification.

The empirical results presented in this section provide suggestive insights about the potential risks to inflation posed by monetary expansions under MF. First, the analysis has shown that these risks are more acute in case of larger increases in the monetary base. Therefore, central banks that may want to experiment with MF should do so starting from a modest scale. Second, the inflation risks posed by monetary base increases appear contained in the context of low inflation, strong central bank credibility, and modest fiscal deficits. On the contrary, central banks with weak credibility should refrain from embarking in monetary expansions under MF because they are much more likely to trigger sharp price responses.

[5] This finding is consistent with Sargent and Surico (2011) who show that the move over the past six decades toward monetary policy rules that respond more strongly to inflationary pressures can rationalize the decline in the low-frequency correlation between money growth and inflation.

[6] Hooley, Nguyen, Saito, and Towfighian (2021) show that in the context of sub-Saharan African countries central bank deficit financing generates significant inflationary pressures.

Figure 3. Factors Influencing the Association between the Monetary Base and Inflation

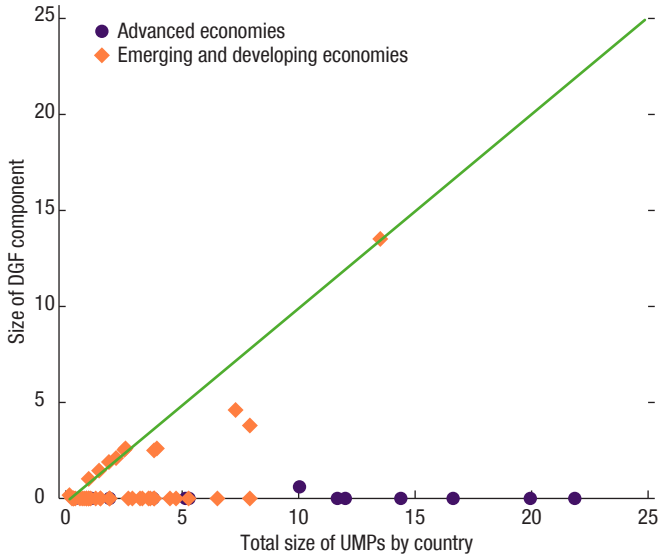


Source: See Annex 3 for sources.

4. UMP Announcements and Inflation Expectations During COVID-19

This chapter uses an alternative approach to assess the inflationary risks posed by MF by examining the extent to which UMP announcements by central banks during the COVID-19 pandemic affected inflation expectations. In advanced economies, central banks mostly embarked on large scale asset purchases in secondary markets within the framework of traditional QE programs. However, in EMDEs, UMP programs included also large components of direct government financing (DGF) through the purchase of government bonds in primary markets and the extension of loans and grants to the government (Figure 4).[1] These operations were motivated with the explicit goal to support fiscal authorities at times of exceptional needs and to preserve stability in sovereign debt markets. Therefore, they could be more naturally interpreted as forms of MF.

Figure 4. UMP Programs and Direct Government Financing during COVID-19
(Percent of GDP)



Sources: List of trackers in Chapter 4, footnote 2; and author calculations.

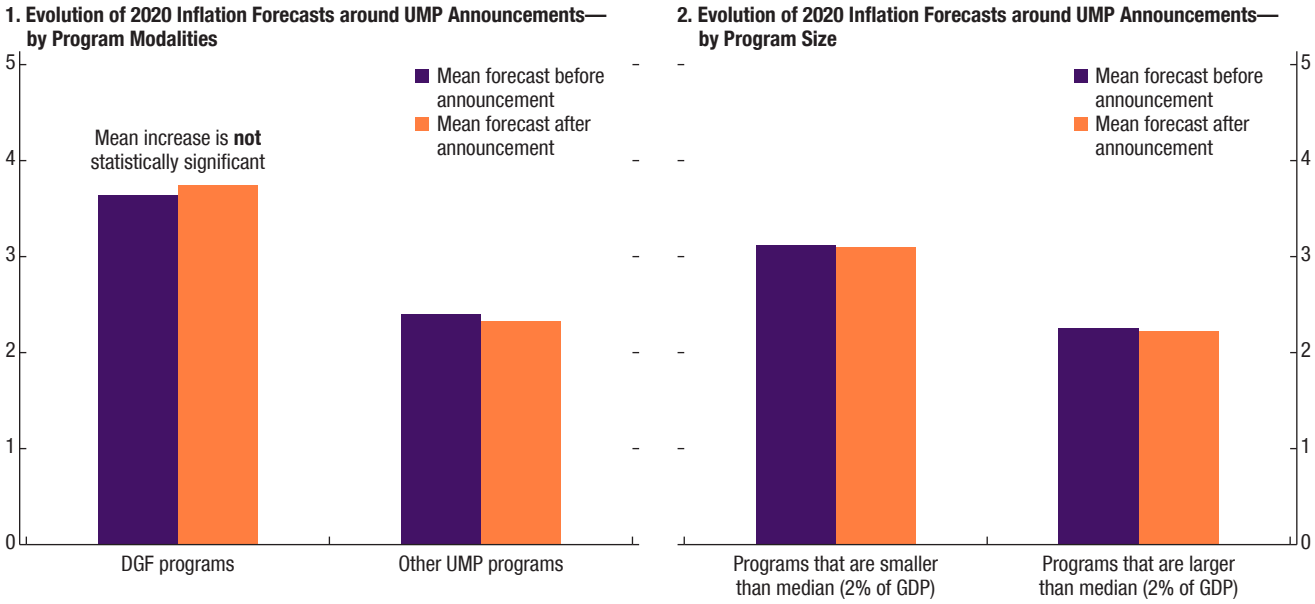
Our analysis considers all UMPs conducted between March 2020 and December 2020 in 49 advanced economies and EMDEs.[2] The samples includes 15 cases of DGF and 64 other UMP cases. EMDE programs have generally been smaller than advanced economies', as shown on the horizontal axis of Figure 4 which illustrates the size of UMP announcements. The smaller size of EMDE programs could relate to financial market depth as larger financial markets may require bigger UMP programs to move yields. But this may also reflect greater hesitance by EMDEs to engage in UMPs given the lack of prior experience.

All DGF programs in EMDEs were associated with central bank statements recognizing a fiscal intent of the program upon its announcement. For example, on May 15, 2020, the Bank of Ghana announced that: "the Bank has purchased a Government of Ghana COVID-19 relief bond with a face value of GH¢5.5 billion at the Monetary Policy Rate with a 10-year tenor and a moratorium of two years (principal and interest). The Bank stands ready to continue with its Asset Purchase Programme up to GH¢10 billion in line with the current estimates of the financing gap from the COVID-19 pandemic." Instead, none of the UMPs conducted on secondary markets had a stated fiscal intent.

[1] Annex 6 provides detailed information on the composition of UMP measures by region, country, type, and size.

[2] Sources used in this exercise are the IMF COVID-19 policies tracker, the Yale COVID-19 financial responses tracker, the ESRB COVID-19 measures tracker, the IMF October 2020 GFSR Chapter 2, the IMF Monetary and Financial Statistics, Cerutti and Helbling (2021), and national authorities. The complete file with links per country case is available on request from the authors. We focus on announced packages because these can directly move market and public expectations. Note, however, that announcements can differ from ultimately implemented packages and that authorities' underlying UMP objectives (for example, as fiscal support) may sometimes differ from those that are officially announced.

Figure 5. Inflation Forecasts Around UMP Announcements



Sources: Consensus Economics; IMF, *World Economic Outlook*; trackers in Chapter 4, footnote 2; and author calculations.

The goal of the analysis is to understand whether UMP announcements—including DGF in EMDEs—affected inflation expectations.[3] To this end, the analysis uses real-time data on inflation expectations from both Consensus Economics (monthly data covering 31 countries in our sample) and WEO forecast vintages (quarterly data covering the other 18 countries) and it looks at end-of-period inflation, which is more reactive to news than annual average inflation.

Figure 5 shows the average inflation forecasts for 2020 before and after the central bank announcements.[4] Panel 1 distinguishes between DGF and other UMP programs. Because of their fiscal connotation, DGF programs might increase inflation expectations even when other UMPs do not. However, a comparison of simple averages does not bear this out: inflation expectations are stable for both DGF and other UMP programs. Panel B dissects the cases by program size, showing no notable difference between relatively small and relatively large UMP programs.[5]

To give the patterns presented in Figure 5 a more formal cast, the analysis also estimates cross-section and panel regressions, reported in Annex 7 and Annex 8, respectively. In Annex 7, the first column of Table 1 represents the baseline cross-section specification. The dependent variable is the 2020 inflation forecast

[3] In the wake of the GFC, many studies investigated the impact of advanced economies' UMP announcements on financial market variables, as summarized in, for example, literature surveys by Bhattarai and Neely (2020), Dell'Ariccia, Rabanal, and Sandri (2018), Fabo and others (2021), Kuttner (2018), and Lombardi, Siklos, and St. Amand (2018). This study adds the dimension of UMPs by EMDEs that have been observed in response to the COVID crisis. Arena and others (2021), Arslan, Drehmann, and Hofmann (2020), Fratto and others (2021), IMF GFSR (2020), Rebucci, Hartley, and Jiménez (2021), and Sever and others (2020) also consider EMDE UMPs during COVID, but center attention on the response of bond yields, whereas this study focuses on inflation expectations.

[4] For example, for an action announced on March 23, 2020, the chart considers the March and April 2020 Consensus inflation forecast, which were gathered in surveys conducted on March 9 and April 6, 2020. If the country is not in the Consensus sample, the chart uses the WEO forecasts published in January and April 2020.

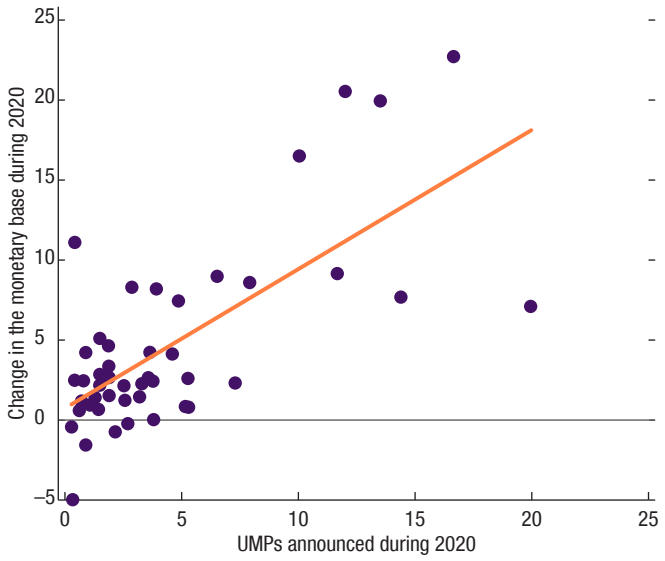
[5] One nuance is that there could be a degree of self-selection at play, whereby countries with relatively good fundamentals, including monetary credibility, choose to engage in UMPs. For example, IMF (2021) shows that asset purchase programs were more likely in EMDEs with greater central bank transparency and intermediate levels of fiscal space. However, our country sample, shown in Annex 6, contains EMDEs of a wide variety of institutional backgrounds and development levels. For example, among the EMDEs in this sample, the structural fiscal deficit ranges from –8.9 to 2.2 percent of GDP and the average 10-year past inflation ranges from 0.8 to 21.4 percent. This may partly assuage concerns that self-selection is the key driving force behind our results.

that is collected in the first survey after the central bank UMP announcement.[6] Explanatory variables in the baseline comprise the latest inflation forecast before the announcement, the country's average inflation over the past ten years, the size of the UMP program, a dummy for DGF programs, the real-time forecast of the 2020 fiscal deficit at the time of the announcement, and a dummy for Mauritius which is an outlier regarding the size of UMP. [7] The regression results show that inflation expectations are persistent and are influenced by past inflation. Indeed, both the lagged dependent variable and average past inflation are key determinants of 2020 inflation expectations. Instead, neither the type (DGF or not) nor the size of UMP programs has a significant effect on the inflation forecast after the UMP announcement. Specifications 2–7 bring in an interaction between the program type and its size, alternative real-time measures of countries' fiscal positions (debt levels and structural and cyclically adjusted deficits), the output gap, and a measure of central bank transparency.[8] UMP related variables do not pick up statistical significance in any of these specifications.

Tables 2 and 3 consider alternative dependent variables. Table 2 examines the effects of UMP and DGF programs on the inflation expectations for 2021 (rather than 2020) collected in the first survey after the announcements. Across all the seven specifications that mimic those in Table 1, there is again no evidence of a statistically significant effect associated with UMP and DGF programs. Table 3 replicates the analysis by considering again the 2020 inflation expectations but collected in the second survey after the UMP announcement. This exercise has the potential advantage of capturing delayed effects of UMP announcements on inflation expectations. But it can be biased by inflation shocks that materialized between the UMP announcement and the second subsequent survey. The baseline results remain similar to Table 1. [9]

The analysis also considers whether the cross-section results may depend on the degree of sterilization, that is, on the extent to which announced UMPs have led to increases in the monetary base. In general, the size of announced UMPs bears a strong relation to subsequent monetary base increases. The trendline in Figure 6 indicates that, on average, announced UMPs translated nearly one-for-one into changes of the monetary base. Nevertheless, this varies across countries. In some instances, efforts to sterilize UMPs, such as through the issuance of central bank bills to commercial banks, have partially unwound the impact on the monetary base. To ensure that our

Figure 6. UMP Announcements versus Observed Changes in the Monetary Base
(Percent of GDP)



Sources: IMF IFS; List of trackers in Chapter 4, footnote 2; and author calculations.
Note: UMPs announced during 2020 are the total of all UMPs by a given country's authorities during 2020. Monetary base (MB) change calculated as MB at Dec. 2020 minus MB at Dec. 2019.

[6] The cross-section regressions combine monthly and quarterly data for, respectively, countries in the Consensus Economics sample and those for which the analysis uses WEO data.

[7] On May 22, 2020, the Bank of Mauritius announced a one-off transfer to the government equal to almost 15 percent of GDP, by far the largest UMP by an EMDE in our sample (see Annex 6). Two months earlier, the Mauritian Rupee had depreciated sharply because of the sudden decline in tourists due to the pandemic. The depreciation was followed by a temporary increase in inflation and in inflation expectations which already came down in the second half of 2020. End of year inflation in 2020 closed at only 2.7 percent.

[8] Many of these specifications have smaller sample sizes than the baseline, because the additional variables are not available for all countries in the sample.

[9] Specifications 4 and 5 do indicate an impact of UMP (but not DGF specifically) on inflation expectations. However, these are regressions for smaller samples (see the previous footnote). Moreover, within the reduced sample regressions (specifications 4–7), this UMP impact is not robust.

results are not driven by such sterilization effects, Table 4 of Annex 7 conducts two robustness tests. The first specification replicates our baseline (namely, the first column of Table 1) for comparison purposes. Specification 2 includes as an explanatory variable the change in the monetary base divided by the total size of announced UMPs (per country; during all of 2020) to check whether the extent of sterilization affects the inflation forecasts. This specification also includes the interaction between this new variable and the DGF dummy. Specification 3 instead trims the sample and includes only UMP cases with little sterilization, that is, where the monetary base increased by at least half of the announced size of UMP programs. Neither specification brings about changes in the relation between UMPs and inflation expectations, as compared to the baseline.

The lack of a sizable, systematic effect of UMP announcements—including DGF—on inflation expectations is confirmed using panel data analysis which allows us to control for time-invariant country characteristics and global shocks to inflation expectations. Using countries with monthly data on inflation expectations from Consensus Economics, the analysis examines the determinants of the 12-month ahead inflation forecast, which is constructed as a weighted average of the 2020 and 2021 inflation forecasts.[10] In Annex 8, the first column of Table 1 represents the baseline panel data estimation. It includes country and (monthly) time fixed effects. The dummy for April 2020 is particularly large, significant, and negative, as inflation expectations around the world nosedived in response to the spread of COVID-19. The explanatory variables are the lag of the dependent variable, the size of UMP programs, and its interaction with a dummy capturing DGF programs. The lagged dependent variable is statistically significant, while the UMP-related variables are not. Specification 2 considers the same regression without country fixed effects, which resembles our cross-section analysis but with a time-series component. Specifications 3 and 4 have the same fixed effects structure as the baseline but add terms dissecting UMP and DGF effects by country type (advanced economies or EMs), as well as quadratic terms for the UMP variables. Here, only the interaction between the EM dummy and the UMP size variable in specification 3 is statistically significant and positive. However, this effect is economically small (a UMP announcement equal to 1 percent of GDP raises inflation expectations by 0.04 percentage points) and it is concentrated on quantitative easing programs: the dummy that focuses on DGF programs among EMs is not statistically significant (and has a negative coefficient).

The empirical analysis provided in this section shows that UMP announcements during the COVID-19 pandemic, including those involving direct government financing in EMDEs, did not lead to an economically and statistically significant increase in inflation expectations. As such, these results may alleviate fears that MF is bound to have immediate and sharp effects on inflation. Yet, these conclusions are subject to important caveats. First, the UMP programs included in the analysis were aimed at countering the impact of a clearly identified and exceptional shock due to the pandemic. Furthermore, these programs were of modest size and designed as one-off interventions, as in the case of Ghana described previously. Estimates from the previous section suggest that larger programs launched under different circumstances could have more destabilizing effects on inflation.

In this regard, history abounds with cautionary tales where MF led by fiscal dominance considerations caused ferocious inflationary responses. Box 1 offers two examples. It first describes the case of Zimbabwe in 2007–08 where continued monetary financing of extreme fiscal deficits led to exorbitant inflation and economic devastation. Yet even a more modest use of MF in the context of fiscal dominance can lead to a significant rise of inflation. This is illustrated by the case of Suriname in 2020.

[10] See the note to Table 1 in Annex 8 for additional detail.

Box 1. The Road to Hyperinflation: Monetary Finance Under Fiscal Dominance

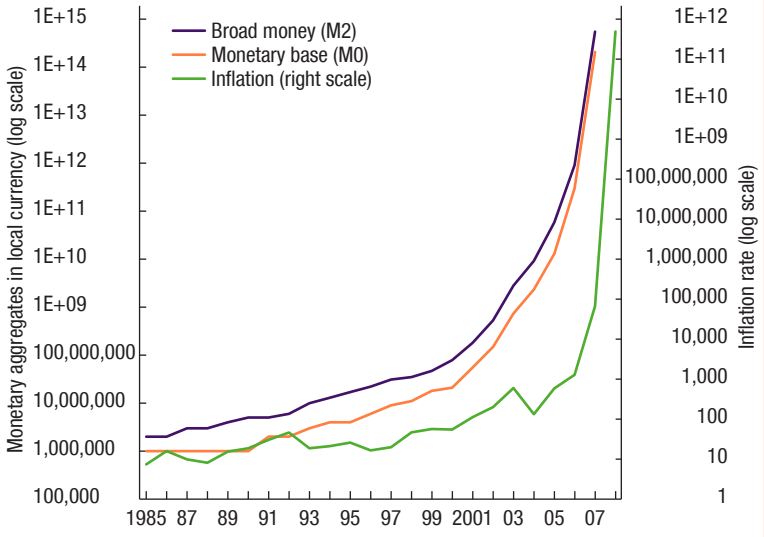
Zimbabwe, 2007–08[1]

The economic experience of Zimbabwe between March 2007 and November 2008 stands out as an extreme case of hyperinflation. At the peak of the crisis in November 2008, the month-over-month inflation rate reached 7.96 x 10^{10} percent, the second-highest rate ever recorded.[2] At this inflation rate, prices double every 24.7 hours. The crisis led to the issuance of a 100 trillion Zimbabwe-dollar note, the largest denomination of currency ever issued. The crisis did not merely result in monetary extremes: by the end, Zimbabwe's per capita GDP was less than half its level a decade earlier and even below the per capita GDP level that the country (then Southern Rhodesia) had attained in the 1950s. The crisis thus erased over half a century of development gains. It also left 70 percent of the population underfed.

Underlying this socioeconomic tragedy were deep-rooted fiscal problems. In the years 2005–08 budget deficits were in the range of 25–45 percent of GDP.[3] These fiscal needs materialized while external financing was severely constrained, including because of international sanctions and unpaid arrears from past IMF programs.

The government of Zimbabwe turned to the central bank to meet its fiscal needs. The Reserve Bank of Zimbabwe had no independence from the Treasury and had actively financed fiscal deficits since the 1990s. But in the run-up to the crisis, the extent of this financing expanded considerably, as seen in Box Figure 1.1. This also included direct fiscal expenditures by the Reserve Bank, such as election-related expenses and the provision of subsidized farming equipment. The ballooning money supply translated into ever higher rates of inflation. Worsening this trend was the rising velocity of money: as soon as payments in Zimbabwe dollars were received, they would quickly be exchanged for either products or foreign currency. In February 2009, the authorities opted to accept several foreign currencies as legal tender, officially enshrining the currency substitution that had already taken place on the ground.

Box Figure 1.1. Monetary Finance and Hyperinflation in Zimbabwe



Sources: Reserve Bank of Zimbabwe; IMF IFS; and IMF (2009).

[1] Sources used for this section are Hanke and Krus (2013), IMF (2009), Koech (2011), and McIndoe-Calder, Bedi, and Mercado (2019).

[2] By comparison, the renowned German hyperinflation of 1922–23 peaked at a monthly inflation rate of 29,500 percent. Only the Hungarian hyperinflation of 1945–46 reached a higher monthly inflation rate (namely, 4.19 x 10^{16} percent).

[3] This includes quasi-fiscal activities by the central bank (IMF 2009). The official budget deficit numbers were considerably smaller.

Box 1. *(continued)*

Suriname, 2020[1]

Suriname has grappled with recurring spells of high inflation since its independence in 1975. In 2015, the central bank extended loans to the government amounting to 11.6 percent of GDP to cover a ballooning fiscal deficit, leading inflation to rise from 3.9 percent in 2014, to 25.1 percent in 2015 and 52.4 percent in 2016. Following this episode, the Ministry of Finance signed a memorandum of understanding with the central bank prohibiting monetary financing of the budget, after which inflation stabilized in the single digits. However, in early 2019 the government revoked this memorandum on the back of a swelling budget deficit, which grew from 6 percent of GDP in 2018 to 21.2 percent in 2019. Heading into elections in May 2020, the government failed to rein in spending, while its access to external borrowing was limited and foreign reserves were near depletion. In all, the central bank provided loans worth 15.9 percent of GDP to the government until July 2020, when a new government took office. By then, the IMF *World Economic Outlook* was forecasting 108.1 percent (end-of-period) inflation for 2020, although the new government's measures to curb inflation ultimately moderated the 2020 outturn to 61 percent. The economic costs of the crisis have been sizable as real GDP contracted 13.5 percent in 2020.

[4] The narative draws largely from the 2019 IMF Staff Report for Suriname.

5. Conclusion

This paper has reviewed the arguments in favor and against MF. When monetary policy is constrained by the ELB and fiscal policy has limited space because public debt is high, MF can be in theory an effective tool to provide macroeconomic stimulus if needed. Relative to a conventional debt-financed fiscal stimulus, a fiscal stimulus financed with money creation is expected to provide a stronger boost to aggregate demand including by preventing an increase in public debt. This is coupled with a stronger increase in inflation that may or may not be welcome depending on whether inflation is below or above target. Theoretical models also show that MF can be used to prevent self-fulfilling sovereign debt crises. By committing to buying government debt in case investors lose confidence in the bond market, the central bank can avert a sovereign default and coordinate investors to re-enter the market.

The key arguments against MF hinge on the dangers for central bank independence and the credibility of monetary policy frameworks and, in particular, the risk of fiscal dominance. If the central bank reveals some tolerance to finance the government, it may face political pressures to provide MF beyond what is warranted to ensure macroeconomic stability. The central bank could then lose the ability to set monetary policy independently, possibly paving the way to hyperinflation and its devastating economic consequences. Central bank independence and, more generally, the institutional framework governing fiscal and monetary policies are key to the eventual outcome. Monetary policy is more likely to deviate from its price stability mandate when pressures are strong (deficits are large) and defenses are weak (governance is poor). Notably, the mere appearance of losing independence would hinder the credibility of the central bank and reduce the effectiveness of monetary policy actions.

The empirical analysis in this paper indirectly supports this view. Considering a large panel of countries with data going back to the 1950s, an increase in the monetary base is associated with only modest price pressures in countries with low inflation, strong central bank independence, and modest fiscal deficits. However, prices increase much more strongly if inflation is already high, central bank independence is weak, and fiscal deficits are large, all conditions that may signal heightened risks of fiscal dominance. Furthermore, inflationary pressures tend to increase more than proportionally with the size of the monetary expansion. The empirical analysis has also documented that UMP announcements during COVID-19—including direct government financing by central banks in EMDEs similar to forms of MF—did not trigger an increase in inflation expectations. Yet, these operations were relatively modest in size and were likely perceived as one-off interventions because of the exceptional economic shock caused by the pandemic.

Based on these considerations, we see merits in further analyzing the conditions under which the use of MF could be warranted. However, relaxing the taboo involves considerable risks. Possible experimentation with MF should thus be limited to extreme circumstances, remain modest in size given the non-linearities documented in the analysis, and be considered only by countries with low inflation and sustainable fiscal positions. Furthermore, it is crucial that central banks retain full independence in deciding if and when the use of MF might be appropriate to achieve macroeconomic stabilization objectives. In the context of elevated inflation, unsustainable fiscal positions, and weak central bank independence—elements that signal a heightened risk of fiscal dominance—policymakers should instead vigorously refrain from using MF because it is much more likely to trigger strong inflationary pressures with disastrous economic outcomes.

Annex 1. Monetary Finance in Historical Perspective

This Annex describes how views about MF have evolved over time until the 2008 GFC. The academic literature and public debate in the years after the GFC and during the COVID-19 pandemic are summarized in the main body of the paper.

The Great Depression

The period of strong economic growth in the United States during the 1920s—soon after the creation of the Federal Reserve System—fostered the idea that advances in monetary technology had unleashed a new era of macroeconomic stability (Friedman 1968). The severity of the Great Depression shattered this notion. Mired in a prolonged liquidity trap, monetary policy seemed unable to provide sufficient macroeconomic support. Inspired by these events, Keynes (1936) argued that monetary policy worked merely as a string. Monetary tightening could raise interest rates and curb economic growth. But monetary easing was largely ineffective in supporting aggregate demand against recessionary forces, especially in a liquidity trap.

Views about the ineffectiveness of monetary policy during the Great Depression were challenged by Friedman and Schwartz (1963). They argued that the severity of the recession was largely due to an insufficient money supply, as evidenced by a prolonged slump in the M2 monetary aggregate. A stronger increase in the monetary base would have offset the deflationary pressures and allowed for a faster economic recovery. This idea was vividly illustrated in Friedman (1969) using the analogy of a helicopter dropping money from the sky:

> "Let us suppose now that one day a helicopter flies over this community and drops an additional $1,000 in bills from the sky, which is, of course, hastily collected by members of the community. Let us assume further that everyone is convinced that this is a unique event which will never be repeated. […] [The "representative" individual] will now want to raise his consumption and reduce his cash balances until they are back at the former level."

The money dropped by the helicopter can be interpreted more prosaically as a tax cut financed with money creation. For example, the government could cut taxes and finance the associated fiscal deficit by withdrawing money from an account at the central bank. Or the government could finance the tax cut by issuing government bonds that are purchased with newly printed money by the central bank and rolled over indefinitely. In either case, the tax cut provides people with extra cash which is financed with a permanent increase in the monetary base. Friedman argued that people would spend this extra income, at least in part, thus strengthening aggregate demand. Therefore, MF would provide a sure way to stimulate economic activity even in a liquidity trap.

The Post-WWII Years and the Great Moderation

Concerns about the liquidity trap faded away in the decades after World War II when nominal interest rates rose comfortably above zero. The focus of central bankers and academics shifted to the opposite problem of how to stem the inflationary pressures of the 1970s. The seminal contributions of Kydland and Prescott (1977) and Barro and Gordon (1983) showed that central banks have an incentive to create surprise inflation to stimulate growth and erode the real value of public debt. This generates a bias towards excessive money creation and inflation. To prevent such outcome, central banks should refrain from discretionary interventions

and commit to operate within a transparent policy framework to deliver stable prices. Crucially, this commitment must be credible so that people can adjust downward their expectations of future inflation, supporting the transition to a new equilibrium with lower inflation.

These considerations prompted a move toward stronger central bank independence and underpinned the adoption of inflation targeting regimes. By committing to keep inflation at target, central banks signaled their refusal to pursue other goals—such as using MF to lower unemployment and monetize public debt—that could conflict with price stability. This regime of monetary dominance proved extremely successful in delivering low and steady inflation. It was also coupled with stable and sustained economic growth (until the 2008 GFC), suggesting that the United States and other advanced economies had entered an era of Great Moderation in macroeconomic conditions (Blanchard and Simon 2001, Stock and Watson 2003).

Japan's Liquidity Trap

Views about MF evolved again in the late 1990s in response to the economic situation in Japan. The asset price bubble's collapse in 1991 led to a severe recession that plunged the country into a liquidity trap. Despite large asset purchases by the central bank and considerable fiscal stimulus, economic activity remained feeble and coupled with deflationary pressures.

In light of these developments, Krugman (1998) argued that the liquidity trap was caused by an "inverse" credibility problem relative to the one faced by central banks during the 1970s. To curb excessive inflation, central banks should prove their commitment to fight inflation. On the contrary, to provide stimulus in a liquidity trap, central banks should "credibly promise to be irresponsible" using Krugman's words. More specifically, central banks should commit to a permanent increase in the money supply that allows for temporary higher inflation after the economy exits the liquidity trap. The expectation of higher future inflation reduces real interest rates and stimulates current aggregate demand. This strategy does not work if central banks are perceived to be very aggressive in avoiding inflation because any monetary expansion during the liquidity trap would be expected to be reversed when inflationary pressures emerge.

Eggertsson and Woodford (2003) formalized and extended Krugman (2008)'s arguments using a dynamic general equilibrium model. Their analysis confirms that to provide stimulus in a liquidity trap, central banks should commit to a lower interest rate path (that is, higher money supply) after exiting the liquidity trap. Auerbach and Obstfeld (2005) reached similar conclusions and argued that the impact of asset purchases by the Central Bank of Japan was likely undermined by the expectation that those operations would be fully reversed.

These considerations raised the question of how to reinforce the expectation that a monetary expansion during a liquidity trap would be permanent. Both Eggertsson and Woodford (2003) and Auerbach and Obstfeld (2005) argued in favor of matching the increase in money supply with a fiscal stimulus. As shown in Eggertsson (2006), this is because by increasing the stock of public debt a fiscal stimulus provides incentives for future debt monetization, thus partially de-anchoring the expectation that the central bank will only care about price stability.

Bernanke (2002, 2003) also called for a tight cooperation between monetary and fiscal authorities to overcome a liquidity trap. He argued that fiscal policy alone is unlikely to provide enough stimulus, especially if public debt is elevated. This is because politicians could be reluctant to undertake fiscal stimulus, fearing adverse market reactions. And, even if they did so, the effectiveness of a debt-financed fiscal stimulus could be hampered by Ricardian equivalence effects, as people expect higher future taxes to lower public debt. Fiscal stimulus would have a stronger impact if the deficit is financed with a permanent increase in the monetary base because people would not expect higher taxes in the future.

Annex 2. Transmission Channels of MF in Partial Equilibrium

Advocates of MF to provide macroeconomic stimulus emphasize its ability to overcome Ricardian equivalence effects (Buiter 2014, 2020, Turner 2015). These arguments are developed in the context of partial equilibrium models, whereby changes in the monetary base do not trigger variations in interest rates or prices. However, Galí (2020) shows that similar findings emerge in general equilibrium.

To illustrate how MF can overcome Ricardian equivalence, the analysis below follows Buiter (2020) and considers a simple consumption problem of a representative household. The household maximizes the utility from consumption C_t and holding money M_{t+1}

$$max \sum_{t=0}^{\infty} \beta^t \left(\ln C_t + \varphi \; ln\left(\frac{M_{t+1}}{P_t} \right) \right) \tag{1}$$

in which P_t is the price level. The household is subject to a standard budget constraint

$$P_t C_t + M_{t+1} + B_{t+1} = P_t Y_t - T_t + (1 + i_t^M) M_t + (1 + i_t) B_t \tag{2}$$

in which Y_t is income, T_t are government taxes, and B_t are government bonds that pay an interest rate i_t. Note that the model allows for a positive interest rate on money, i_t^M, to account for the fact that some components of the monetary base, such as central bank reserves, may pay interests.

Household nominal spending is equal to

$$P_t C_t = \frac{1 - \beta}{1 + \varphi} \left(\overbrace{(1 + i_t^M) M_t + (1 + i_t) B_t}^{W_t} + \sum_{j=t}^{\infty} \Lambda_{j,t} \left(P_j Y_j - T_j \right) \right) \tag{3}$$

in which $\Lambda_{j,t}$ is the nominal discount factor at time j relative to time t. This expression shows that nominal household spending is proportional to the household's nominal wealth W_t and the present discounted value (PDV) of income net of taxes.

To understand how MF affects household spending, it is helpful to consider its impact on the PDV of taxes. To ensure government solvency, the PDV of taxes should cover the outstanding stock of public debt net of the PDV of nominal seigniorage seized by the government through increases in money supply:

$$\sum_{j=t}^{\infty} \Lambda_{j,t} \, T_j = (1 + i_t) B_t - \sum_{j=t}^{\infty} \Lambda_{j,t} \left(M_{j+1} - (1 + i_t^M) M_j \right) \tag{4}$$

It is helpful to re-write the PDV of seigniorage as follows

$$\sum_{j=t} \Lambda_{j,t} (M_{j+1} - (1 + i_j^M) M_j) = \sum_{j=t}^{\infty} \Lambda_{j+1,t} \, (i_{j+1} - i_{j+1}^M) M_{j+1} - (1 + i_t^M) M_t + \lim_{j \to \infty} \Lambda_{j,t} M_{j+1} \tag{5}$$

Using this expression and substituting out the PDV of taxes in equation (3), household nominal spending is equal to

$$P_t C_t = \frac{1 - \beta}{1 + \varphi} \left(\sum_{j=t}^{\infty} \Lambda_{j,t} P_j Y_j + \sum_{j=t}^{\infty} \Lambda_{j+1,t} \, (i_{j+1} - i_{j+1}^M) M_{j+1} + \lim_{j \to \infty} \Lambda_{j,t} M_{j+1} \right) \tag{6}$$

This expression provides useful insights regarding the effectiveness of MF compared to a bond-financed fiscal stimulus. Note first that the level of taxation does not enter the equation because of Ricardian Equivalence. A debt-financed tax cut—which leaves the monetary supply unchanged—is thus unable to provide stimulus because it does not change the PDV of taxes. This is because a tax cut in a given period generates an increase in public debt that will need to be repaid—together with the accrued interests—through higher future taxation.

On the contrary, a tax cut boosts household spending if it is financed through an increase in the monetary base. The last two terms in equation (6) shows that for a given sequence of prices and interest rates, a higher level of money stimulates nominal household spending through two channels:

- *Interest rate savings*. Provided that money pays a lower interest rate than government bonds, $i^{M}_{j_+1} < i_{j+1}$, money creation reduces the interest rate bill of the government relative to issuing bonds. This reduces the PDV of taxes and stimulates nominal household spending.

- *Irredeemable property*. If the growth rate of money exceeds the nominal discount factor so that $\lim_{j\to\infty} \Lambda_{j,t} M_{j+1} > 0$, a permanent increase in the money stock allows for lower taxation. This is because money is an irredeemable liability of the government: the government never has to raise taxes to repurchase the outstanding stock of money.

The extent to which the boost to nominal household spending triggered by MF feeds into higher prices or higher output depends on the degree of price stickiness. If prices are fully flexible, higher nominal spending will lead to an instantaneous increase in prices, leaving output unchanged. If instead prices are slow to adjust, higher spending will temporarily increase output.

Annex 3. Data Sources Used in Section 3

MB, M2, Inflation	IMF International Financial Statistics and authors' calculations
Real GDP	Penn World Tables 10.0
De jure independence	Garriga (2016)
Government deficit	Mauro and others (2013)

Whenever a country's time series for inflation, real GDP growth, or government deficit stops before 2020, it is extended using data from the IMF World Economic Outlook database.

Annex 4. Empirical Specifications with Quadratic and Interaction Terms

The regression specification that underpins Figure 2 includes a quadratic term for money growth:

$$\pi_{it+h} = \beta_{h0}\, d\log M_{it} + \delta_{h0}\,(d\log M_{it})^2 + Z_{it}\Gamma_h + \varepsilon_{it+h}$$

with $Z_{it}\Gamma_h$ is defined as in the baseline regression.

The regression specifications used to construct Figure 3 include an interaction term of money growth with the level of inflation or with the degree of central bank independence or with a dummy equal to one when the deficit is above 3% of GDP. Denoting with X_{it} one of these three interaction variables, the specification is thus given by

$$\pi_{it+h} = \beta_{h0}\, d\log M_{it} + \delta_{h0}\, d\log M_{it} * X_{it} + Z_{it}\Gamma_h + \varepsilon_{it+h}$$

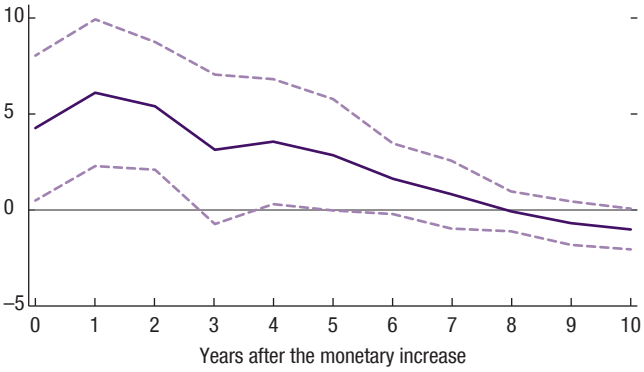
with

$$Z_{it}\Gamma_h = \sum_{l=1}^{10}\beta_{hl} d\log M_{it-l} + \sum_{l=0}^{10}\lambda_{hl}X_{it-l} + \sum_{l=1}^{10}\rho_{hl}\pi_{it-l} + \sum_{l=0}^{10}\gamma_{hl} d\log Y_{it-l} + \kappa_i + \tau_t$$

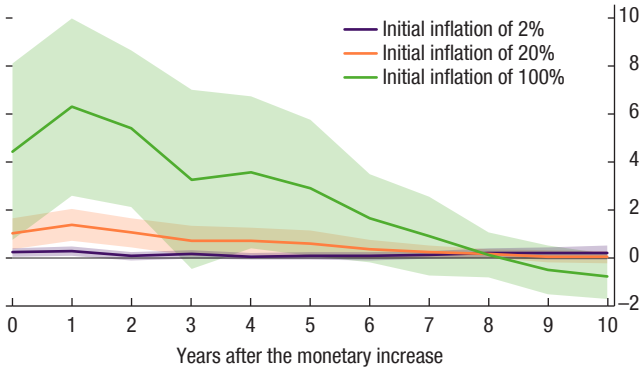
Annex 5. Association Between MB and Inflation Excluding Hyperinflation Episodes

Appendix Figure 5.1. Robustness of the Results on the Association Between MB and Inflation Excluding Hyperinflation Episodes

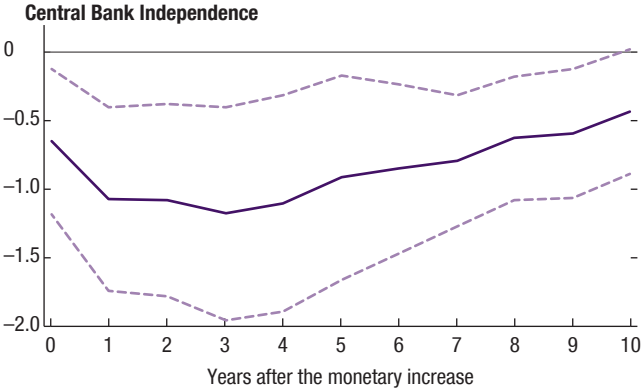
1. Regression Coefficient on the Interaction between Money Growth and Initial Inflation



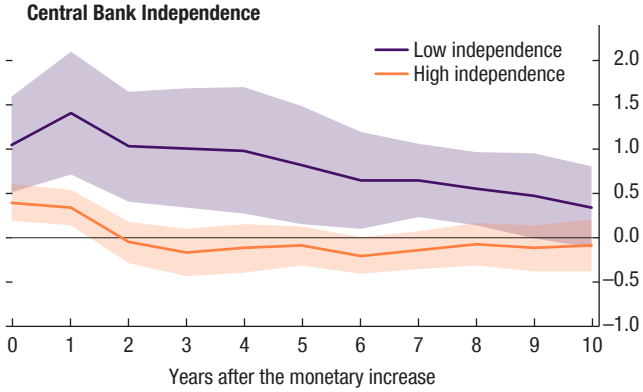
2. Change in Inflation after a 10 Percent Increase in MB Conditional on the Initial Inflation Level



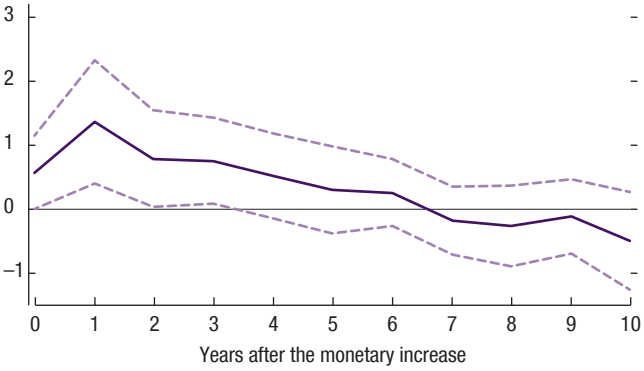
3. Regression Coefficient on the Interaction between Money Growth and Central Bank Independence



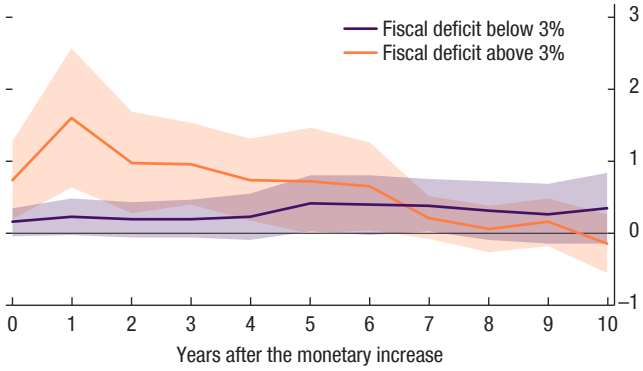
4. Change in Inflation after a 10 Percent Increase in MB Conditional on Central Bank Independence



5. Regression Coefficient on the Interaction between Money Growth and the Fiscal Deficit



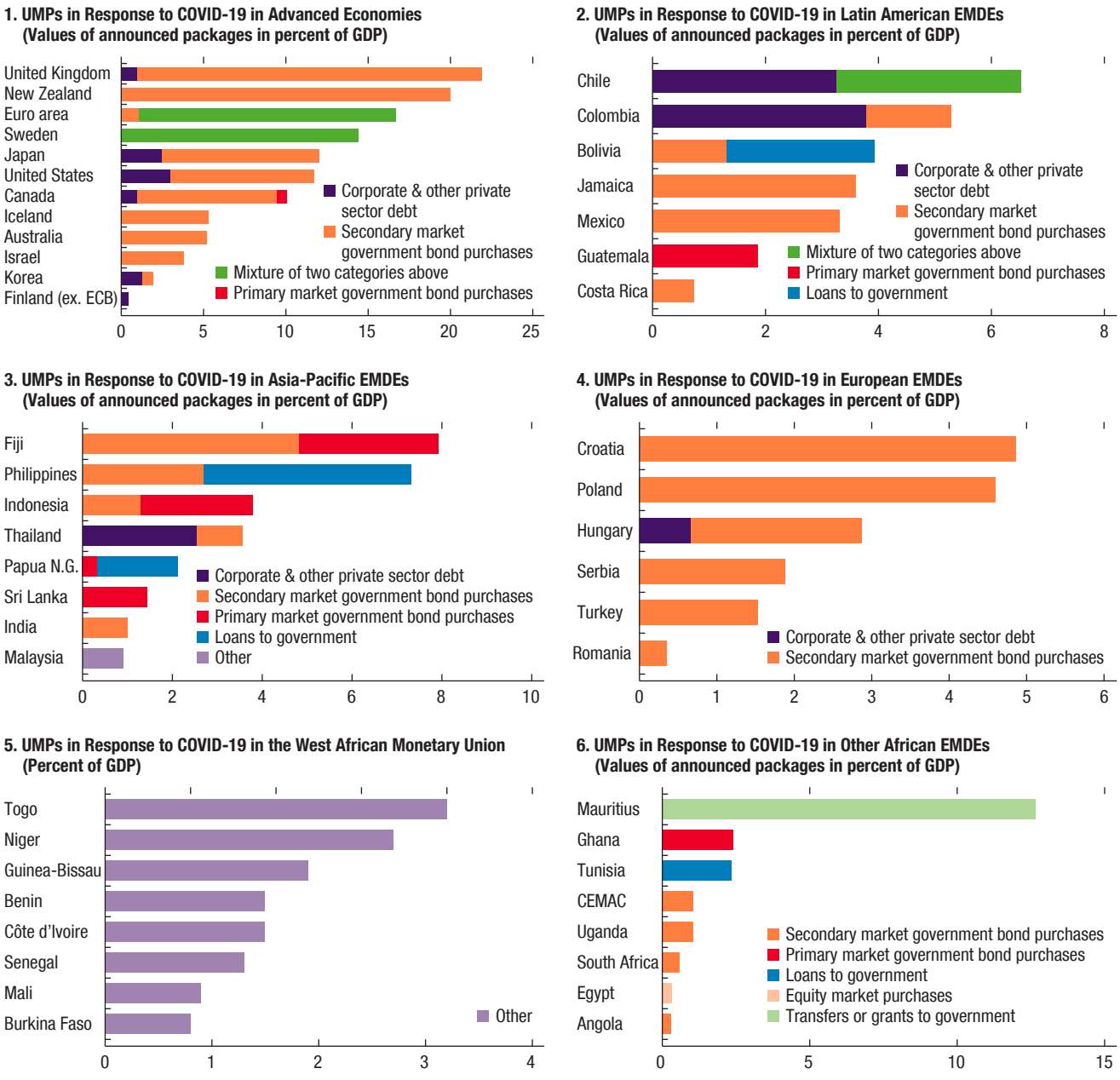
6. Change in Inflation after a 10 Percent Increase in MB Conditional on Fiscal Balance



Source: See Annex 3 for sources.
Note: Hyperinflation episodes refer to observations with an annual rate of inflation above 100%.

Annex 6. Unconventional Monetary Policies During 2020[1]

Appendix Figure 6.1. Unconventional Monetary Policies During 2020



Sources: IMF COVID-19 policy tracker; Yale CFRT; ESRB COVID-19 policies tracker; IMF MFS; IMF GFSR Oct. 2020; Cerutti and Helbling (2021); National authorities; and authors' calculations.
Note: For Panel 1, Bank of Finland purchases are in addition to ECB package. For Panels 5 and 6, values of announced packages may differ from ultimate purchases.

[1] For details on the UMP programs in the "other" category, see the 2021 IMF Staff Reports on the West African Economic and Monetary Union and Malaysia.

Annex 7. Cross-Country Regressions to Examine the Response of Inflation Expectations to UMP Announcements

Appendix Table 7.1. Dependent Variable: First Inflation Forecast for 2020 After UMP Announcement

	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6	Spec 7
Last inflation forecast before announcement	0.835*** (0.159)	0.835*** (0.161)	0.851*** (0.163)	0.779*** (0.178)	0.760*** (0.176)	1.116*** (0.0911)	0.781*** (0.181)
Average 10-year past inflation	0.364*** (0.131)	0.364*** (0.133)	0.330** (0.137)	0.488*** (0.147)	0.483*** (0.147)	−0.170** (0.0837)	0.428*** (0.156)
DGF dummy	−0.586 (0.404)	−0.563 (0.634)	−0.562 (0.409)	−0.266 (0.495)	−0.520 (0.470)	−0.0642 (0.244)	−0.527 (0.444)
UMP size (in % GDP)	0.0175 (0.0456)	0.0180 (0.0470)	−0.0204 (0.0485)	0.0549 (0.0454)	0.0519 (0.0451)	0.00202 (0.0224)	0.0417 (0.0466)
DGF * UMP size		−0.00708 (0.154)					
Fiscal deficit	0.0819 (0.0546)	0.0813 (0.0570)				0.0497* (0.0266)	0.0503 (0.0548)
Mauritius dummy	6.738*** (1.338)	6.804*** (1.972)	6.655*** (1.348)	6.154*** (1.296)	6.350*** (1.279)	6.809*** (0.656)	6.399*** (1.281)
Gross government debt			0.00526 (0.00498)				
Structural deficit				0.0859 (0.0612)			
Cyclically adjusted deficit					0.104* (0.0593)		
Output gap						0.0945** (0.0411)	
Central bank transparency							−0.0429 (0.0738)
Constant	−0.285 (0.411)	−0.290 (0.428)	−0.964** (0.393)	−1.001** (0.389)	−0.797** (0.389)	0.687** (0.321)	−0.365 (0.866)
Observations	64	64	64	47	48	47	51
R-squared	0.878	0.878	0.875	0.912	0.917	0.951	0.913

Standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1; fiscal and output gap variables are WEO forecasts.
The regression table analyzes whether the size and type of a UMP announcement had an impact on the first inflation forecast for 2020 after the announcement.
The regressions control for various factors that can influence the inflation forecast. such as the inflation forecast prior to the announcement, the average inflation rate in the prior ten years, fiscal conditions, the output gap, and central bank transparency.

Annex Table 7.2. Dependent Variable: First Inflation Forecast for 2021 After UMP Announcement

	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6	Spec 7
Last inflation forecast before announcement	−0.0982 (0.199)	−0.106 (0.202)	−0.0596 (0.203)	−0.328 (0.259)	−0.337 (0.272)	0.967*** (0.0894)	−0.225 (0.260)
Average 10-year past inflation	1.081*** (0.129)	1.084*** (0.131)	1.046*** (0.135)	1.303*** (0.160)	1.263*** (0.166)	0.0673 (0.0696)	1.133*** (0.170)
DGF dummy	−0.260 (0.480)	−0.0980 (0.760)	−0.243 (0.478)	−0.296 (0.614)	−0.739 (0.609)	−0.0560 (0.155)	−0.435 (0.593)
UMP size (in % GDP)	0.0207 (0.0526)	0.0237 (0.0541)	−0.00182 (0.0547)	0.0652 (0.0553)	0.0589 (0.0571)	0.00196 (0.0141)	0.0431 (0.0605)
DGF * UMP size		−0.0499 (0.180)					
Fiscal deficit	0.0184 (0.0633)	0.0133 (0.0664)				0.00842 (0.0171)	−0.00502 (0.0714)
Mauritius dummy	3.078* (1.542)	3.541 (2.280)	3.112** (1.530)	2.866* (1.594)	3.369** (1.635)	2.636*** (0.416)	2.789 (1.660)
Gross government debt			0.00501 (0.00576)				
Structural deficit				0.0361 (0.0760)			
Cyclically adjusted deficit					0.0723 (0.0774)		
Output gap						−0.0528** (0.0259)	
Central bank transparency							−0.105 (0.0953)
Constant	−0.0834 (0.494)	−0.113 (0.509)	−0.458 (0.509)	−0.331 (0.521)	0.0318 (0.529)	−0.477** (0.206)	0.903 (1.126)
Observations	64	64	64	47	48	47	51
R-squared	0.837	0.838	0.839	0.870	0.863	0.971	0.854

Standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1; fiscal and output gap variables are WEO forecasts.
The regression table analyzes whether the size and type of a UMP announcement had an impact on the first inflation forecast for 2021 after the announcement.
The regressions control for various factors that can influence the inflation forecast. such as the inflation forecast prior to the announcement, the average inflation rate in the prior ten years, fiscal conditions, the output gap, and central bank transparency.

Annex Table 7.3. Dependent Variable: Inflation Forecast for 2020 in the Second Survey after UMP Announcement

	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6	Spec 7
First inflation forecast for 2020 after UMP announcement	1.015*** (0.0598)	1.015*** (0.0603)	1.019*** (0.0595)	1.036*** (0.0292)	1.028*** (0.0352)	1.045*** (0.0418)	1.003*** (0.0444)
Average 10-year past inflation	0.0359 (0.0663)	0.0356 (0.0670)	0.0284 (0.0659)	0.0249 (0.0341)	0.0522 (0.0406)	−0.0490 (0.0371)	0.0930* (0.0513)
DGF dummy	−0.296 (0.226)	−0.269 (0.352)	−0.294 (0.229)	−0.0439 (0.120)	0.138 (0.137)	−0.0978 (0.149)	−0.0603 (0.155)
UMP size (in % GDP)	0.0130 (0.0250)	0.0135 (0.0258)	0.00668 (0.0262)	0.0209** (0.0103)	0.0242* (0.0124)	0.0161 (0.0124)	0.0208 (0.0164)
DGF * UMP size		−0.00867 (0.0847)					
Fiscal deficit	0.0170 (0.0303)	0.0162 (0.0315)				−0.00900 (0.0148)	−0.00898 (0.0193)
Mauritius dummy	4.813*** (0.828)	4.895*** (1.153)	4.766*** (0.825)	4.381*** (0.345)	4.212*** (0.414)	4.669*** (0.487)	4.700*** (0.523)
Gross government debt			0.000679 (0.00270)				
Structural deficit				−0.000102 (0.0139)			
Cyclically adjusted deficit					−0.0104 (0.0168)		
Output gap						0.0658** (0.0246)	
Central bank transparency							0.0431 (0.0263)
Constant	−0.0466 (0.228)	−0.0507 (0.237)	−0.163 (0.217)	−0.306*** (0.0930)	−0.430*** (0.113)	0.200 (0.188)	−0.954*** (0.304)
Observations	62	62	62	45	46	45	49
R-squared	0.971	0.971	0.970	0.997	0.995	0.990	0.992

Standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1; fiscal and output gap variables are WEO forecasts.
The regression table analyzes whether the size and type of a UMP announcement had an impact on the second inflation forecast for 2020 after the announcement. The regressions control for various factors that can influence the inflation forecast, such as the inflation forecast prior to the announcement, the average inflation rate in the prior ten years, fiscal conditions, the output gap, and central bank transparency.

Annex Table 7.4. Dependent Variable: Same as in Table 1

	Spec 1	Spec 2	Spec 3
Lag of dependent variable	0.835*** (0.159)	0.763*** (0.178)	0.787*** (0.114)
Average 10-year past inflation	0.364*** (0.131)	0.437*** (0.149)	0.219* (0.126)
DGF dummy	−0.586 (0.404)	−0.432 (0.542)	−0.441 (0.342)
UMP size (in % GDP)	0.0175 (0.0456)	0.0266 (0.0523)	−0.00796 (0.0420)
Fiscal deficit	0.0819 (0.0546)	0.0809 (0.0567)	0.0454 (0.0367)
Mauritius dummy	6.738*** (1.338)	6.736*** (1.405)	6.862*** (0.816)
Change in MB/UMP size		0.0386 (0.0409)	
DGF dummy * previous variable		−0.183 (0.425)	
Constant	−0.285 (0.411)	−0.402 (0.438)	−0.0517 (0.312)
Observations	64	61	42
R-squared	0.878	0.882	0.928

Standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1.
This regression table compares the baseline regression in Table 1 (Spec 1) to two specifications that include terms to capture sterilization effects (Spec 2) or excludes countries that engaged in significant sterilization (Spec 3).

Annex 8. Panel Regressions to Examine the Response of Inflation Expectations to UMP Announcements

Annex Table 8.1. Dependent Variable: 12-Month Ahead Inflation Forecast
(see note for details)

	1	2	3	4
Lag of dependent	0.791***	1.004***	0.791***	0.792***
	(0.0418)	(0.00428)	(0.0415)	(0.0420)
UMP size (in % GDP)	0.000364	0.000753		0.00894
	(0.00558)	(0.00550)		(0.0130)
DGF dummy * UMP size	−0.000816	−0.00407		−0.00850
	(0.0168)	(0.0165)		(0.0454)
February dummy	0.00302	0.000307	0.00302	0.00301
	(0.0423)	(0.0435)	(0.0419)	(0.0423)
March dummy	−0.0449	−0.0504	−0.0449	−0.0449
	(0.0423)	(0.0435)	(0.0419)	(0.0424)
April dummy	−0.488***	−0.485***	−0.515***	−0.494***
	(0.0463)	(0.0474)	(0.0471)	(0.0473)
May dummy	−0.218***	−0.116***	−0.237***	−0.222***
	(0.0471)	(0.0438)	(0.0473)	(0.0475)
June dummy	−0.137***	−0.0119	−0.136***	−0.137***
	(0.0489)	(0.0436)	(0.0485)	(0.0490)
July dummy	−0.127**	−0.00127	−0.131***	−0.128**
	(0.0490)	(0.0436)	(0.0489)	(0.0494)
August dummy	−0.0415	0.0817*	−0.0416	−0.0411
	(0.0487)	(0.0436)	(0.0483)	(0.0488)
September dummy	−0.0450	0.0586	−0.0451	−0.0448
	(0.0469)	(0.0435)	(0.0465)	(0.0470)
October dummy	−0.0431	0.0460	−0.0435	−0.0430
	(0.0458)	(0.0435)	(0.0455)	(0.0460)
November dummy	−0.0766*	0.00019	−0.0758*	−0.0782*
	(0.0449)	(0.0436)	(0.0445)	(0.0451)
December dummy	−0.00729	0.0669	−0.00672	−0.00871
	(0.0447)	(0.0435)	(0.0444)	(0.0449)
AE * UMP size			−0.00192	
			(0.00548)	
EM * UMP size			0.0421**	
			(0.0172)	
EM * DGF * UMP size			−0.0391	
			(0.0322)	
$(\text{UMP size})^2$				−0.000628
				(0.000855)
$(\text{DGF * UMP size})^2$				0.000579
				(0.00571)
Constant	0.618***	0.00144	0.618***	0.616***
	(0.125)	(0.0332)	(0.124)	(0.125)
Country fixed effects	YES	NO	YES	YES
Observations	372	372	372	372
R-squared (within)	0.759	0.749	0.764	0.760
Number of countries	31	31	31	31

Standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1. Sample period: Jan.–Dec. 2020 (incl. Dec. 2019 for lag of Jan. 2020)
The dependent variable is constructed as weighted average of 2020 & 2021 inflation forecasts: i.e., Dec. 2019 entry equals 2020 forecast; Jan. 2020 entry equals 11/12 on 2020 forecast and 1/12 on 2021 forecast, etc.
This regression table examines whether the size and type of a UMP announcement, and whether it was conducted by an AE or EM, had an impact on the 12-month ahead inflation forecast.
All specifications include time fixed effects and some specifications (1, 3 and 4) include country fixed effects.

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